

FIFTEENTH BIENNIAL REPORT
STATE BOARD OF HEALTH
OF THE STATE OF IOWA

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INFANTILE PARALYSIS

Special Bulletin of the Iowa State Board of Health

History of Increasing Prevalence.—The actual founder of the doctrine of acute spinal paralysis in children is thought to be Jacob Von Heine. As early as 1840 he prepared a written account of the disease and gave a somewhat exhaustive bedside representation of it, especially in regard to the defective nourishment, and the deformities which followed. Some cases were described prior to Von Heine, by Underwood in 1784, Shaw in 1822, Bedham in 1835, and perhaps a few others; but knowledge concerning the disease was limited, and the separation of acute spinal paralysis from other forms of paralysis among children had not been established. In Von Heine's time the disease was comparatively rare; but his work started an epoch which was followed by numerous discussions, and during the years which followed a number of works were published, among whose authors were the noted Barthez, Kennedy, Vogt, Bierbaum and others, prominent among them being the investigations of Duchenne (de Boulogne). These furnished a very interesting bedside picture of the disease.

The discussions which followed brought out various opinions in regard to the location of the disease and the parts of the nervous system affected. It was observed that certain parts of the body became paralyzed; and, if the patient recovered, these parts were poorly nourished afterward and in many instances were deformed and useless, indicating that some part of the nervous system had been destroyed beyond repair. The real location of this destruction remained obscure, and various theories were advanced in regard to whether this disease was an essential, spinal or external paralysis. These discussions were carried on, advancing theories rather than presenting the results of personal observations. In 1860 Von Heine presented a second edition of his work, in which he declared without any reservation that the seat of the disease was in the spinal cord. Since that time the disease has been known as spinal infantile paralysis. Von Heine believed the changes to exist in the gray matter (the cellular portion) of the spinal cord. This was also the opinion of Duchenne, though on different grounds. Microscopic examinations of the spinal cord had not reached general acceptance at this time, hence better methods had to be secured in order to demonstrate through the microscope the particular parts of the spinal cord that were obliterated by the disease.

It was soon apparent that the investigators of spinal paralysis had reached a period when they began to study the disease from a bedside and microscopic standpoint. The actual number of cases belonging to this disease was more accurately defined and limited, and all deaths where possible were investigated. Such procedures led to a more definite understanding of the changed conditions of the diseased spinal cords of persons dying from infantile paralysis.

In 1863 Cornil first discovered alterations in the spinal cord itself, but in 1865 Prevost and Vulpian made positive observation that the injury to the spinal cord was situated in the gray nerve cells of the anterior horns. This was later confirmed by Lockhart and Clarke in 1868. In 1870 Charcot and Joffroy carefully investigated a case which stands at the very beginning of a number of observations which, in all cases of spinal infantile paralysis, demonstrated a positive disease of the spinal cord, especially of the gray matter in the anterior horns. That there was a destruction of nerve cells was established beyond all doubt by the cases investigated by Parrot and Joffroy, Roger and Damaschino, Roth, Leyden, F. Schultze, W. Mueller and others; and examinations of recent years have proven that in all cords examined, of persons dying from this disease, none are found without the loss of certain portions of the anterior horns. Some difference of opinion have arisen among observers regarding the significance or the origin of the process, and some apparently conflicting conditions have been discovered, but no one disputes that in this disease there is a destruction of the nerve cells in the anterior horns of the spinal cord. About this time it was proven beyond all reasonable doubt that this was not exclusively a disease of early childhood, but that it might occur in its typical form, during the later years of childhood or even in adult life. Later, reports from Charcot, Weiss, Schultze and others have verified these observations. The line of distinction between the form of the disease in adults and other forms of spinal disease, more especially acute ascending paralysis, acute central inflammation of the spinal marrow or its membranes, hemorrhage into the spinal cord, etc., can only be completed by further investigations.

Definition.—Infantile or spinal paralysis has very sharply defined clinical or bedside characteristics, and may be described as beginning suddenly, usually with fever, with severe brain symptoms (deafness, a profound sleepy condition, delirium, and general convulsions), there is very rapidly developed and complete paralysis with entire relaxation of the muscles, the paralysis being of variable distribution over the trunk and extremities, but generally in the form which attacks both the lower limbs; there is an absence of any severe disturbances of sensation, no paralysis of the muscles which control the bowels, neither has the patient any bed-sores. A rapid improvement sometimes takes place and the general condition becomes better if the paralysis proves not to be of a progressive character—indeed, gradual improvement of the same begins, although the restoration of movement is not uniform and remains in part lost forever. In some of the muscles there is extreme and rapidly progressing diminution of the muscles affected, together with degeneration of tissue; the development of the bones is retarded; the extremities cold and blue. During the further course of the affection considerable deformities of the limbs and trunk arise (club-foot, curvatures of spine, paralytic contractions, etc.). The general condition of the patient is admirable, in spite of the permanent defects in the motor apparatus (moving parts) which almost invariably remain.

The disease may occur at all periods of life, though it is most frequent in children between the ages of one and four years. It is susceptible of an unusual number of grades of severity, attacking some mildly while other are made almost complete helpless.

The injury to the spinal cord, although not quite certainly determined for all cases, may be regarded as most probably consisting in an acute inflammation of the gray matter (nerve cells) of the anterior columns (anterior horns), which may extend more or less over the

greater part of their entire length, but is disposed to be most heavily localized in the cervical (neck) and lumbar (back) enlargements.

Some Pathological Observations.—In spite of the numerous investigations of the past few years, the pathological anatomy of the *acute spinal paralysis* can only be incompletely given. We are, no doubt, justifiable in laying down as a strict requirement that only those cases shall be considered as affording conclusive anatomical results which have been accurately observed during life, and *which have presented the well-marked clinical characteristics of the disease*. It can hardly be otherwise, however, than that a disease with so sharp and well-characterized a clinical picture should have some uniform anatomical lesion as its basis. The use of the microscope has shown a more or less entire disappearance of the large, multipolar ganglio-cells; while those still remaining are found partly in all stages of degeneration and atrophy, partly, however, quite well preserved. It has not yet been possible to demonstrate any regular localization of these changes in definite groups of ganglion-cells within the anterior horns. A degree of softening which has been observed in the anterior horns has been accompanied by an entire *disappearance* of the *nerve-fibers* and *axis cylinders* within the area of the softening. In the immediate vicinity of the softening there is frequently quite a striking multiplication of nuclei, as though preparation were being made for a species of encapsulating process. The appearance of the anterior horn, as a whole, is wasted and diminished in size.

These areas, or foci, sometimes extend, by means of little prolongations, backwards, or towards the sides. The tissue surrounding them may be more or less completely or approximately normal, with well preserved ganglion-cells. Generally, however, *slighter and more diffused changes* can be demonstrated throughout a greater or less portion of the gray matter usually throughout the entire dorsal portion, consisting of single granule-cells scattered through the tissue, and multiplication of nuclei, dilation of blood-vessels, the disappearance of individual ganglion-cells. *The accompanying diagram gives a clear picture of the localization and extent of the softening in the lumbar enlargement of the spinal cord, according to Roth.* Note illustrated lesions in Fig. 1, pg. 11.

Some very interesting observations made between seventeen and sixty-one years after the origin of the disease, by Cornil, Prevost, Lockhart and others, show that atrophy and shriveling of certain portion of the spinal cord are much more evident, even to the naked eye, and the wasting of the antero-lateral columns and the shrinking of anterior horns are especially prominent. These are irregularly reduced in their dimensions in various directions, narrowed and shriveled so that the entire form of a transverse section of the cord, as well as its markings, seem to be changed; this is especially prominent if the lesion is limited to one side. (See Fig. 2., pg. 11).

Infantile Paralysis Not a New Disease.—It has been known and described accurately by many authors and has been appearing in epidemic form more frequently in the last years, the conditions being in some way favorable for its spread, and this is in no way peculiar to this disease, having been observed in regard to epidemics of influenza, plague, smallpox and other diseases. The following figures show its increasing prevalence throughout the world in the last thirty years:

Years	Cases.	Outbreaks.	Average No. Cases
1880-1884	23	2	11.5
1885-1889	93	7	13
1890-1894	151	4	38
1895-1899	345	23	15
1900-1904	349	9	39
1905-1909	8,054	25	322

It is easily seen from the above table that the disease has been on the increase during the past two decades. The disease has been increasingly prevalent in the northern section of the United States within the last five years, with an aggregate of over 5,000 cases. In 1907 New York suffered an epidemic of 2,500 cases, while in 1909 Massachusetts had 1,000 cases, Nebraska 619, and Minnesota several hundred. A newspaper report from Washington, D.C. estimates 100 cases there in summer.

Occasionally cases of infantile or spinal paralysis have been noted in Iowa for years, but only in the last year has it assumed any great importance. Records in the Department of Vital Statistics show that during 1909 there were fifteen deaths reported as due to this disease, while in many other death certificates the causes of death are vaguely attributed to paralysis, brain paralysis, meningitis, etc., and it is safe to assume that some of these at least were really infantile paralysis. Since January 1, 1910, to August 24, 1910, death certificates filed in the Vital Statistics Department show that twenty-nine cases died from infantile or spinal paralysis. It is to be presumed from these reports of death that there were at least ten times as many cases which had occurred in the State of Iowa.

See Map, Pg. 12.

See Map, Pg. 13.

In April a few cases appeared at Mason City, Cerro Gordo County, Iowa, and the months of May and June ushered in a well-marked epidemic of infantile or spinal paralysis in that city. The health authorities appealed to the Iowa State Board of Health, who in turn appealed to the Public Health and Marine Hospital Service of the United States Government, Washington, D.C., for aid in making an investigation into the causes of this epidemic. Surgeon General Wyman responded at once, and Past Assistant Surgeon Wade H. Frost was sent into Iowa to aid the Iowa State Board of Health and the local authorities at Mason City in determining the causes, if possible, that were operating to bring this disease into Iowa. Dr. Frost is at present working in Mason City, and is gathering all the information possible for the national government and the Iowa State Board of Health, which in due time will be published.

This is the first evidence at hand, showing that Iowa is in the throes of an epidemic of infantile or spinal paralysis. There have been reported to the Iowa State Board of Health Office since the first cases appeared at Mason City, 186 cases and 29 deaths.

The following counties of Iowa have reported cases and deaths as follows:

**Report of cases of Anterior Poliomyelitis in Iowa
from January 1, 1910 to August 25, 1910, inclusive.**

<u>County</u>	<u>Cases</u>	<u>Deaths</u>	<u>County</u>	<u>Cases</u>	<u>Deaths</u>
Adair			Davis		
Adams			Decatur		
Allamakee			Delaware	1	
Appanoose			Des Moines	1	
Audubon			Dickinson	1	1
Benton			Dubuque		
Black Hawk	12	4	Emmet	1	
Boone	1	1	Fayette	1	
Bremer			Floyd	2	
Buchanan			Franklin	3	
Buena Vista	1		Fremont	1	1
Butler	3	2	Greene		
Calhoun	1		Grundy	15	3
Carroll	2		Guthrie	2	
Cass			Hancock	19	1
Cedar	1		Hamilton		
Cerro Gordo	59	9	Hardin	1	
Cherokee			Harrison	2	
Chickasaw	3	1	Henry		
Clarke			Howard		
Clay			Humboldt		
Clayton	2		Ida		
Clinton			Iowa		
Crawford	1		Jackson		
Dallas	1		Jasper	5	1

Jefferson			Polk	6	
Johnson			Pottawattamie	2	
Jones			Poweshiek	1	
Keokuk	1	1	Ringold		
Kossuth			Sac		
Lee	5	1	Scott	3	
Linn			Shelby		
Louisa			Sioux		
Lucas			Story	1	
Lyon			Tama	1	
Madison			Taylor	1	
Mahaska			Union		
Marion	2		Van Buren		
Marshall	1		Wapello	1	
Mills			Warren		
Mitchell			Washington		
Monona			Wayne		
Monroe	1		Webster	1	
Montgomery			Winnebago		
Muscatine	1		Winneshiek	3	
O'Brien	1		Woodbury	4	
Osceola			Worth	6	3
Page			Wright		
Palo Alto					
Plymouth			<u>Total</u>	<u>186</u>	<u>29</u>
Pocahontas	1				

Experimental researches within the last year have demonstrated beyond doubt that the disease is infectious and communicable to monkeys. While the germ has not been isolated, it has been shown that it is present not only in the spinal cord, but also in the nasal mucous membrane, salivary glands and lymphatic glands of infected animals. The disease may be communicated to monkeys, not only by injections of the veins, but by feeding it into the stomach and by rubbing it into the nose. It is also suspected, though not proven, that the virus is present in the intestines. Special care should therefore be given in disinfecting the sputum, stools and urine, besides the general precautions used in scarlet fever. Studies of epidemics have confirmed the laboratory findings as to the infectious, communicable nature of this disease. The exact modes of transmission from person to person are not known. The disease is possibly transmitted through the *air* in *dust*, *fomites*, *food* or *drink*, possibly by *insects*, or even by *animals*. Healthy persons may apparently carry infection from the patient to the third person.

The following should be carefully noted:

1. The use of a solution of perhydrol (Merck's) containing 1 percent of hydrogen peroxide is advised as a gargle or spray for the throat in cases of disease. Also the same

solution is recommended as a prophylactic for children exposed to the infection. The value of perhydrol in combating naso-pharyngeal and oral infections is confirmed by Dr. Simon Flexner of the Rockefeller Institute for Medical Research, New York, and Dr. Paul A. Lewis, of New York, whose experimental investigations of epidemic poliomyelitis, carried out during the past several months, have added a large number of important facts to the knowledge of this disease. In their seventh note on "Active Immunization and Passive Serum Protection" (Jour. A.M.A., May 28, 1910), the authors state: "In view of the fact that the virus of poliomyelitis can enter the nervous system through the abraded mucous membrane of the nose, we have tested the effects of hydrogen peroxide and some other disinfecting agents on the virus. The virus is quickly destroyed by a dilution of perhydrol containing 1 percent of hydrogen peroxide."

This authoritative statement confirms that made by W. Ford Robertson, pathologist to the Scottish Asylums, Edinburgh, who in a paper on "General Paralysis and Tabes Dorsalis," read before the Interstate Medical Congress at Melbourne (Lancet, Nov. 14, 1908), stated:

"We have endeavored to combat the naso-pharyngeal and oral infections by local measures. In view of the evidence of the destructive action of oxygen upon certain strains of the special bacilli, it occurred to me that Merck's perhydrol would be worthy of trial in the form of a nasal spray. We have used this extensively in a 1 percent solution, both as a nasal spray and as a mouth wash (applied daily or every other day), and there can be little doubt that distinct benefit has resulted in many cases."

2. There are types of the disease in which the paralysis is slight, involving only face muscles. In young children, cases with respiratory paralysis often resemble pneumonia, and such cases should be carefully observed to see if there is any paralysis of the limbs.

3. There is strong evidence that some cases of this disease show only premonitory symptoms, possibly sore throat and slight fever. These cases are believed to be as dangerously contagious as the paralytic cases, and when anterior poliomyelitis is prevalent, all such suspicious cases should be treated with the same precautions as typical cases.

4. Massachusetts has recently made this a "reportable" disease, and has issued a circular advising physicians to isolate cases and disinfect excreta of all kinds. The American Pediatric Society and the American Orthopedic Association, in session at Washington in May, 1910, recognizing that epidemic infantile spinal paralysis is an infectious, communicable disease, recommended careful studies of epidemics and measures similar to those adopted in Massachusetts for preventing its spread. Other States are also carrying out the same measures because of the fact that this disease has a mortality of 5 to 20 percent, and 75 percent or more of the patients recovering are permanently crippled.

5. The belief of medical men and experimental observers in laboratories is that infantile or spinal paralysis is due to a germ infection, and numerous observers have been led to examine the spinal fluid during life and the tissues after death for the presence of bacteria. To the present time the results have been unsatisfactory and, taking into consideration the possibility of contamination and accidental infection, chiefly negative. Landsteiner and

Popper, in 1909, successfully inoculated two monkeys with the spinal cord from fatal cases of poliomyelitis. Flexner and Lewis (Rockefeller Institute, New York) have infected monkeys and produced a disease similar to that in the human. They were able to transmit the disease through a series of monkeys by way of the *brain, peritoneal cavity* and *circulation*. *They were unable to discover bacteria by any method*. These detailed experiments prove beyond question that infantile paralysis is an infectious disease and is transmissible from one individual or animal to another.

6. The epidemics in Iowa have occurred in the summer and fall months, and this accord with the epidemics in other States and other parts of the world. It seems that dry, dusty weather is particularly favorable to the spread of the disease.

7. The serious aspect of the conditions which confronts our State can be fully understood when it is stated that the mortality ranges from 8 to 20 percent in the various epidemics, the death rate being highest in very young children, and in adults, and lowest in children from three to ten years of age. That which is worse than the direct mortality is the permanent paralysis of one or more of the arms or legs, with the consequent withering of the affected member and the crippling of the patient for life. This occurs in over 75 percent of the cases and constitutes the worst feature of this scourge.

8. The disease occurs in two types, the well-marked type followed by paralysis of one or more muscle groups and the recently recognized abortive type which, owing to greater resistance of the patient and a lessened virulence of the infection, runs a milder course and terminates without paralysis.

9. The literature of this disease is only now being written and but little dependence can be placed upon descriptions in the textbooks. Especially should the physician avoid trying to make all cases conform to any hard and fast description and refusing to recognize as infantile paralysis any cases which do not so conform. Many border-line cases will be found in the present epidemics.

10. In short, infantile or spinal paralysis is a contagious and infectious disease and must be handled as such. The degree of susceptibility to the disease is low. Only about six percent of exposed persons develop the disease as compared to seventeen percent for diphtheria, 22 percent for scarlet fever and nearly 90 percent for measles. This low degree of susceptibility is fortunate but has led to considerable misunderstanding and doubt as to the transmissibility of the disease because so many exposed persons escape infection.

11. It is to be noted that infantile or spinal paralysis is most prevalent during the months of *August and September*, and the Iowa State Board of Health requests that all local boards of health and health officers consider the necessity of acting quickly in this important work of educating the people to the extent that the disease is communicable and can be transmitted.

12. The National Public Health and Marine Hospital Service is rendering every efficient and timely aid to the Iowa State Board of Health at this time, by sending Passed Assistant Surgeon, Wade H. Frost, of the Service, into Iowa to make, in conjunction with the Iowa

State Board of Health, a thorough investigation of the epidemic now prevalent in our state. This action on the part of the National Government shows that Surgeon General Wyman is the right man in the right place.

SPECIAL RULES OF THE IOWA STATE BOARD OF HEALTH,
REGARDING INFANTILE PARALYSIS.
ADOPTED AUGUST 17, 1910.

All cases of infantile or spinal paralysis, or suspected cases, shall be immediately reported by the attending physician or head of the family to the local board of health, who in turn must report the same at once to Dr. Guilford H. Sumner, Secretary, Iowa State Board of Health, Des Moines, Iowa.

The State Board of Health recommends the quarantine of all cases of infantile or spinal paralysis for at least two weeks after the beginning of the disease, and a thorough disinfection of all infected premises after the termination of the disease.

It is a well established fact that the infectious material is found in the secretions of the nose and mouth of afflicted persons, and the Iowa State Board of Health therefore, recommends the use of sprays and gargles of perhydrol (Merck's) containing 1 percent of hydrogen peroxide to prevent the further spread of the disease. All discharges from the patient should be disinfected by means of bichloride of mercury, carbolic acid or chloride of lime.

SANITARY PRECAUTIONS TO BE OBSERVED IN CARE OF CASES
OF EPIDEMIC, INFANTILE OR SPINAL PARALYSIS

1. Put patient in clean, bare, well ventilated room, screened to keep out insects.
2. The rest of the family should be kept at home as far as possible.
3. No person should be allowed to enter sick room except doctor and nurse.
4. Disinfection should be thoroughly carried out. Make disinfection solution as follows:

Solution No. 1. For stools and urine:

Add $\frac{1}{4}$ pound of Chloride of Lime to two gallons of water. Make fresh every day.

Solution No. 2. For hands and clothing:

Add two teaspoonfuls of Carbolic Acid, 95 percent to one quart of water.

Solution No. 3. For hands and clothing:

Add two teaspoonfuls of Formalin to one quart of water.

5. To disinfect stool add one quart of Solution No. 1 and let stand for one hour. To disinfect urine add one pint of Solution No. 1 and let stand one hour.

6. When nurse leaves the room she should wash her hands in Solution No. 2 or Solution No. 3. She should wear an over-garment and remove the same on leaving the room.
7. All clothes and bed clothes before removing from sick room and all washable clothes before removing from premises should be soaked for one hour in Solution No. 2 or No. 3 as preferred.
8. All eating utensils and remnants of food used by patients should be boiled before taken from sick room.
9. All milk bottles received at the house must be boiled before returning to the dairy.
10. The rest of the family should take frequent baths and use perhydrol (Merck's) containing 1 percent of hydrogen peroxide as a gargle and nose spray.
11. The house should be kept as free from dust as possible by sprinkling floors before sweeping and by using damp cloths for dusting.
12. All dogs, cats and other pets should be kept from the sick room.
13. Surrounding premises should be sprinkled daily.
14. Patients shall be kept isolated until placard is removed and house has been fumigated.

The above instructions should be carried out minutely not only for infantile or spinal paralysis, but for all contagious and infectious diseases. The use of deodorants to create smell in the room is useless and objectionable.

The Iowa State Board of Health wishes information on all cases of infantile or spinal paralysis and will furnish blanks for some upon applications. A special request is made that all animals suffering from paralysis in any form should be noted and reported in connection with cases of infantile or spinal paralysis. For blanks address, Dr. Guilford H. Sumner, Secretary, Iowa State Board of Health, Des Moines, Iowa.

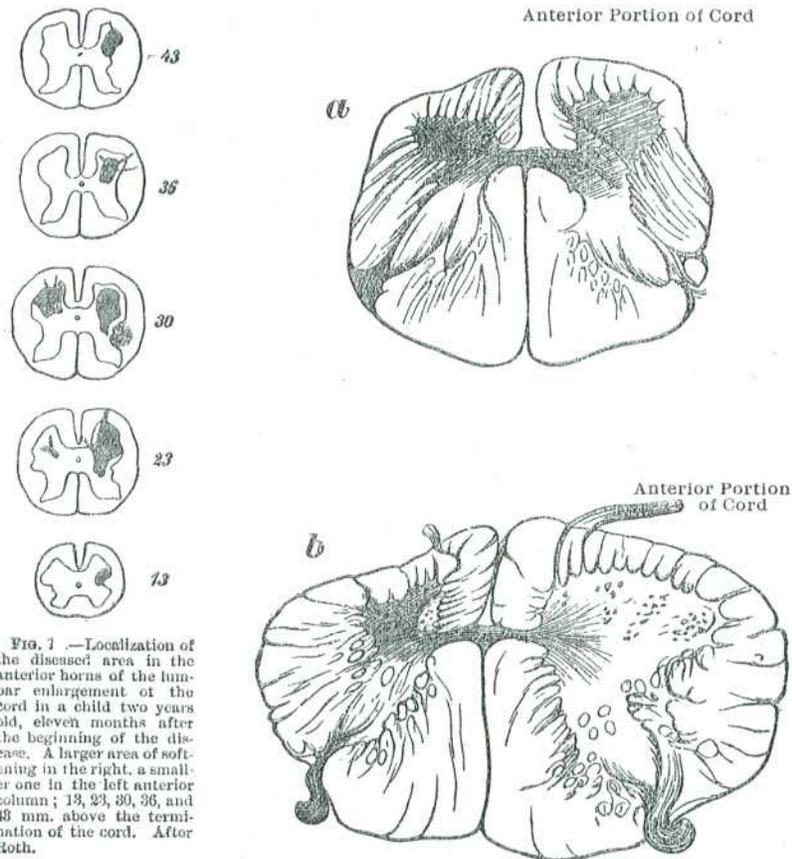


Fig. 1.—Localization of the diseased area in the anterior horns of the lumbar enlargement of the cord in a child two years old, eleven months after the beginning of the disease. A larger area of softening in the right, a smaller one in the left anterior column; 13, 23, 30, 36, and 43 mm. above the termination of the cord. After Roth.

Fig. 2.—Spinal cord with acute spinal paralysis, forty-three years after the beginning of the disease. (a). Section through the lumbar (back) enlargement; both anterior horns and antero-lateral columns strongly shrivelled, more on the left side than on the right. No ganglion-cells are present. (b). Section through the cervical (neck) enlargement; the left anterior horn and antero-lateral column very strongly shrivelled. No ganglion-cells are present. The posterior columns and posterior horns in both sections are normal. A careful study of these figures will reveal much information regarding the lesions in the spinal cord as a result of acute infantile or spinal paralysis. After Charcot and Joffroy.

