POLIOMYELITIS: STUDIES ON DISTRIBUTION OF PARALYSIS AND MANAGEMENT OF DEFORMITIES IN THE LOWER LIMBS OF CHILDREN IN IBADAN

BY

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ABSTRACT

Poliomyelitis or Heine-Medin's disease is one of the commonest crippling diseases amongst children under the age of five years in Nigeria.

Though the disease is found in most parts of the world, it is more noticeable in developing countries. In Nigeria, it is endemic.

The disease is infectious and caused by entero-viruses namely Types I, II and III. The polio-virus enters the body through the upper respiratory tract from where it gains access to the anterior horn cells of the spinal cord or the motor nuclei of the brain stem. The virus may damage or destroy the cells thereby causing flaccid paralysis of the muscles supplied by the affected spinal segments. Sensation is not affected.

Five hundred and forty-four poliomyelitis children referred from paediatric neurology and surgical out patient clinics in the University College Hospital, Ibadan were studied between 1978 and 1980. Two thousand, six hundred and eighty-seven muscles of the lower limbs were carefully tested for muscle power and graded in accordance with Medical Research Council of England scale 0 to 5. The grades of muscle power were recorded on special muscle assessment chart. Analysis of the results portrayed the likelihood of contractures and deformities in the affected limbs. The magnitude of the deformities were measured with goniometers and recorded in geometrical degrees.

Studies were carried out of the age, sex distribution, frequency of paralysed muscles and resultant deformities. The inequality of the length of some limbs were observed as well as the monthly and seasonal occurrence for each year of the study. Five hundred and nine deformities were classified in the hips, knees, ankles and feet of one or both limbs. They were corrected conservatively if mild. In moderately severe contractures with between 25^{0} and 50^{0} of fixed flexion deformity, corrective manipulations, followed by the application of rigid supports were carried out.

Severe contractures of more than 50^{0} of fixed flexion deformity were treated surgically by the orthopaedic surgeon. The physiotherapist was responsible for physical rehabilitation.

The results of this study revealed a predominance of male over female cases with the highest incidence among the age group 1 - 2 years. Both lower limbs were more incriminated than either the left or the right limb; but the left limb was slightly more affected than the right.

Quadriceps muscle (13.2%) was most frequently paralysed than any other group of muscles. One hundred and fifty-two (29.9%) tendo-Achillis and 50 (29.4%) of tensor fascia lata contractures were responsible for the highest numbers of deformities.

Monthly occurrence of the disease was of no significance as well as its correlation with rainfall.

The use of plaster casts, knee cages, calipers and other rehabilitation aids like the parallel bars, push carts, crutches, sticks and wheel chairs enabled the polio victims to gain confidence in ambulation, as well as independence in other daily activities.

Education of the children in regular schools and prevention of the disease by immunisation were always emphasised to the parents.

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I wish to gratefully acknowledge the assistance of Prof. A. Adeloye, Neurosurgeon, Department of Surgery, University College Hospital, Ibadan for the advice and guidance he gave me throughout this study as my supervisor. I am grateful to the staff of Physiotherapy Department, University College Hospital, Ibadan and the poliomyelitis children for their co-operation.

My acknowledgement also goes to Professor J. B. Familusi of the Department of Paediatrics, University College Hospital and Mr. C. A. A. Oyemade, Senior Lecturer and Consultant Orthopaedic Surgeon, Department of Surgery, University College Hospital, Ibadan for useful advice.

I am thankfully indebted to Prof. O. Ayeni, Medical Statistician, for his assistance with the statistical analysis. To my wife and children my gratitude exceedingly goes for their continuous support and encouragement. I very much appreciate the meteorological information on rainfall given to me by Prof. J. S. Oguntoyinbo of the Department of Geography, University of Ibadan, Ibadan.

I also wish to thank the staff of the Biomedical Communication Centre, University College Hospital, Ibadan for the illustrations and photographs. The untiring secretarial assistance given by Mrs. M. O. Ige is also greatly appreciated.

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CERTIFICATION

I certify that this work was carried out by Mr. T. Abayomi Oshin in the Departments of Surgery and Physiotherapy, University of Ibadan.

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DEDICATION

These efforts are dedicated to the memory of my parents, Emmanuel Adesanya Oshin and Susanah Abosede Oshin.

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CHAPTER ONE

I N T R O D U C T I O N

Poliomyelitis or Heine-Medin's disease is one of the commonest crippling diseases amongst children in Nigeria (Sinnette, 1966). Paralytic poliomyelitis is common among children who are under 5 years of age (Richard, 1969), hence the disease is referred to as infantile paralysis.

The disease exists throughout the world (Huckstep, 1975) but continues to be a major health problem in the developing countries inspite of the availability of effective vaccines (Marube, 1969).

Poliomyelitis is an infectious disease and caused in its acute stage by a group of entero-viruses, namely, Brunhilde, Lansing and Leon or simply Types I, II and III respectively. Each virus is about 27mμ in diameter and can be grown on tissue culture. There is no cross-immune reaction between these viruses, therefore, the vaccine must contain the three types (Monnier and Rajon, 1978). Infection by one type confers immunity to the strains of that particular type and not to the other two types. A child may therefore have subsequent attacks due to the strains of another type of polio-virus.

The polio-virus enters the body through the upper respiratory tract or by oral ingestion of contaminated food or through droplet infection (Richard, 1969). Transmission could be direct through inter-human contact or indirect, as a result of poor sanitation. The virus can be cultivated from the faeces in the early stages of infection.

On gaining entry into the body, the polio-virus enters the anterior horn cells of the spinal cord, for which it has special affinity, and the motor nuclei of the brain stem. The virus may damage or destroy these structures completely and irrevocably or temporarily (Green, 1951). See Figs. 1.1 and 1.2

The resultant effect of the attack by the polio-virus is a lower motor neurone type of lesion with asymmetrical flaccid paralysis of the affected muscle groups. The sensation is normal (Huckstep, 1975). Where destruction of the motor cells has taken place mainly in the spinal cord, the patient has the spinal type of poliomyelitis. But if the virus attacks cells at higher levels in the central nervous system, such as the motor nuclei of the cranial nerves, or cells of the respiratory or cardio-vascular centres in the medulla, the patient has the bulbar type of poliomyelitis. An attack of both the spinal cord and the brain results in the bulbo-spinal type of poliomyelitis (Reynolds, 1955). The disease could be non-paralytic or abortive, but sometimes presents as polio-encephalitis.

The cases studied in this work were all of the spinal type of poliomyelitis. The bulbar type is very rare among Nigerians (Taylor, 1966). Thus, only three bulbar cases were reported out of the 1,259 cases of poliomyelitis studied in University College Hospital, Ibadan.

The child with poliomyelitis, in the early stages of the disease develops a fever. This follows the incubation period of about two weeks. Thereafter, the clinical features may include pain, muscle spasm and tenderness, muscle wasting, flaccid paralysis, stiffness of joints in the neck and the back (Richard, 1969). Injection for whatever

Fig. 1.1 Normal motor nerve cell columns (Sharrard, 1955).

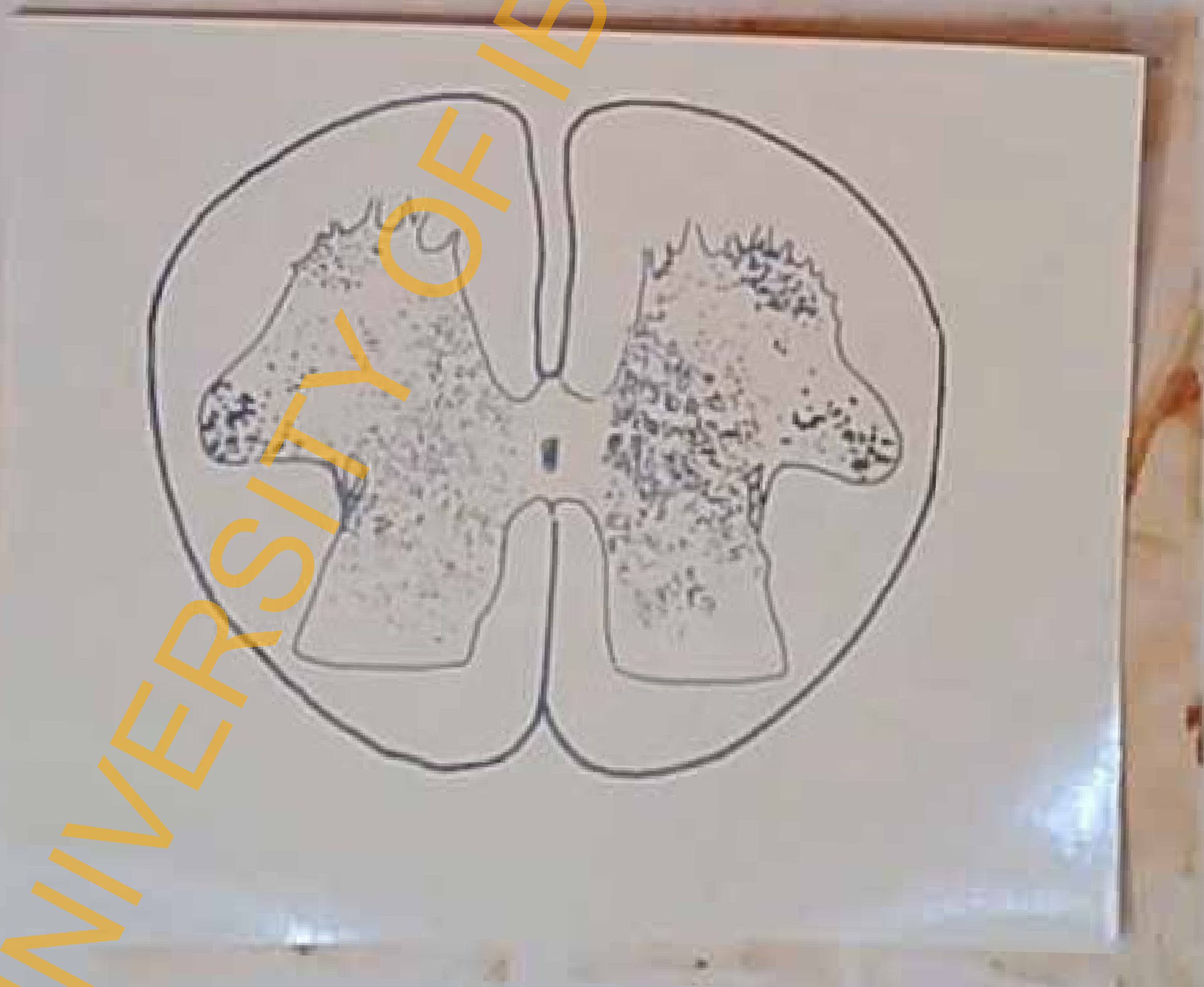


Fig. 1.2 Motor nerve cell columns destroyed by polio-virus (Sharrard, 1955).

reason at this period may provoke paralysis within a few days in the limb so treated (Wyatts, 1980).

1.1 Epidemiology

Poliomyelitis is both epidemic and endemic. In Nigeria it is endemic and most children are exposed to the infection up to the age of five years. Older children and adults are seldom affected (Collis and others, 1961). In the more advanced countries of the world, however, acute poliomyelitis may occur in patients older than 15 years of age (Singer and Ross-Innes, 1963).

Three stages of the disease have been identified as follows (Green, 1951):

Acute stage. This can be sub-divided into pre-paralytic phase and paralytic phase. It terminates 48 hours after the temperature becomes normal.

Convalescent stage. It is a stage of recovery, and lasts for about 16 months.

Chronic stage. This is the period of permanent disability.

1.2 Purpose of the study

The purpose of this study is to present the distribution of paralysis in the lower limbs of children afflicted with cases of anterior poliomyelitis. The cases represent 45.2% of the total population of patients with poliomyelitis referred to the Physiotherapy Department of the University College Hospital, Ibadan. In this work, we also examine how the pattern of paralysis causes deformities in the affected limbs as well as their management and prevention.

The study was carried out predominantly on children who were in the paralytic and recovery stages of the disease. It was limited to the lower limbs because these were the dominant region of affectation. Other parts of the body, like the trunk and upper limbs, were sparingly or less affected.

Richard (1969), observed that the upper limbs were affected ten times less frequently than the lower limbs.

1.3 Location of the study

The study was carried out mainly in the Physiotherapy Department of the University College Hospital, Ibadan. Field work extended to the Oluyole Cheshire Home for the Handicapped and the School for the Physically Disabled Children, Jericho, Ibadan.

CHAPTER TWO

REVIEW OF THE LITERATURE

There had been evidence to show that poliomyelitis existed over 5,000 years ago in ancient Egypt (Huckstep, 1975). Egyptian mummies found between 3,700 B.C. and 1,209 B.C. were known to have deformities of the foot and wasted leg muscles. Visitors to the present Cairo Museum will observe that some ancient mummies have had equinus deformities of the foot before their demise.

In Europe, it was believed that poliomyelitis was probably noticed in England in the year 1559 but the first description of the disease was made by Underwood in 1789 (Huckstep, 1975). Not much was known about the epidemiology until in 1834 when the first epidemic of poliomyelitis struck the Island of St. Helena. In 1840, Dr. Jacob Heine of Germany recognised the disease to be the result of damaged or destroyed nerve cells. A few years later Dr. Medin of Stockholm first reported the characteristics of the early symptoms of the disease. Hence poliomyelitis is called Heine-Medin disease.

The myth that surrounds the pathology of poliomyelitis was revealed by Duchenne in 1855 when he first described the pathology of the disease and associated same with the affectation of the anterior horn cells of the spinal cord.

In recent times, many authors had written on the various aspects of poliomyelitis both in the developed and developing countries. A few of them will be discussed herewith.

Sharrard (1955) described the nature of recovery in the muscles of 142 poliomyelitis patients he studied. Two years later (1957), he published the results of yet another study on a group of 149 patients in connection with the pattern of paralysis in them. His major work was on the permanent paralysis in the lower limbs in poliomyelitis. The cases he reported on were those he previously studied for the nature of recovery in their muscles in 1955. His findings will be highlighted in subsequent chapters.

Before Sharrard, Lovett (1915, 1917), Mitchell (1925) and Legg (1929) published tables on the relative frequency of paralysis and paresis in muscles of lower limbs. Sharrard (1955, 1957) confirmed some of their findings.

In North America, Sister Kenny focussed attention on the existence of muscle 'spasm' and tightness in victim of acute poliomyelitis and advocated the use of hot packs as a relief. In 1945, President Roosevelt, himself a victim of poliomyelitis, reinforced the use of warmpool for improving circulation in paralysed limbs. The warm spring in Atlanta, Georgia became in the early forties the Mecca for patients of the disease including President Roosevelt himself.

In some African countries, the incidence of poliomyelitis is endemic while in others there are occurrences of epidemics. In Kenya, the epidemic of poliomyelitis in 1954 and 1957 were respectively described by Walker (1956) and Fendall and Lake (1960). The results of previous epidemics between 1965 and 1966 were published by Kaur and Hotsolaar (1967).

At the Kenyatta National Hospital, studies carried out on 70 cases of endemic acute paralytic poliomyelitis between 1969 and 1971 by Ayim (1973) revealed that immunisation in endemic areas for all infants up to three months supplemented later by follow-up might eliminate the disease. He observed that 95% of the victims were below six years. Europeans and Asians were more afflicted than indigenous Africans because of the latter's habit of living which made them to acquire immunity by natural contact with poliovirus.

Huckstep (1971, 1975) published books based on his experiences in the management of poliomyelitis cases in Uganda. His latest publication dealt almost with all aspects of management including some rehabilitation methods.

Cockburn and Drozdov (1970) reviewed the incidence of poliomyelitis in the world. They discovered that there was a steep fall in Europe and North America but in tho countries of the tropics and sub-tropics, the incidence was static or increasing.

In Nigeria, Professor W.R.F. Collis, assisted by Dr. O. Ransome-Kuti and Physiotherapists M.E. Taylor and L.E. Baker were the first to publish an article (1961) on poliomyelitis in Nigeria. The publication was on the 350 cases studiod by them at the University College Hospital, Ibadan in three years. They reported the age and seasonal incidence, anatomical affectation, prevention and physiotherapeutic management of the disease.

Adesuyi (1964) compared the notifications in the former regions of Nigeria, namely, Northern, Eastern, Western and Lagos in respect of months of incidence and seasons of the year. His study was confined to the 747 cases seen in the whole country.

Adewole (1964) reviewed 100 cases of poliomyelitis at the Royal Orthopaedic Hospital, Igbobi, Lagos. He found among others, that post poliomyelitis paralysis appeared mostly in the lower limbs and that physiotherapy was the most useful method of treatment.

Montefiore (1964) observed that from serological studies in Ibadan, nearly 100% of children are immune to all three types of polio-virus by the age of four years. The most common virus causing paralysis are the Types I and II. He associated the sharp increase in poliomyelitis notification in Ibadan between the months of October and December 1963 to the extensive flooding in the latter part of August and the first few days of September. He advocated mass immunisation against the disease after describing the different types of polio-vaccine and their effects.

Taylor (1966) carried out a survey of 1,322 poliomyelitis patients referred for physiotherapy at the University College Hospital, Ibadan between 1956 and 1965. She highlighted the nationalities and tribes of the victims as well as the towns where illness was contracted. The muscles affected and the deformities encountered were discussed. She gave the modalities used in the management of patients.

A survey of one hundred patients with flexion - abduction contractures of the hip due to poliomyelitis was published by Richard (1967). The study was carried out on 131 hips at the University College Hospital, Ibadan. Paralysis of hip extensors and adductors was recognised in the patients studied with some degree of tightness in the tensor faciae latae.

The highest incidence occurred in cases with between 20° and 30° of contracture while the least affected had 70^{o} contracture. Management was by the application of corrective plaster of Paris hip spica for mild cases and surgery for severe ones.

Richard (1969) referred to the 1,322 poliomyelitis patients surveyed by Taylor (1936). Out of those cases, 51% were under two years of age at the onset of the disease. The article dealt extensively with cause, stages, recovery, deformities and management in general. He emphasised the use of simple splints and appliances for the purpose of rehabilitation. Co-operation of mothers or parents is essential for attaining successful treatment. He also advocated the use of effective polio vaccine as a preventive measure.

Familusi and Adesina (1977) gave an account of the pattern of poliomyelitis in University College Hospital, Ibadan between 1964 and 1973. They reviewed 2,063 cases with particular reference to age and sex incidence and the monthly and seasonal distribution. They observed that the second year of life was the peak incidence. They also noted that there was no relationship between the seasons of the year and number of notification. In developing countries, and particularly in Nigeria, killed "Salk type" vaccine was recommended in the place of "Sabin Oral Type".

This agreed with Montefiore and others, 1963; Montefiore, 1973 who indicated that oral vaccine in the tropics was unstable and could easily be interfered with by enteroviruses. Familusi and his co-workers therefore advocated a quadriple vaccine which would immunise an infant against tetanus, poliomyelitis, diphtheria and pertussis.

The killed Salk polio-vaccine should be in the preparation.

Oyemade (1961) studied 260 cases of poliomyelitis in children of varying ages. The youngest group was between one and two years old. The study included the trunk, upper and lower limbs. They agreed with some of the findings of Collis and others (1961), Richard (1969) and Sharrard (1955) with regards to the predominant affliction of the lower extremities. But he noted that both lower limbs combined are more involved than individual limb paralysis.

CHAPTER THREE

PATIENTS STUDIED AND METHODS USED IN THE PRESENT STUDY

The patients studied were children with paralytic poliomyelitis in the recovery stage referred for physiotherapy from the Paediatric Neurology and Surgical Out-Patient Clinics in the University College Hospital, Ibadan between January 1978 and December 1980. A further study was undertaken among the inmates of the Oluyole Cheshire Home for the Handicapped, Ibadan and the pupils of the School for the Physically Disabled Children in Jericho area of Ibadan.

In the Physiotherapy Department, relevant details of the history of the disease as well as those of the family, social and economic situations of the parents were obtained. The age, sex and the limbs affected were also recorded on the physiotherapy treatment card (Fig. 3.1). Physical and functional assessments were carried out in order to ascertain the extent and distribution of muscle paralysis in the lower limbs as well as the presence and degree of contractures and deformities. The amount of true shortening of the limbs and the degree of muscle wasting were recorded. Observations and recordings were also made of the mode of locomotion and ambulation where applicable.

The extent and distribution of muscle paralysis was studied by using the manual muscle test scale. The grade recorded was that of the power of a muscle in the third of three contractions through the greatest range of movement of the joint concerned.

The scale of muscle power testing used in this study was that recommended by the Medical Research Council of United Kingdom in 1942.

Fig. 3.1 Physiotherapy request and treatment card.

Fig. 3.1 Physiotherapy request and treatment card.

The scale ranges from 0 to 5.

Grade 0 - No contraction

Grade 1 - Flicker or trace of contraction

Grade 2 - Active movement with gravity eliminated

Grade 3 - Active movement against gravity

Grade 4 - Active movement against gravity and some resistance

Grade 5 - Normal power

Grades of Muscle Power used in Manual Testing

The assessment of muscle power should be carried out after the fourth week following onset. At that period, the patient would have recove-red from the acute stage of the illness. Pain and tenderness in the muscl had subsided. In testing muscle power in the patient, skill and experienc are essential especially where the patient had developed some trick movem

Methods had to be devised so that a child's muscles responded to external stimuli where possible. The methods used by the author were pro-prioceptive stimulations over the dermatome of the nerve to the muscles being tested. Stroking over the muscles with a broom-stick or the tip of a blunt finger nail had yielded good results.

Other methods used were tickling of the antagonist muscles in order to provoke withdrawal reflex. This method was used to elicit contraction of the toe flexors and extensors in children.

Quadriceps muscle contraction was not easy to provoke on request in small children. Two methods were adopted. One was to hold the thigh of the affected limb with one hand, while the other hand holds the leg and passively extends the knee. When the leg was dropped it either flops down with the heel touching the flexor aspect of the thigh when the muscle was completely paralysed (Fig. 3.2a), and if not, it remained extended reflexly by contraction of the quadriceps (Fig. 3.2b). The other method was to place the child in side lying with the affected knee in flexion. At times the limb was suspended manually by the thigh in that position. Quadriceps contraction was demanded by stroking over the muscles or by pinching the hamstrings (Fig. 3.2c).

To elicit the contraction of gluteus maximus, the natal cleft was stroked and observation made of the movement in it. The parachute dive position had been very reliable for this purpose. The child was held at the armpits and lifted from the ground to a reasonable height. Suddenly his head was swung downwards. Reflexly, the limb with gluteus maximus is thrown into extended position while the paralysed one hangs down limply (Fig. 3.2d).

In the case of psoas and iliacus muscles (hip flexors), with the child held at the armpits and lifted by the mother, the sole of the foot was stimulated either by stroking or pinching. The child then voluntarily bends the hip and knee if the muscle power was grade 3, otherwise the limb hangs down powerless for grade 0.

Hamstring muscles remained contracted against gravity when the knee is passively bent with the child in prone position. If hamstrings were paralysed the leg flopped into extended position (Fig. 3.3).

A child who could speak and who understood the language of communication presented no problem since he often responded to commands

Figs. 3.2a Quadriceps paralysed - leg drops
3.2b Knee extended by strong quadriceps
3.2c Quadriceps provoked into action in neutral position
3.2d Parachute dive to activate gluteus maximus
3.2e Degree of hip flexion deformity (T.F.L. Contracture)

Fig. 3.3 Hamstrings paralysed - passively flexed leg drops

or instructions when asked to move the required parts of the limbs. The positions of the limb were altered so that the muscles being tested could move actively when gravity was eliminated or against the force of gravity.

The results of the manual muscle tests were recorded on a special muscle assessment chart designed by the author (Fig.3.4). The chart contained other information and is currently being used by the physiotherapists at the University College Hospital, Ibadan.

3.1 Muscle power grades - Methods of Assessment

Grade 0 - Complete flaccid paralysis. No response to stimuli or command.

Grade 1 - A flicker of contraction. The child adequately undressed was placed on a plinth or on the mother's thighs in order to gain co-operation from it. In the presence of a good source of light, the muscle in question was pinched with the index finger and thumb or stroked with a broom-stick. On close observation, flicker of contraction or muscle twitch was noticed.

Grade 2 - Active contraction with gravity eliminated. The limb was kept in neutral position before requesting the contraction of the affected muscle. When it occurred, the muscle was graded as 2. Stroking with broom-stick or command was used.

Grade 3 - Active contraction against gravity. The limb was placed such that the muscle being tested would move the limb against the force of gravity.

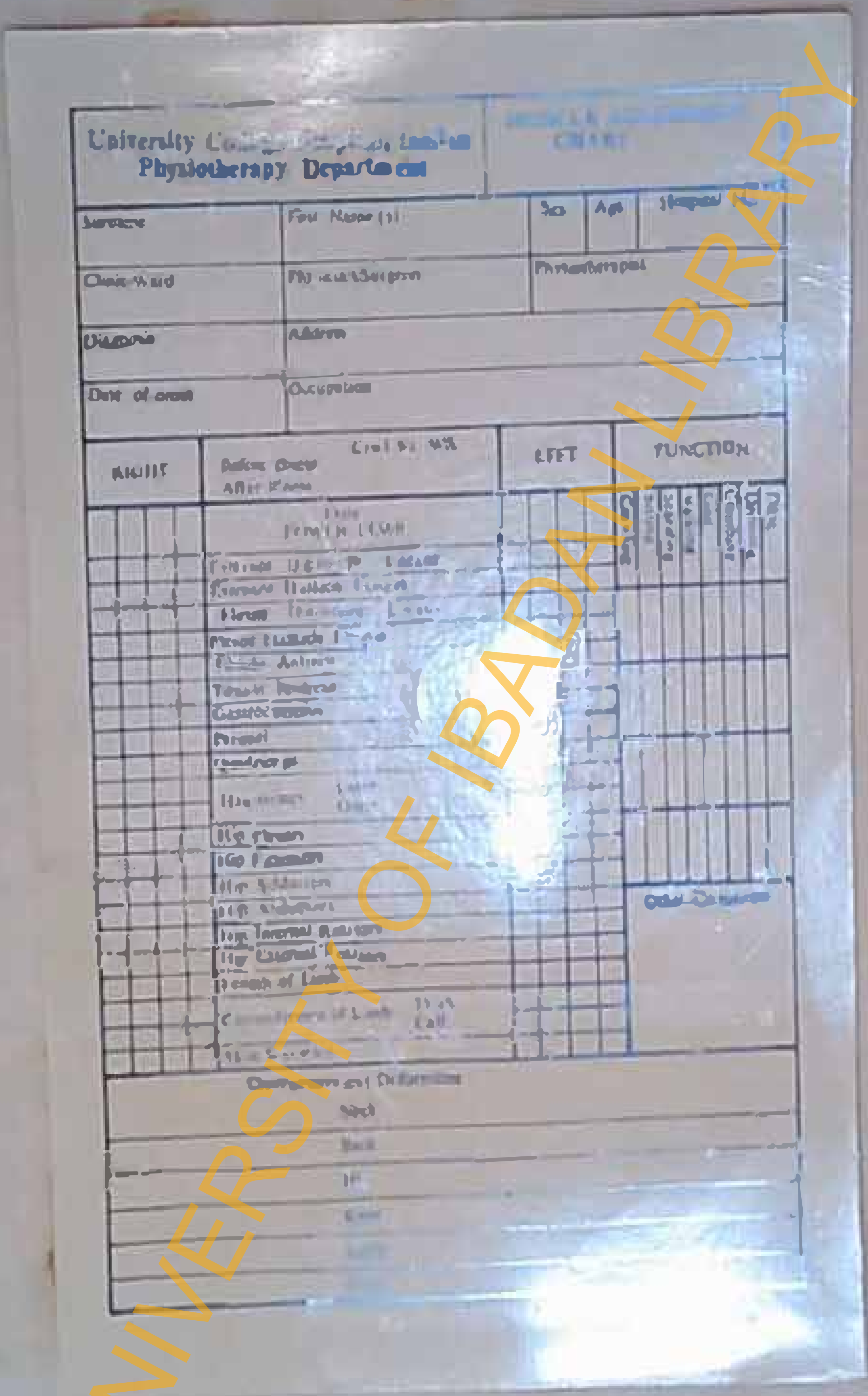


Fig. 3.4 Muscle Assessment Chart

Grade 4 - Active contraction against gravity and some resistance. The position and method of eliciting the grade was almost the same as those for Grade 3. The difference was the application of manual resistance to supplement that of gravity.

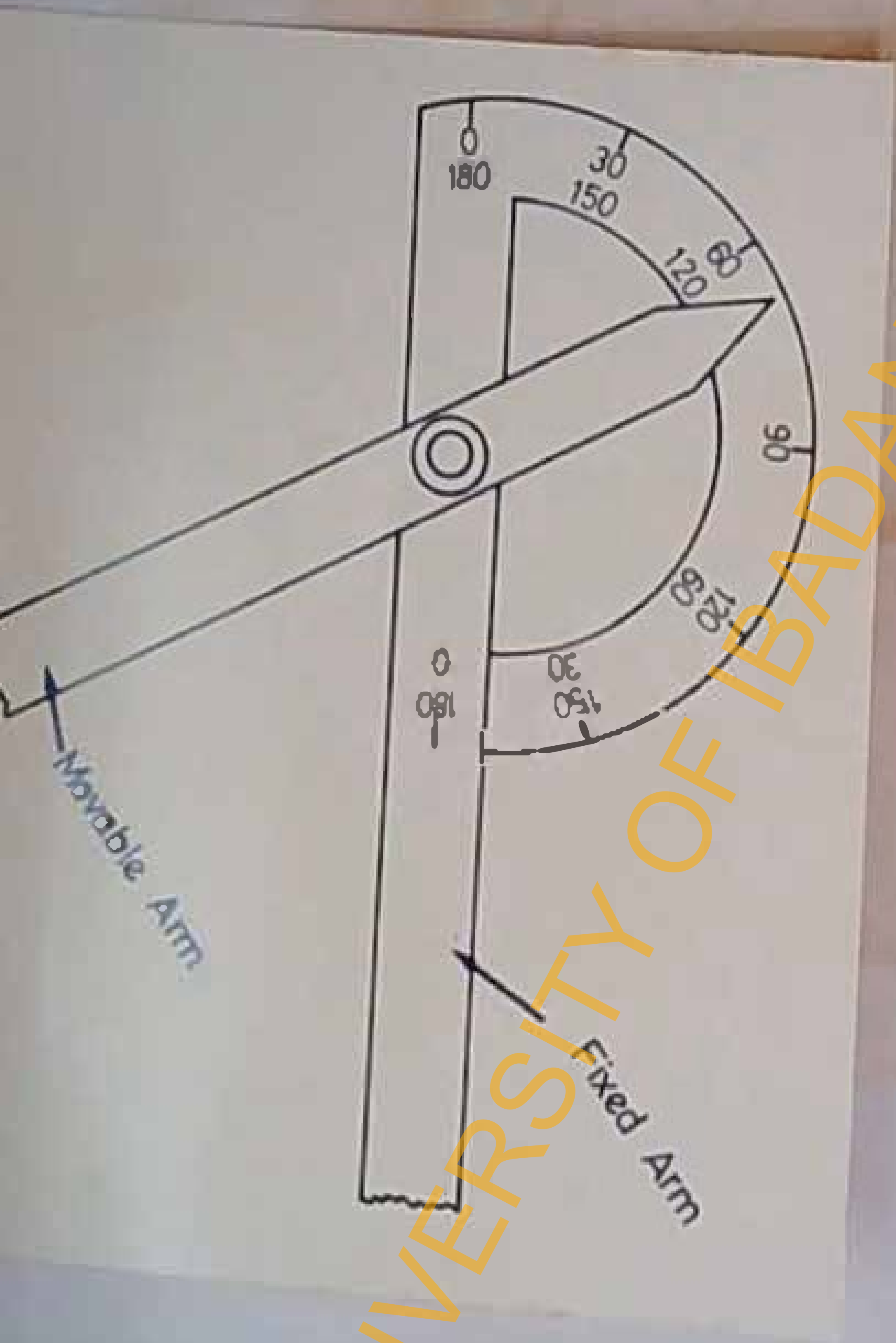
Grade 5 - Normal muscle power. This was obtained by applying greater resistance than that required for Grade 4 or by comparing the power with the same muscle in the normal contralateral limb.

It is necessary to note that a more scientific approach to the assessment of muscle power, in general, is by Electromyography.

3.2 Deformities

Contractures occur due to muscle power imbalance over a joint. The stronger group of muscles pull the affected part into a shortened position. When left in that position for too long, contractures become evident. Any attempt to stretch the shortened muscle was resisted due to pain. The position was therefore maintained and deformity became manifest. The extent of contracture and deformity was assessed by passive movements and measurement with an angle measure, the goniometer (Fig. 3.5). The result was recorded in geometrical degrees.

From the available history and assessments, a comparative study of the age and sex distribution of the patients were made; analysis of the distribution and frequency of paralysed muscles and deformities were carried out; discrepancies in the length of paralysed limbs were noted; anatomical distribution of affected side was observed as well as the monthly and seasonal incidence of poliomyelitis in Ibadan. All of the above were accounted for each year of the study.


0
180
30
150
60
120
90
Movable Arm
Fixed Arm

In addition, the management of the deformities encountered was discussed in detail while the effect of the paralysed limbs on locomotion and ambulations were examined.

3.3 Assessment of deformities

The deformities encountered in the lower limbs during this study were those of the hips, knees, ankles and feet. The degrees of severity were measured as a prelude to the management.

Oyemade and others (1981) graded deformities as mild, when there is 25° of fixed flexion deformity (FFD); moderately severe, when between 25° and 50° of fixed flexion deformity (FFD); severe, when more than 50° of fixed flexion deformity (FFD).

3.4 Hip

The deformity encountered in the hip was flexion - abduction deformity (Fig.3.6). The methods of assessment vary. The following procedure was adopted. The affected child was positioned on a high table or plinth in supine lying. The unaffected hip was flexed fully against the abdomen in order to obliterate lumbar lordosis and to fix the pelvis. The affected limb was then gradually extended and adducted fully at the hip joint in order to stretch the tight tensor fascia lata. The degree of deformity was measured with a goniometer. Richard (1969) and Huckstep (1975) had used this method (Fig.3.2e).

In older children, severe residual contractures were encountered due to neglect. Assessment was carried out in lying, standing and walking positions.

Fig. 3.6 Hip flexion - abduction deformity

3.5 Knee

Flexion (Fig. 3.8) deformity was caused mostly by the muscle imbalance between strong hamstrings and weak or paralysed quadriceps muscle. Prone lying was the best position adopted for carrying out measuremtnt of the deformity. In this position, the hip was in full extension and the deformtity was prevented from increasing by the contracted hamstrings.

Measurement was taken with the aid of a goniometer from as much extension allowed by the deformity to the neutral position (Fig. 3.8). When there is no deformity the knee was at 0^{o} neutral position.

Genu - Recurvatum (Fig. 3.9) is simply hyper-extension of the knee. Huckstep (1975) believed that it was due to early weight-bearing on a weak knee rather than muscle imbalance between the quadriceps and hamstrings.

Richard (1969) confirmed that it was not always associated with paralysed hamstrings and an active quadriceps. He further observed that fixed equinus deformity of the ankle was a predisposing factor in that the knee was forced backwards in order that the heel might reach the ground when standing or walking.

Assessment of the deformity was carried out with the patient in supine lying position. The leg was raised and the knee fully extended. The angle of hyper-extension was measured with a goniometer (Fig. 3.10).

Genu Valgum (Knock Knee) is a deformity in which the leg is angulated relative to the thigh. Contracture of the tensor fascia latae and the presence of valgus foot is a common cause of it in poliomyelitis.

Assessment of the deformity was by measuring the distance between

Fig. 3.8 Knee flexion deformity

Fig. 3.9 Bilateral genu recurvatum with right talipes varus deformity.

Fig. 3.10 Measurement of genu-recurvatum

the medial malleoli of the legs after the knees have been made to touch slightly without crossing each other. A goniometer was also used to measure the angle of deviation (Fig. 3.11).

Genu Varum (Bow Leg) is not a common occurrence in poliomyelitis. In the deformity, both knees and medial malleoli cannot be brought together. Bad posture and gait due to muscle imbalance in the leg was the cause. The method of assessment was the same as that of genu valgum.

3.6 Ankle

Equinus deformity (Fig. 3.12) which is a fixed plantar flexion of the foot at the ankle joint was caused by muscle imbalance between strong plantar flexors and weak dorsiflexors. Gravity and bad posture in lying, sitting and standing were common causes.

Flexion contractures of the hip and knee were found to be associated with the deformity (Fig. 3.12.1). The patient was positioned in supine lying with the knee extended before measurement was taken from the neutral position at 90° to the tibia (Fig. 3.13a).

Calcaneus deformity occurred when the calf muscles (plantar flexors) were weak or paralysed and the dorsiflexors of the ankle were strong. There was contracture of the latter muscles.

In order to get accurate measurement, the angle between the foot and neutral position was measured and recorded (Fig. 3.13b).

3.7 Foot

A number of foot deformities were encountered during this study.

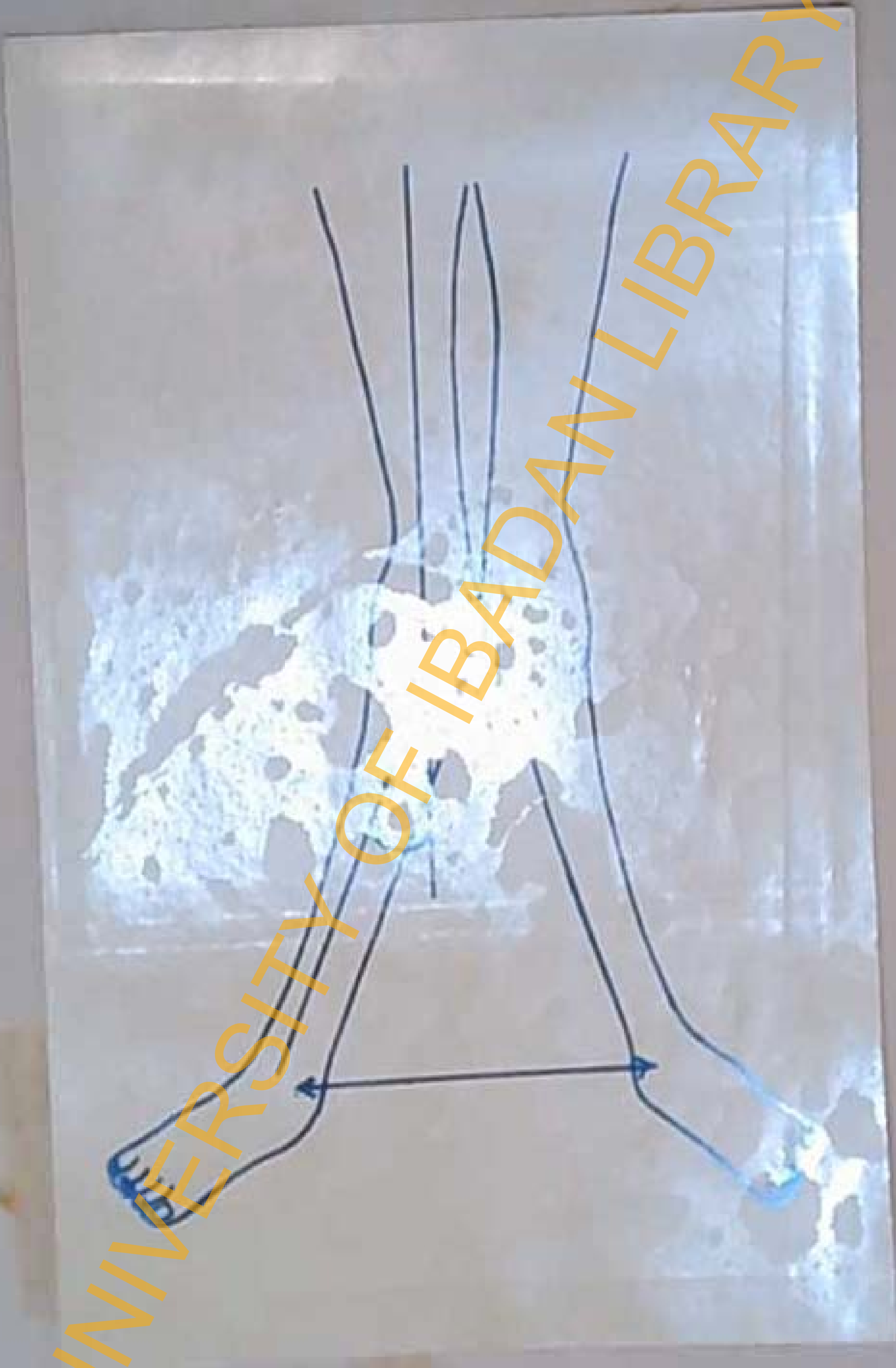


Fig. 3.11 Distance between medial malleoli and the degree of valgus deformity.

Fig. 3.12 Left talipes equinus deformity

Fig. 3.12.7 Right hip and knee contractures with resultant talipes equinus deformity.

Figs. 3.13a Measurement of equinus deformity
3.13b Degree of calcaneal deformity
3.13c Degree of varus deformity

Assessments were performed in order to plan management.

Varus deformity of the foot was noticed when there was over-activity of the invertors of the foot in the presence of weak evertors at the sub-taloid and mid-tarsal joints (Fig.3.14).

Measurement was performed after passively everting the foot to its limit. Its position was then related to 0^{o} neutral.

Valgus deformity kept the foot in everted position because the peronei muscles were stronger than the paralysed tibialis anterior and tibialis posterior muscles. Tight tendo-Achillis was known to have exaggerated the deformity (Richard, 1969). Assessment was taken from the neutral position.

In equino-varus deformity there was combined plantar flexion and inversion of the foot. It was markedly disabling. Weak or paralysed dorsiflexors and evertors of the foot in the presence of strong plantar flexors and invertors were responsible. The goniometer was used to assess the severity of the deformity.

Equino-valgus deformity kept the ankle and foot in plantar flexed and everted positions, respectively. The plantar flexors and evertors of the foot were observed to be strong while the dorsiflexors and invertors of the foot were weak or paralysed. The degree of deformity was assessed in the same manner as that of equinus-varus deformity with emphasis on the valgus foot

Fig. 3.14 Varus foot

CHAPTER FOUR

RESULTS

In the three-year period of this work, 1,202 new patients diagnosed as paralytic poliomyelitis were referred for physiotherapy. Of this number, 544 cases (45.2%) with lower limb involvement were studied. Four hundred and thirty-five (79.9%) of the cases were living in Ibadan, 81 (14.8%) came from nearby towns and villages and 28 (5.1%) from more than 120km. The following were the results obtained from the materials and data collected on the 544 cases.

TABLE 1

Age distribution at onset of management

Year	Number of Patients	Percentage of total
0 - 1	128	23.5
1 - 2	264	48.5
2 - 3	79	14.5
3 - 4	37	6.8
4 - 5	15	2.8
5 - 6	12	2.2
6 - 7	5	0.9
7 - 8	4	0.8
-	544	100.0

Table 1 and Fig.4.1 show the age incidence of patients when first seen in the physiotherapy department of University College Hospital, Ibadan. Below the age of 5 years were 96.1% of the cases.

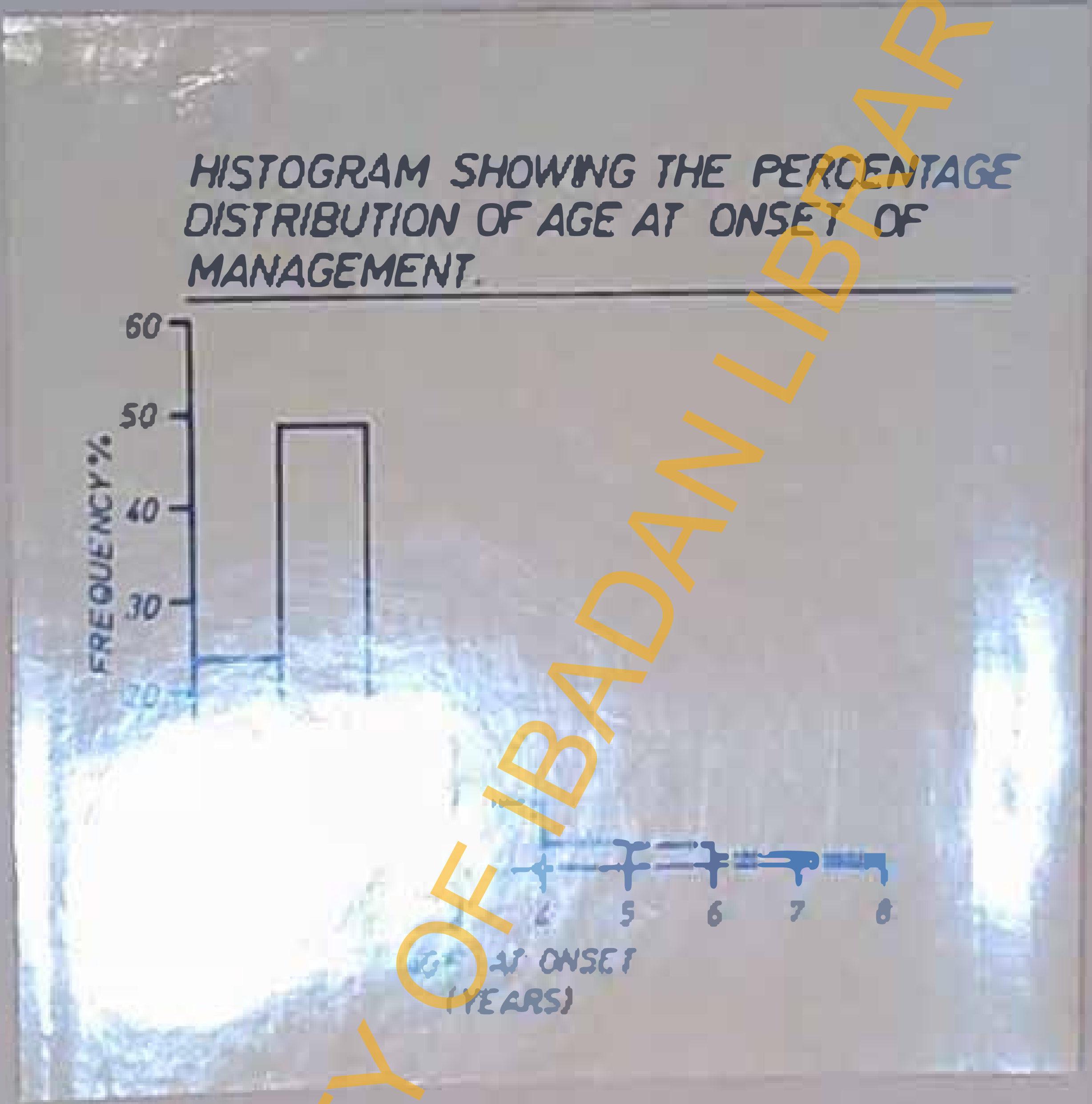

HISTOGRAM SHOWING THE PERCENTAGE DISTRIBUTION OF AGE AT ONSET OF MANAGEMENT.
FREQUENCY %
60
50
40
30
20
4
5
6
7
8
AT ONSET
(YEARS)

Fig. 4.1

TABLE 2

Sex distribution

Year	Male	Female	Total
1978	92	71	163
1979	98	94	192
1980	100	89	189
TOTAL	290	254	544

Table 2 and Fig.4.2 represent the sex distribution of the 544 cases of poliomyelitis studied for each year of the three years. There was a predominance of male over female.

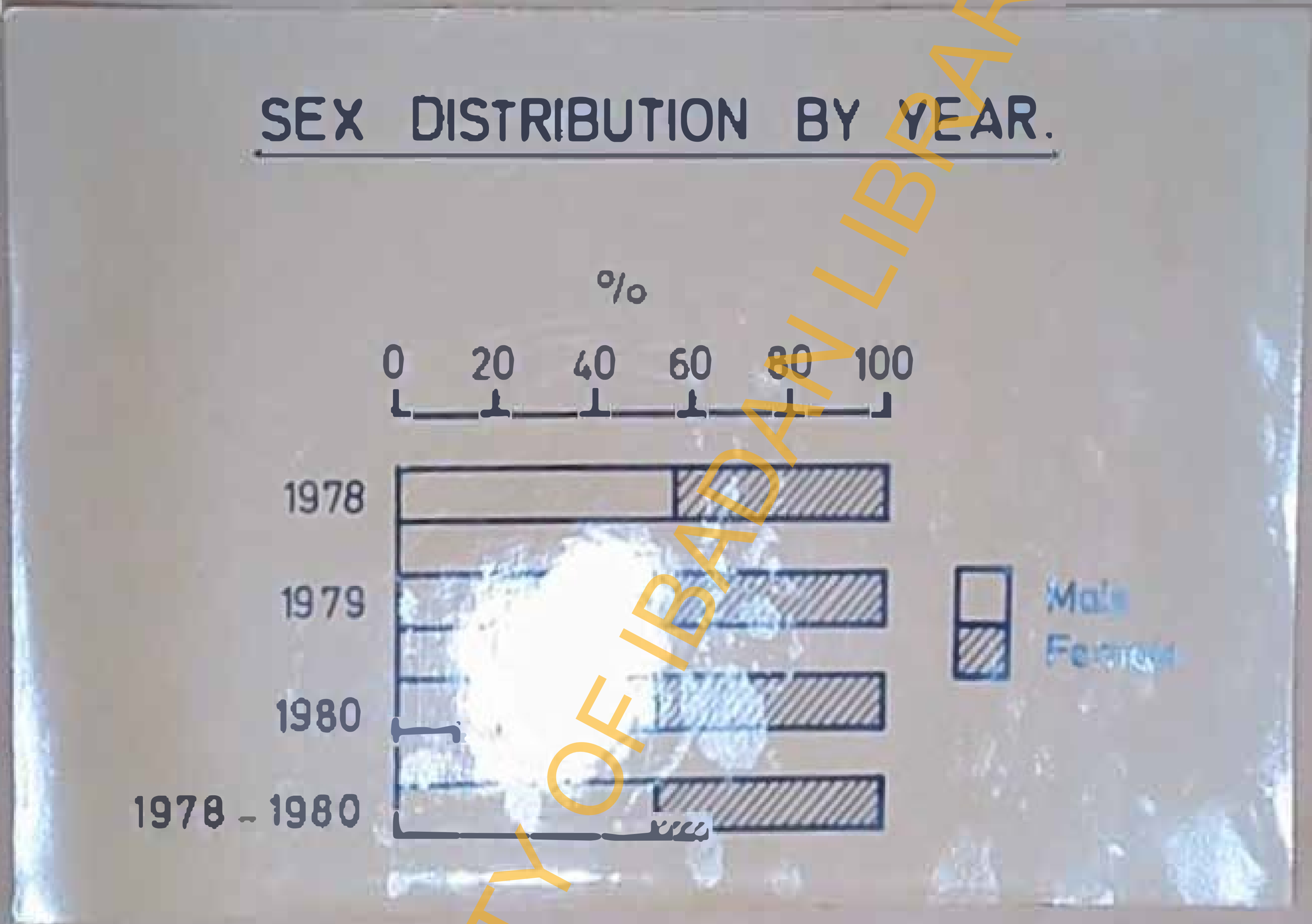

SEX DISTRIBUTION BY YEAR.
%
0
20
40
60
80
100
1978
1979
1980
1978 - 1980
Male

Fig. 4.2

TABLE 3

Anatomical distribution of paralysis

Year	Right	Left	Both
1978	44	49	70
1979	58	64	70
1980	61	53	75
TOTAL	163	166	215

Table 3 and Fig.4.3 show the anatomical site of paralysis by year. For the three years, the right lower limb represents 30%, the left 30.5% and both limbs 39.5%.

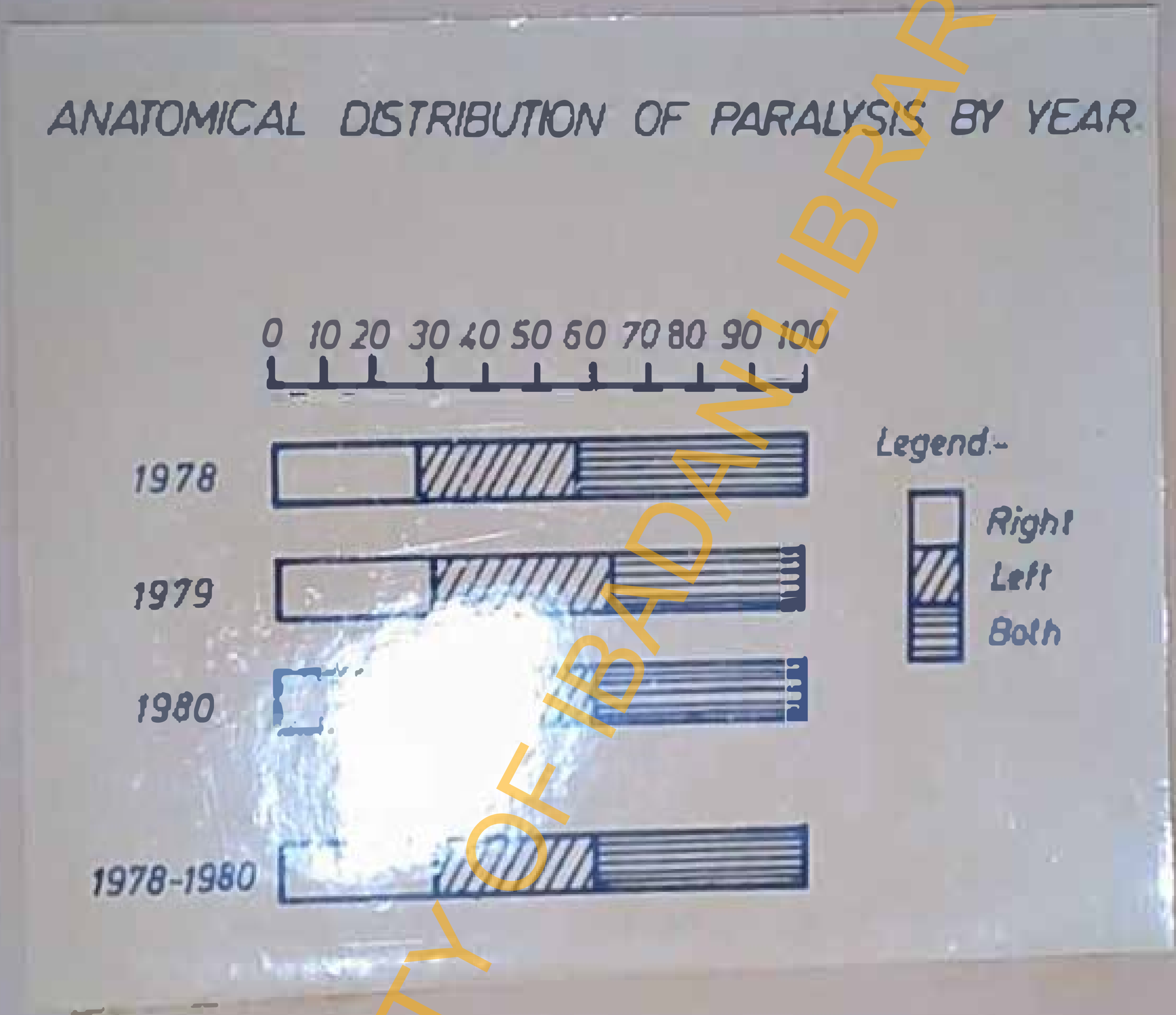

ANATOMICAL DISTRIBUTION OF PARALYSIS BY YEAR
0 10 20 30 40 50 60 70 80 90 100
1978
1979
1980
1978-1980
Legend:-
Right
Left
Both

Fig. 4.3

TABLE 4

Distribution of paralysis in 2,687 muscles of the lower limb

Muscle	Number Affected	Percentage(%)
Quadriceps	354	13.2
Hip Adductors	278	10.3
Tibialis Anterior	258	9.6
Peronei	229	8.5
Gastrocnemius	199	7.1
Hamstrings	182	6.[illegible]
Gluteus Maximus	176	6.6
Tibialis Posterior	175	6.5
Extensor Hallucis Longus ..	174	6.5
Extensor Digitorum Longus ..	169	6.3
Hip Abductors	154	5.7
Hip Flexors	127	4.7
Flexor Hallucis Longus	115	4.3
Flexor Digitorum Longus	107	3.9
TOTAL	2,687	100.0

Table 4 and Fig.4.4 show the frequency distribution of paralysed muscles with quadriceps at the peak.

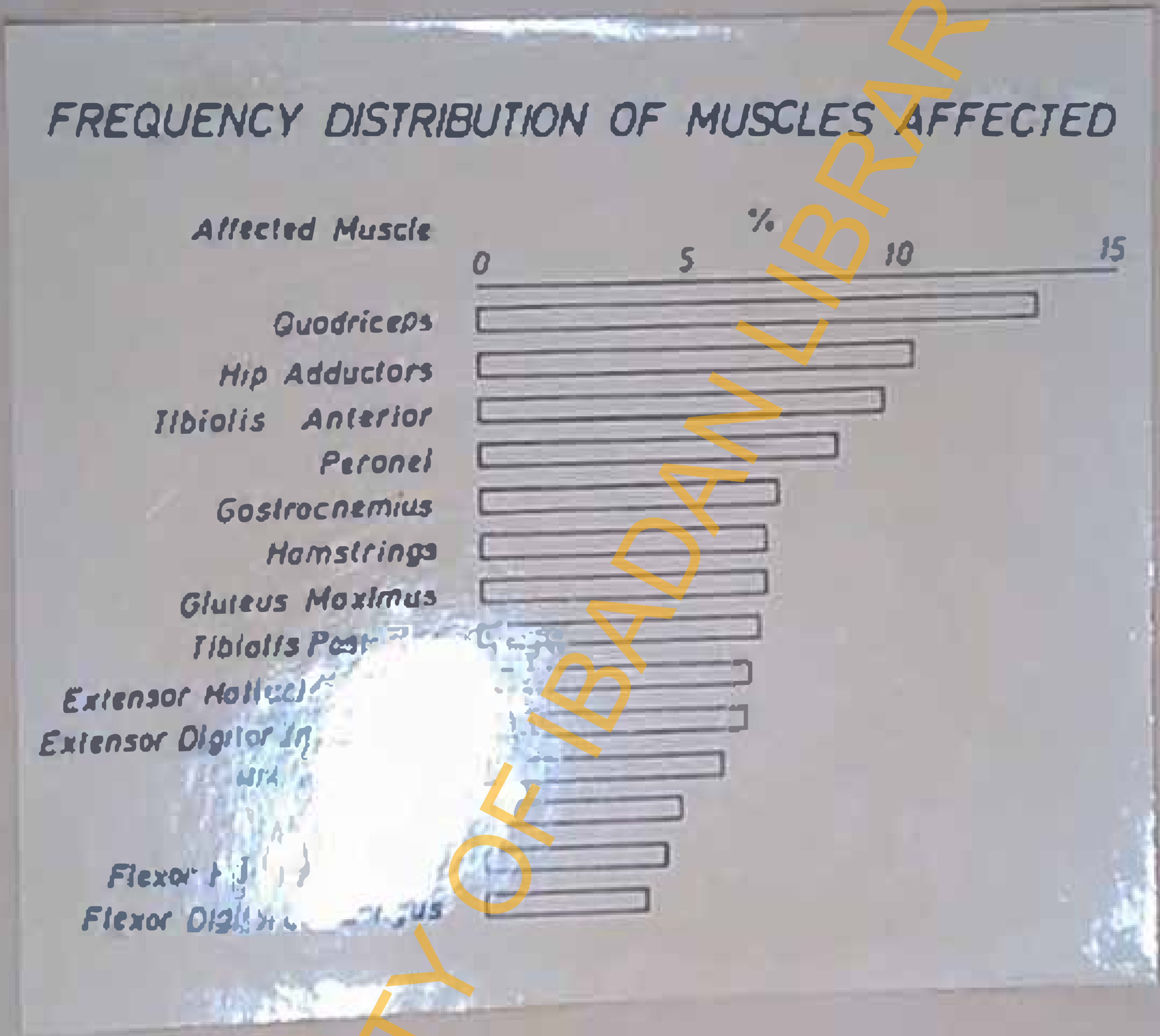

FREQUENCY DISTRIBUTION OF MUSCLES AFFECTED
Affected Muscle
%
0
5
10
15
Quodriceps
Hip Adductors
Tibiolis Anterior
Peronei
Gostrocnemius
Hamstrings
Gluteus Maximus

Fig. 4.4

TABLE 5

Distribution of deformities in the lower limb

Deformity	Number	Percentage
a Tendo-Achillis (Fixed foot drop)	152	29.9
b Tensor Fasciae latae (Hip flexion)	150	29.4
c Genu Recurvatum	87	17.1
d Knee Flexion	43	8.4
e Talipes Equinus	36	7.1
f Talipes Valgus	18	3.5
g Genu Valgum	8	1.6
h Equino-Varus	5	1.0
i Genu Varum	4	0.8
j Talipes Varus	3	0.6
k Equino-Valgus	2	0.4
l Talipes Calcaneus	1	0.2
TOTAL	509	100.0

Looking at Table 5 and Fig. 4.5 it will be observed that tendo-Achillis and tensor fasciae latae were most affected respectively.

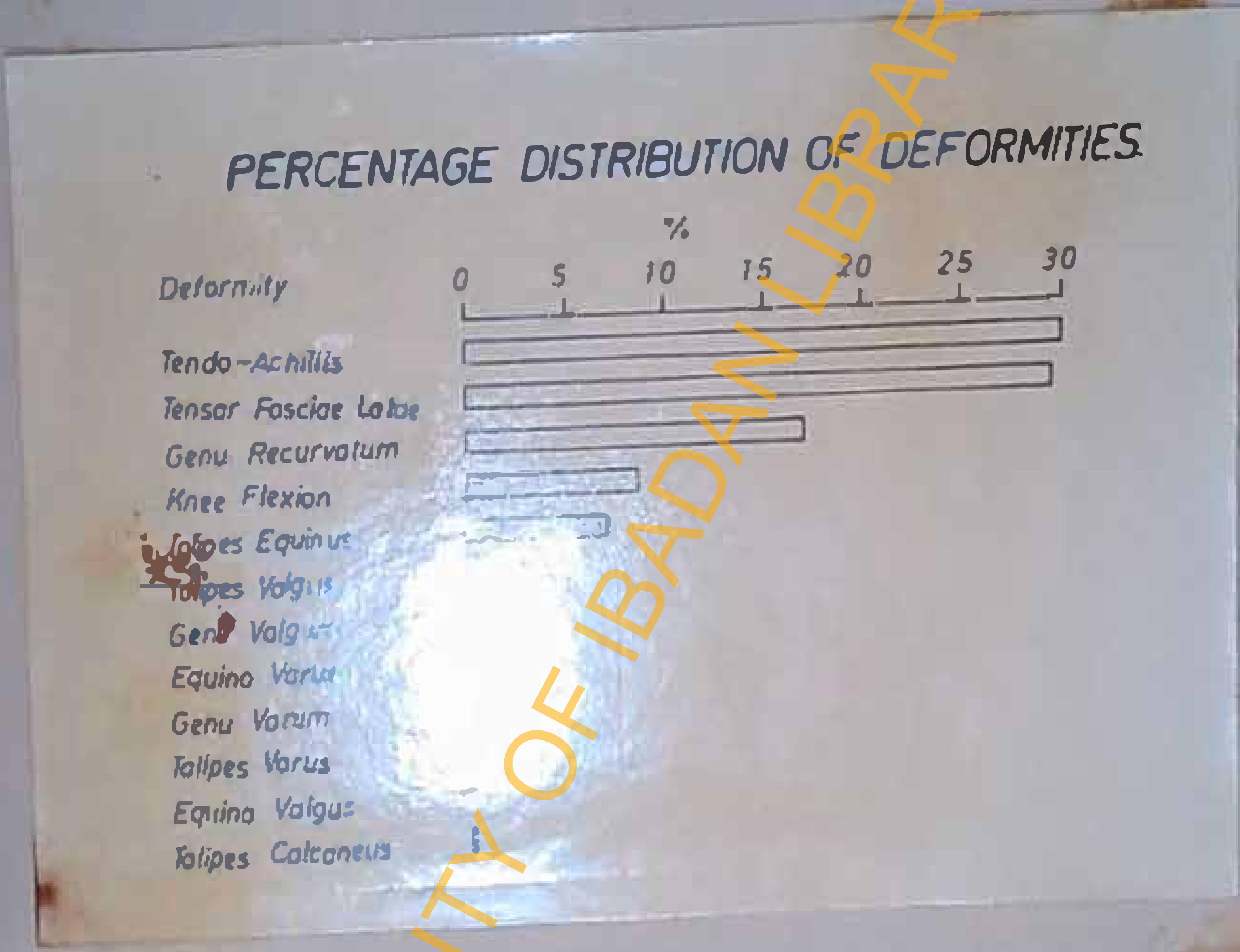

PERCENTAGE DISTRIBUTION OF DEFORMITIES
%
Deformity
0
5
10
15
20
25
30
Tendo-Achillis
Tensor Fasciae Latae
Genu Recurvatum
Knee Flexion
Equinus
Genu
Equino
Genu Varum
Talipes Varus
Equino Valgus
Talipes Calcaneus

Fig. 4.5

TABLE 6

Sex incidence of deformities in the lower limb

Deformity	Male		Female		Total	
	No	%	No	%	No.	%
Tendo-Achillis (Fixed foot drop)	95	32	57	26.8	152	29.9
Tensor Fasciae Latae (Hip flexion)	86	29	64	30.2	150	29.4
Genu Recurvatum	62	20.8	25	11.8	87	17.1
Knee Flexion	13	4.4	30	14.2	43	8.4
Talipes Equinus	19	6.4	17	8.0	36	7.1
Talipes Valgus	10	3.4	8	3.8	18	3.5
Genu Valgum	3	1.0	5	2.4	8	1.6
Equino-Varus	3	1.0	2	0.9	5	1.0
Genu Varum	1	0.3	3	1.4	4	0.8
Talipes Varus	2	0.7	1	0.5	3	0.6
Equino Valgus	2	0.7	0	0.0	2	0.4
Talipes Calcaneus	1	0.3	0	0.0	1	0.2
TOTAL	297	100	212	100	509	100

Table 6 shows the sex incidence of each deformity.

TABLE 7

Incidence of shortening of limbs

Year	½"	1"	1½"	2"	2½"	3"
1978	4	3	2	1	-	-
1979	3	2	-	-	-	-
1980	2	-	-	-	-	-
TOTAL	9	5	2	1	-	-

Table 7 and Fig. 4.6 illustrate the amount of shortening observed in the lower limbs.


DISTRIBUTION OF SHORTENING
OF LOWER LIMBS.
10
0
NO OF LIMBS.
0.5
1.0
1.5
2.0
2.5
EXTENT OF SHORTENING
INCHES

Fig. 4.6

TABLE 8

Monthly distribution of lower limb paralysis at onset of management

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1978	25	16	19	10	10	12	22	16	5	10	12	5	163
1979	7	17	15	16	17	11	30	24	17	6	17	15	192
1980	10	27	20	22	13	9	18	14	14	15	21	6	189
TOTAL	43	60	54	48	40	32	70	54	36	31	50	26	544

Table 8 and Fig.4.7 indicate the monthly occurrence of paralysis in the lower limb.

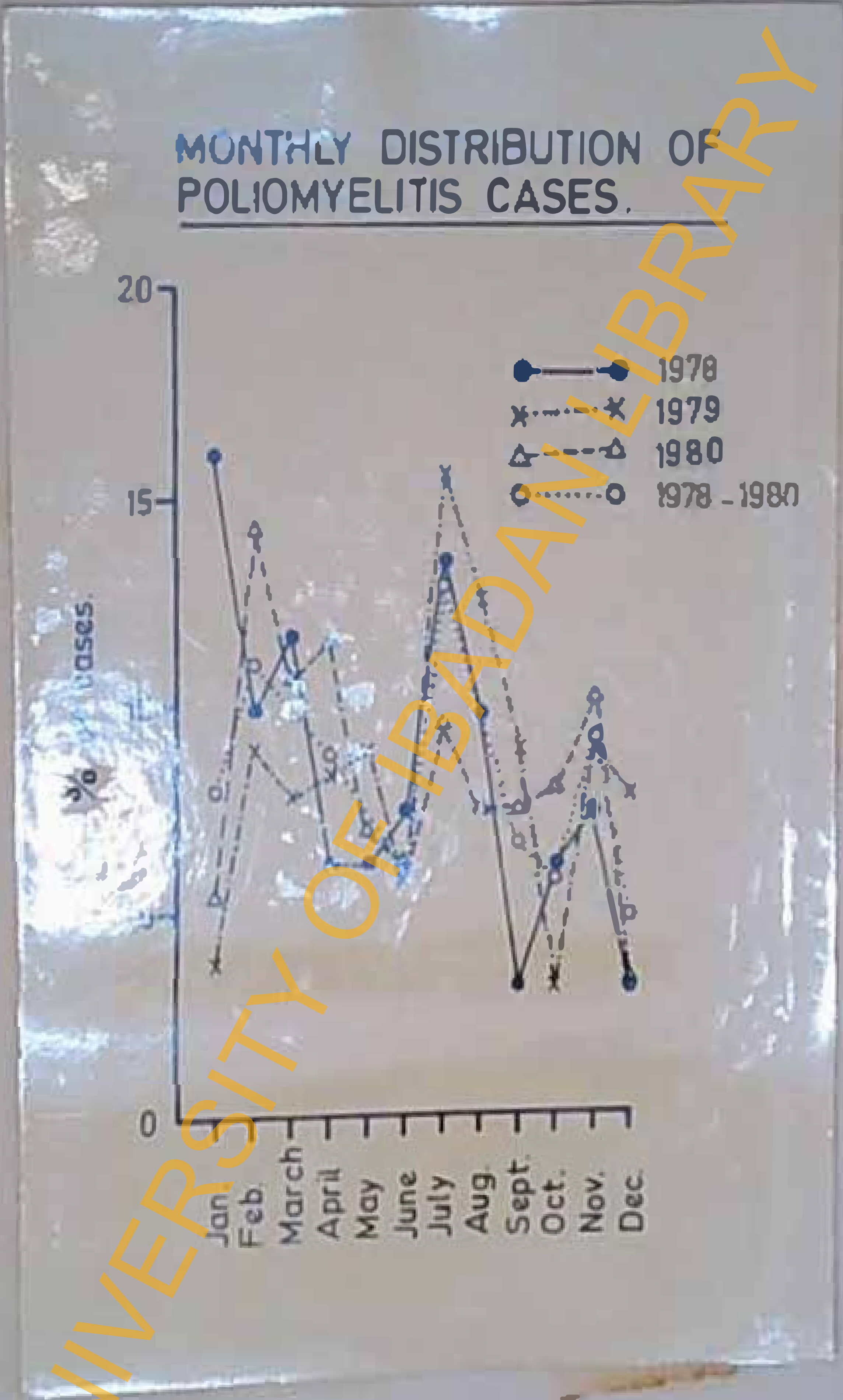

MONTHLY DISTRIBUTION OF
POLIOMYELITIS CASES.
20
15
0
% cases.
1978
1979
1980
1978 - 1980
Jan
Feb
March
April
May
June
July
Aug
Sept
Oct.
Nov.
Dec

Fig. 4.7

TABLE 9

Monthly distribution of lower limb poliomyelitis cases (1978 - 80)

Month	Number of cases	Percentage of Total
January	43	7.9
February	60	11.0
March	54	9.9
April	48	8.8
May	40	7.4
June	32	5.9
July	70	12.9
August	54	9.9
September	36	6.6
October	31	5.7
November	50	9.2
December	26	4.8
TOTAL	544	100.0

Table 9 and Fig.4.8 illustrate the monthly distribution of poliomyelitis cases between 1978 and 1980. The distribution is not constant for each month of the respective years studied.


MONTHLY DISTRIBUTION OF
POLIOMYELITIS CASES 1978-1980
20
15
10
April
May
June
July
Aug
Sept
Oct
Nov
Dec
MONTHS

Fig. 4.8

TABLE 10

Monthly incidence of poliomyelitis affecting all parts of the body in University College Hospital, Ibadan.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1978	47	28	36	29	29	30	40	32	19	26	28	11	355
1979	16	27	42	49	40	37	43	36	30	16	33	32	401
1980	29	39	46	46	51	33	41	26	36	36	36	27	446
TOTAL	92	94	124	124	120	100	124	94	85	79	97	70	1202

Table 10 shows the total number of poliomyelitis patients seen in University College Hospital, Ibadan during the years of 1978 - 80.

TABLE 11

Monthly rainfall in relation to the incidence of poliomyelitis in Ibadan after the floods of August 1963 and August 1980 respectively.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	
1963	Nil	47.7	48.0	[illegible]	163.9	141.0	211.3	351.2	270.1	[illegible]	11.3	1.0	1567.4	Rainfall in milliemeter
	12	6	5	4	-	3	12	7	21	36	40	39	[illegible]	Number of patients
1980	Nil	16.3	23.0	112.5	136.6	[illegible]	319.6	329.0	332.3	323.2	51.2	Nil	[illegible]	Rainfall in milliemeter
	21	39	45	46	51	33	41	26	35	36	36	37	446	Number of patients

Table 11 shows the relationship of rainfall to the incidence of poliomyelitis in Ibadan after the floods of August 1963 and August 1980 respectively.

CHAPTER FIVE

MANAGEMENT OF THE DEFORMITIES

Five hundred and nine deformities affecting one or both lower limbs were recognised in 450 (82.7%) cases out of the 544 children studied. These consisted mostly of contractures in the hips, knees, ankles and feet. Sixty (11.0%) patients had paralysis of some muscles of the limbs but without any contracture because both the agonist and the antagonist muscles were paralysed leaving the limbs flail. Thirty-four (6.25%) cases did not develop contractures though there were muscle imbalance around the joints of action. The management was guided by the cause and severity of the deformity.

Conservative measures were taken when the contracture was mild and resulting in about 25° of fixed flexion deformity. The treatment, often performed by the physiotherapists, involved passive stretchings of the tight structures and application of corrective and supportive splints.

In moderately severe contracture causing between 25° and 50° of fixed flexion deformity, treatment was by manipulation and application of plaster of Paris as support or for serial correction.

Surgical intervention in the form of release operation followed by application of plaster of Paris was the method adopted in severe cases with more than 50° of fixed flexion deformity. These were treated by the orthopaedic surgeon.

5.1 Hip deformity

The commonest deformity of the hip observed in this work was flexion-abduction deformity. There were 150 cases. When mild, passive stretchings of the contracted tensor fasciae latae muscle were performed by the physiotherapist at each treatment visit. The mothers of the patients were taught the procedure which should be carried out at least three times daily.

The procedure consisted of fixation of the unaffected hip in flexion with one hand whilst the other hand was used to extend and adduct the affected hip firmly and as fully as possible. The child was kept in supine position throughout the treatment.

If the contracture was moderately severe, immobilisation in a single plaster hip spica (Fig. 5.1) after corrective stretching as indicated above was carried out by the physiotherapist or orthopaedic surgeon. Double hip spica was applied in bilateral cases. In both instances the plaster was retained for six weeks.

During the period of immobilisation the child was encouraged to walk within parallel bars. The plaster was protected at the sole with rubber shoes made from pieces of old motor tyre and inner tube (Fig. 5.1). At a later stage, walking with the aid of crutches was taught. The child found this more difficult than when he had to walk with the limb supported in long leg caliper.

In severe contracture of more than 50° deformity, the surgical procedure adopted in University College Hospital, Ibadan involved section of tight structures on the anterior aspect of the hip joint as well

Fig. 5.1 Child in plaster hip spica with protective rubber shoe

as division of the ilio-tibial band above the knee. Similarly, tight bands in the gluteus medius and minimus and the fascia covering them were divided (Richard, 1967). This procedure was also adopted for all the patients that had severe fixed flexion deformity of the hip in this study.

5.2 Knee flexion deformity

All patients that had mild deformity were treated by passively stretching the contractures and applying plaster of Paris back slab. In moderately severe cases, serial or wedged plaster cylinder (Fig. 5.2) was applied after manipulation. On removal of the plaster and following full correction, a knee cage or a caliper was worn to prevent recurrence of the deformity. The caliper was made such that the knee piece was tight and the posterior strap loose on application.

When the deformity was severe as a result of the contracture or shortening of the hamstrings, surgical intervention was performed by the orthopaedic surgeon in the form of division of the contractures and supra-condylar osteotomy. Physiotherapy, after operation, consisted of posture correction and re-education of walking pattern.

5.3 Genu recurvatum

In this study, genu recurvatum was more common than any other deformity of the knee. Eighty-seven cases were seen. The treatment in its mild and moderately severe forms was the application of plaster cylinder which extended from below the gluteal fold to about one inch

Fig. 5.2 Plaster of Paris [illegible] cylinder marked for serial correction.

above the medial malleolus. The knee was kept in slight flexion and the plaster worn for about three months.

On attaining full correction, a knee cage or caliper was worn so as to prevent re-appearance of the deformity. The caliper often had loose knee piece and tight posterior strap.

Corrective osteotomy was performed in severe cases when the surgeon considered it necessary.

5.4 Genu valgum

The physiotherapist stretched the lateral ligaments of the knee passively, several times, in order to effect correction of genu valgum. The mother of the child was taught and supervised about the procedure for the purpose of home management. Some therapists had also applied shoe raise on the medial side of the heel so as to relieve the strain on the medial collateral ligament of the knee when the child was ambulant. The effect was very minimal.

In moderately severe condition, serial or wedged plaster was applied with remarkable degree of success.

Supracondylar osteotomy of the femur followed by plaster fixation was carried out in severe cases. The patient was taught exercises to strengthen the quadriceps muscles and to re-educate walking after the corrections.

5.5 Genu varum

Like in the case of genu valgum, passive stretching of soft structures and manipulations were applied in order to correct the deformity. When the deformity was moderately severe, serial or wedged plaster was applied weekly in order to increase the correction. Strengthening of the quadriceps muscles and correct gait were taught before and immediately the plaster was removed.

The orthopaedic surgeon operated on the knee in severe cases. Such patients were offered supracondylar osteotomy at the site of election and fixation in plaster of Paris until union occurred. Physiotherapy was continued with emphasis on correct gait.

5.6 Equinus deformity

Equinus deformity was the most common deformity encountered in the ankle in this study. There was foot drop due to muscle imbalance. The deformity was managed by supporting the foot in plaster of Paris night splint after manual stretching during the mild stage. Lively splint in the form of toe raising device (Fig. 5.3) was worn by the patient if he was ambulant. Babies were fitted with special lively splint (Fig. 5.4). This splint was also used for babies with "Ọja" palsy. This palsy, often neurapraxia, was noticed in babies who were carried in the traditional way on the back and strapped with "Ọja" which compressed the common peroneal nerve over the head of fibula. Foot drop was the result of the nerve injury. In other cases, a below knee caliper or long leg caliper with posterior stops was worn in order to prevent foot drop and high stoppage gait.

Moderately severe cases were treated by the application of serial or wedged plaster at weekly intervals in order to achieve dorsi-flexion of the ankle (Fig. 5.5).

Subcutaneous elongation of tendo-Achillis followed immediately by application of plaster of Paris was the method of management in severe

Fig. 5.3 Toe raising apparatus.

Fig. 5.3 Toe raising apparatus.

Fig. 5.4 Toe raising device designed by the author for babies. Rubber bands replace springs.

Fig. 5.5 Kito's plasters marked for serial correction of equinus deformity.

cases. The plaster was removed after healing had taken place usually after about six weeks. A caliper with posterior stop was worn by the patient to prevent re-occurrence. Physiotherapy was in the form of correct pattern of walking and posture training.

5.7 Calcaneus deformity

This deformity was rare. The one case in this series was [illegible] was treated by passive stretchings and fixation in plaster of Paris [illegible] night splint. When the patient started walking, a below-knee caliper with an anterior stop to prevent dorsiflexion was [illegible].

5.8 Talipes valgus

Valgus of the foot was seen in 1[illegible] cases. Majority of these were left until operation was possible. Passive movements to stretch the dorsiflexors and peroneal were performed as the first line of treatment. When operation was necessary, the tendo-Achillis was elongated followed by the wearing of a below-knee caliper with back stop.

In some severe cases, peroneus longus tendon was transferred medially to assist with plantar flexion and dorsiflexion. [illegible] (Grice operation) was carried out on four patients.

5.9 Talipes varus

Where there was mild adduction of the fore foot with inversion, a single inside iron and outside T-strap was worn. This had not successfully corrected the deformity. A more permanent arrangement had been subtaloid triple arthrodesis or tendon transplantation followed by physiotherapy in the form of electrical stimulation for transplants.

The author had in many instances advised the wearing of left shoe on right foot and vice versa. With such manipulation, the straight outer border of the shoes helped to straighten the adducted foot.

5.9.1 Equinovarus deformity

The varus part of the deformity was the first to be corrected before the equinus. This was done by serial or wedged plaster as advocated by Kite (1952).

Effective and more permanent correction of the deformity was achieved by transplanting tibialis anterior tendon to the base of the second or third metatarsal bone. Adduction or varus deformity was corrected at the same time by soft tissue release. Active exercises, re-education of walking and support of the foot in night splint were carried out.

5.9.2 Equinovalgus deformity

The two cases in the study were treated by passive stretchings and corrective casting.

Below-knee caliper with outside iron and inside T-strap helped the patient to ambulate. No operation was done even though it might be of great advantage in correcting the deformity.

CHAPTER SIX

DISCUSSION

6.1 Age distribution

The age distribution shown in Table 1 was that of the patients on commencement of physiotherapy. The maximal incidence of 264 cases (48.5%) occur in the age group of one to two years, after which is the age group 0 to 1 year with 128 (23.5%) cases. Those below 5 years of age are 96.1% while the youngest case is three months old.

Nunube (1972) reported in Uganda that 94 per cent of cases were under 5 years of age; in Nigeria, Familusi and Adesina (1977) observed that 96 per cent of their patients were below 4 years of age.

Indeed, others have shown that the highest incidence is during the first two years of life (Collis et al, 1961; Singer and Ross-Innes, 1963; Taylor, 1966; Richard, 1967; Ayim, 1974; Oyemade, 1981), the peak period being at the age of 2 years.

From the foregoing, there is no doubt whatsoever that poliomyelitis, by and large, is still a disease of young childhood in some developing countries.

6.2 Sex distribution

Table 2 represents the sex distribution of the 544 cases of poliomyelitis studied for each of the three years. It is evident that the pattern is the same for each year with male predominance over female. The male to female ratio overall is 1.14:1 i.e. (53.3%) male and (46.7%) female. Similar preponderance of males over females among victims of poliomyelitis were reported by Collis and others (1961); Adewole (1964) and Familusi and Adesina (1977).

6.3 Anatomical distribution of paralysis

Table 3 reproduces the gross anatomical location of paralysis. The highest incidence occurs in both lower limbs simultaneously; the left lower limb is the next more affected whilst the least affected is the right lower limb.

This finding is partially at variance with the experience of Adewole (1964) and Oyemade (1981) who reported a predominance of the right lower limb over the left. Nevertheless, they agreed that both lower limbs were more affected than either the right or the left.

6.4 Distribution of paralysis

Among our 544 patients, 2,687 lower limb muscles were observed to be paralysed. The frequency of involvement of the affected muscles is shown in Table 4.

The quadriceps muscle was the most affected (13.2%) and the flexor digitorum longus (3.9%) was the least affected. This observation about the distribution of paralysis in poliomyelitis, differs from that of Lovett (1915, 1917), and that made some forty years later by Sharrard (1957). Both Lovett and Sharrard postulate that the muscles nearest the trunk are more frequently affected than the distal ones. The reasons given by those authors are that the large muscles nearest the trunk deal with coarser and less frequent movements whilst the muscles of the leg and foot are continuously active in performing small, fine and complicated movements.

In this study, the hip flexors, hip abductors and gluteus maximus muscle do not follow this pattern which ought to place them higher in the frequency of affectation. Similarly, tibialis anterior and the peronei muscles should be infrequently affected. Quadriceps was at the top in Sharrard's list of 2,464 affected muscles of the lower limb (Sharrard, 1955). This finding also agrees with those of Adewole (1964); Taylor (1966); Oyemade (1981) and in the author's list.

One is tempted to conclude that the reason why the muscles of the hip and thigh are less frequently affected, apart from the quadriceps, in the studies conducted in Africa might be due to the age at affliction. Children under and up to the age of two years are affected in the tropical countries and presumably have to use the muscles of the hip and thigh more than those of the leg and foot when learning to walk. In the temperate countries, on the other hand, poliomyelitis affects mostly those above five years of age.

The physiotherapeutic management of poliomyelitis depends on the accurate muscle charting of the affected limb. It has been demonstrated that certain muscles are more affected than the others. According to Sharrard (1955) the highest frequency of paralysis takes place in the tibialis anterior, tibialis posterior, long flexors and extensors of toes.

In the same manner, Sharrard (1955) observed that the pattern of muscle paralysis are related to the arrangement of cell columns in the anterior horns of the spinal cord. The representation of individual muscle or group of muscles is determined in the affected motor cell columns at varying segmental vevels. It was discovered that cell columns which lie ventrally in the anterior horn supply muscles in the proximal part of the lower limb whilst those in the dorsal region of the anterior horn supply muscles of the leg and foot, which are more distally placed.

Columns which supply flexor muscles are located medial and caudal to those supplying corresponding extensors. These columns are variablo in length. As an example, tibialis anterior, tibialis posterior, flexor digitorum longus and flexor hallucis longus have short columns whereas hip flexors, adductors and quadriceps have long colu muscle groups which are innervated by long motor cell columns are more often paretic than paralysed (Sharrard, 1955).

The concept of associated paralysis of muscles has also been formulated by Sharrard (1955, 1957). It has been demonstrated that each muscle can be associated with three or four others. For example, it is discovered that the paralysis of peronei is associated with the paralysis of extensor digitorum longus and extensor hallucis longus. A similar association exists between the tibialis anterior and tibialis posterior.

Sharrard (1957) explained the phenomenon of the association of paralysis in muscle groups in poliomyolitis by the unique example noted of the paralysis of the calf muscles and biceps femoris in the disease. The cell columns of the two muscles lie side by side and they are of the same length approximately. Should one of the cell columns be completely damaged by poliovirus, there is all likelihood that the other column will be equally destroyed as well. For this reason the two muscles are associated not only in paralysis but also in escape from paralysis.

In a further study, Sharrard (1957) discovered that the power of a muscle was closely related to the percentage of residual motor nerve cells in the spinal column (Table 12). It is interesting and astonishing to observe

TABLE 12

Relationship between Muscle Power and Residual Motor Cells in the Spinal Cord (Sharrard, 1955).

Muscle Power (Medical Research Council Scale)	Percentage of Residual Motor Cells
0	0 - 2
1	2 - 3
2	3 - 5
3	5 - 10
4	10 - 20
5	20 - 40

from his findings that a muscle of grade 3 had only 5 - 10% of its normal nerve supply unaffected whilst a muscle with normal grade has just 40% of motor nerve cells left. He also discovered that muscle contraction can be elicited in a muscle which has only 2% of motor nerve cells intact.

From the study of the lumbo-sacral motor cell columns and the concepts postulated by Sharrard (1957), it is possible to determine the pattern and distribution of paralysis and the anticipated pattern of deformities in limbs affected by poliomyelitis.

It is also helpful in determining the extent of recovery to be expected in a poliomyelitis patient and the approximate duration of treatment. Some physiotherapists continue to treat patients who have permanent paralysis and fibrosis of muscles for a long period of time with the hope of recovery in the affected limbs. A knowledge of the above study as well as studies with electromyography will reduce wasted efforts and thus permit early rehabilitation programme for the patients.

6.5 Distribution of deformities

It has been established that flaccid paralysis in poliomyelitis leads to loss of function. The accompanying muscle imbalance with resultant contracture and the effect of gravity were responsible for the formation of deformity. Deformity once established will inhibit the recovery and function of paralysed muscles which are kept stretched beyond their normal length. In children, deformity is increased and exaggerated as they grow (Fig. 6.1). Hence it must be prevented from occurring or corrected when established as quickly as possible.

From the results obtained in this study, (Table 5), it is observed that deformity due to the contracture of tendo-Achillis was highest. One hundred and fifty-two cases had this contracture which represented 29.9% of the total deformities encountered.

Huckstep (1975) agreed that tendo-Achillis contracture is one of the commonest deformity seen in children with poliomyelitis. Green and Grice (1953) observed that loss of power of dorsiflexion was the most frequently encountered disability in paralysis of the foot.

Singer and Rose-Innes (1963) reported the works of Lovett and Martin (1916); Mitchell (1925); and Legg (1929, 1937) which showed that there was a high incidence of paralysis in tibialis anterior, tibialis posterior, peronei and long flexors and extensors of the toes during an attack of poliomyelitis. Contracture of tendo-Achillis is due to unopposed action of gastrocnemius in the presence of paralysed tibialis anterior.

Sharrard (1957) proved that susceptibility of the tibialis anterior to a heavy attack by polio virus was due to the length of its cell column which is 8 mm compared with that of its antagonist, the gastrocnemius, which is 14 mm long.

One hundred and fifty patients had contracture of the tensor fasciae latae (Table 5b). The deformity is as a result of the tightness of hip flexors and abductors when the gluteus maximus and

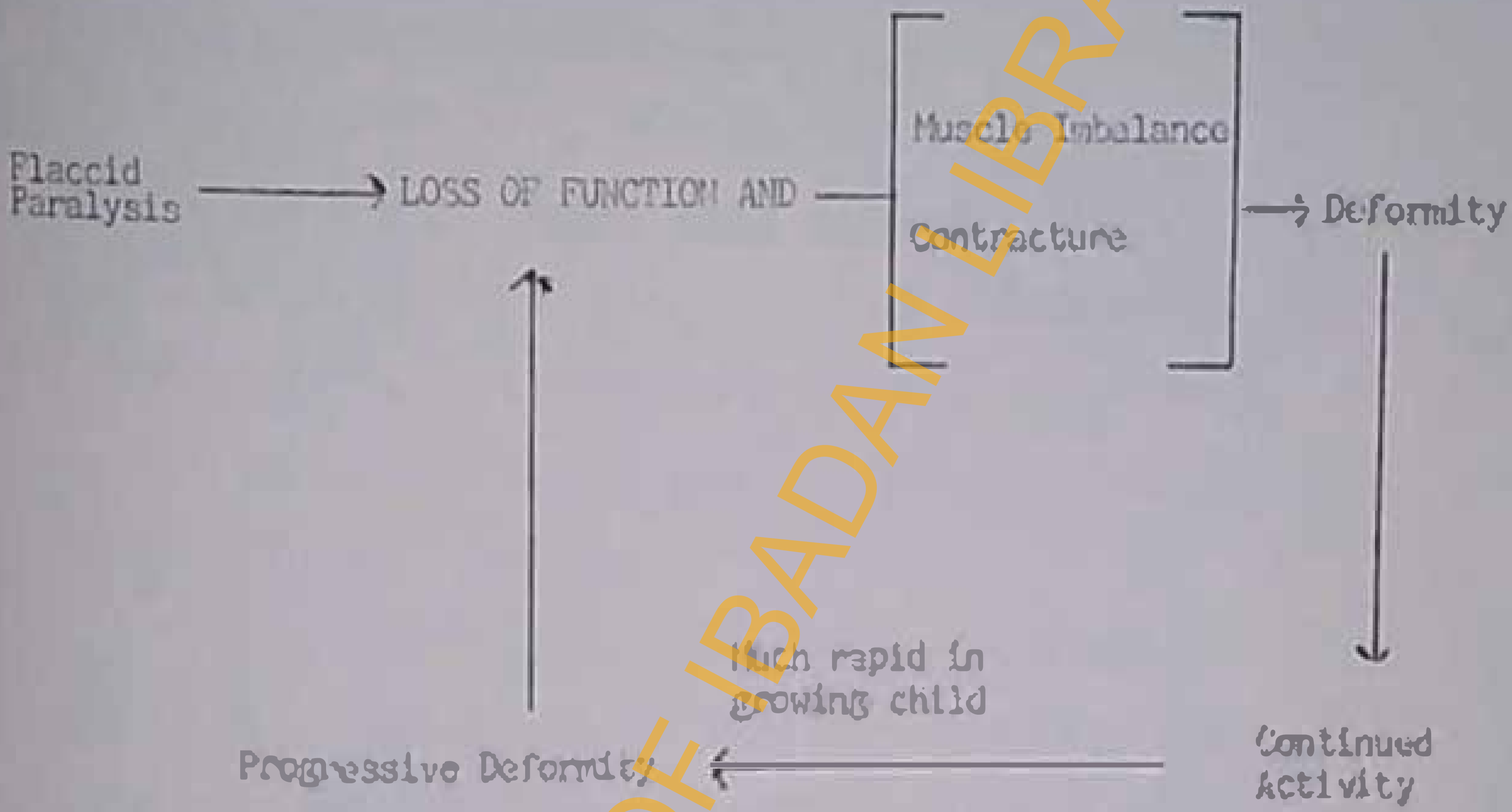


Fig. 6.1 Vicious circle of loss of function following flaccid paralysis.

hip adductors are paralysed. The high incidence (29.4%) is at variance with the findings of Sharrard (1957) who felt that gluteus maximus and hip adductor muscles are less frequently paralysed because of their long cell columns of 17 mm and 22 mm respectively.

It is most likely that a partially paralysed gluteus maximus and hip adductors might have been paralysed as a result of adaptive lengthening. This can occur when the child crawls about as well as when he is strapped in a crouching position on the mother's back in the Nigerian traditional way.

The effect of this deformity is disabling in a growing child. When it lies on its back, the limb falls outwards into abducted position because of the tightness in the gluteus medius and minimus. In addition, the pelvis becomes tilted laterally thereby causing apparent lengthening of the affected limb (Fig. 6.2). Mothers are discouraged from carrying their children in crouching position on the back as well as allowing them to crawl about. These might prevent contractures of tensor fasciae latae at onset of the disease and increase the deformity if already established.

Genu recurvatum represented 17.1% of the total number

Fig. 6.2 Apparent lengthening of right lower limb. Note compensatory pelvic tilt and level of the patellae.

of deformities observed in this study (Table 5c). Paresis of the quadriceps muscle, which has long cell column of 22 mm, and early ambulation, may be responsible for the fairly high occurrence in the limbs. The highest age group is one to two years. This may be responsible for genu recurvatum in children who are learning to walk. Others who have tendo-Achillis contracture and weak or paralysed quadriceps develop the deformity while making effort to reach the ground with the heel in standing or walking. The deformity causes much strain on the posterior ligaments of the knee. The degree of the strain increases with weight bearing thus affecting the posture of the patient in standing and walking (Fig. 5.3).

Forty-three (8.4%) of the patients had flexion deformity of the knee. This is likely due to the mode of locomotion, such as crawling, and the effect of gravity on the dependent leg when the child is on the mother's back. Strong hamstrings in the presence of paralysed quadriceps is responsible for the position of the limb in this deformity.

The child cannot walk in upright position; therefore, he takes to crawling on hands and knees with the development of gross contractures. Evidence of crawling is indicated by the thick calosity over the patellae and on the skin over the dorsum of the metatarsal heads and the phalanges (Fig.6.4). Where severe contracture has not developed, the patient supports the knee with one hand in order to lock and protect it before weight transference when walking.

Talipes equinus (foot drop) constitutes 7.1% (Table 5c) of the deformities treated. It is the commonest of all the foot disabilities

Fig. 6.3 Patient with bilateral genu-recurvatum.
Gluteal muscles are paralysed and wasted.
Patient can only stand with support.

Fig. 6.4 Crawling on hands and knees. Body weight transfered to upper limbs causing bowing of elbows.

in this study. Apart from the unopposed gastrocnemius muscles being dominant over the paralysed tibialis anterior leading to tendo-Achillis contracture and fixed foot drop, the high incidence of tensor fasciae latae contracture may be a predisposing factor. Because of the tight tendo-Achillis, the patient walks on the toes. In moderately severe case, the patient walks with high stepping gait. He flexes the hip and knee in order to clear the ground; else, he trips and falls.

Another deformity with reasonably noticeable occurrence is talipes valgus. There are eighteen (3.5%) cases. Isolated paralysis of tibialis anterior and over-acting peroneus longus and extensor hallucis longus are responsible. These limbs have valgus heel because of the paralysis of tibialis posterior.

Table 58 shows the fairly low incidence (1.6%) of genu valgum deformity which by comparison is higher in number of frequency than genu varum. Only four limbs (.8%) were recorded to have genu varum deformity (Table 5i). The patient walks with the affected knee obstructing the other in genu valgum whilst a patient with genu varum develops a wobbling gait.

Equino-varus deformity (Table 5h) was noticed in five limbs whilst two limbs had the equino-valgus deformity (Table 5i). They represent 1% and .4%, respectively, of the total number of the deformed limbs.

Three (.6%) feet have varus disability (Table 5j) as against one (.2%) with calcaneal deformity. This case has an accompanying cavus foot (Fig. 6.5).

FIG. 6.5 Left calcaneus deformity with cavus foot.

Inequality in the lengths of the legs in poliomyelitis is not as common as previously thought in Nigeria. [illegible] (1968) observed that a difference of more than one inch is rare in Nigeria. Taylor (1966) recorded only sixteen (1.3%) cases of leg shortening out of a total of 1,259 cases of poliomyelitis she studied.

In this study, nine limbs were shorter than their counterparts by half an inch; five by one inch; two by one and a half inches and one limb by two inches. In all, 3.1% had discrepancy in the length of limbs. Shoes that have the soles and heels raised in order to compensate for the shortening are worn by the patients affected (Fig. 5.6).

A leg-length inequality of one inch and above was not ignored. Otherwise, the child walks with Trendelenburg gait, the pelvis is tilted laterally with the possibility of developing lumbar scoliosis.

5.6 <u>Monthly and seasonal incidence of poliomyelitis</u>

Although some workers have suggested a seasonal incidence in poliomyelitis, this study shows (Tables 8, 9, 10 and 11) that there is no definite pattern of relationship of poliomyelitis to the months of the year. Montefiore (1964) in Ibadan observed a sharp increase in cases seen between October and December [illegible]. At the same time Adesuyi (1964) reported a similar trend in Lagos. The heavy rains of the period and the subsequent flooding were incriminated. In a similar study by Familusi [illegible] significant correlation

Fig. 6.6 Long leg caliper with posterior stops. Shoe raise compensates for limb shortening.

between rainfall and incidence of poliomyelitis was noted in Ibadan. This study agrees with Familusi and Adesina since a rainfall of 529.0 millimeter in August of 1930 did not result in any significant increase (24.1%) of the cases of poliomyelitis as compared with a rainfall of 381.2 millimeter in 1963 which yielded as much as 62.3% of the total cases referred.

6.7 Management

Of the 544 patients studied, 509 deformities of one or both lower limbs manifest and are treated by conservative and or surgical methods depending on the severity.

All of the deformities are noticed on first attendance in the physiotherapy department. This suggests that there is time lag since the onset of the disease and when treatment commenced. Information given by some of the parents concerning date of onset is inaccurate and has to be abandoned for this presentation. There are instances of contradiction of information between the father and the mother when they accompany their child to the hospital. It is a common occurrence for such misinformation because of the thought of being paralised for bringing the child late to the hospital. Richard (1967) noted an average delay of fifteen months including a few who presented 9 - 12 years after onset. Some of these patients have developed hip contractures. Fifty-six per cent of the cases he studied were seen within six months. Oyemade (19[illegible]1) observed that most poliomyelitis patients attended University College Hospital, Ibadan between the onset of the disease and six months after. This study confirms these observation on the late presentation of patients.

A flail limb is cold, wasted, powerless and therefore cannot function. In the same vein, a joint of the lower limb which has lost its control due to muscle paralysis is unstable and cannot support the body adequately. Therefore physiotherapeutic measures are taken to prevent the affected limbs from having excessive strains on the ligaments, articular cartilages and other periarticular structures. Cases which have stiff joints are put through full range of passive movements. The limbs that have paretic muscles lying by the sides of the paralysed ones are encouraged to perform active movements against resistance in order to gain strength. These exercises are sometimes preceded by the warming of the cold limbs in warm water baths. Crawling and pivoting on the buttocks as means of locomotion are discouraged.

A child who has not walked for sometime due to paralysis of the muscles of the lower limbs has to re-learn the act beginning with balancing and postural control in standing box (Fig. 6.7).

As soon as he can stand, re-education of walking is taught in parallel bars (Fig. 6.8), followed by the use of push carts (Fig. 6.9). At a later stage the child is encouraged to use crutches before using walking sticks (Figs. 6.10). Some of the children who have unilateral affectation are made to utilise walking sticks without going through the stage of crutch walking.

Fig. 6.7 Standing balance in boxes before walking.

Fig. 6.8 Re-education of walking in parallel bars.

Fig. 5.9 Walking practice with push carts.

Fig. 6.10 A physiotherapist teaches poliomyelitis child to walk with crutches.

Fig. 6.10 A physiotherapist teaches poliomyelitis child to walk with crutches.

Supports are used in order to stabilise flail or weak limbs and joints. In this study some children wear back slabs, others wear plaster of Paris cylinders and knee cages in order to stabilise the knee joints (Fig. 6.11). Weak hips are supported in plaster hip spica whilst flail feet are cared for by the wearing of laced up boots.

Completely paralysed limbs are supported in ring top calipers and laced up shoes with posterior stops or toe raising springs. The wearing of these supports does not exclude the use of walking aids as supplements and for extra stability. Surgery in the form of release, elongation, transplantation and reconstruction are performed in very severe cases by the orthopaedic surgeons.

Walking aids and orthoses are supplied locally. Crutches and sticks are adjusted to fit the children while calipers, knee cages and raised shoes are made to measure either by the orthotist or by the Occupational Therapy Department. In the University College Hospital, Ibadan, this department has been of great help in the making of the knee cages and toe raising devices used by some of the children in this study. Similarly, the Medical Social Department assists with the location of defaulters as well as with economic support in the form of transport fares for the needy parents.

The involvement of these two departments and other disciplines emphasises the importance of team approach in the management of paralytic poliomyelitis.

Fig. 6.11 Walking with the aid of knee-cages and sticks.

6.8 Education of the poliomyelitis children

Surprisingly, only four children of school age are attending the school for the physically handicapped in Jericho, Ibadan and two in the primary school of the Oluyole Cheshire Home for the handicapped also in Ibadan. These are the two main primary schools for the disabled aside from the ones for the blind, the deaf and the dumb children.

Hayes (1958) postulated that the same educational standards, restrictions, opportunities, regulations and curricula should be made available to all physically handicapped children as with their normal colleagues.

The parents are advised to send their paralysed children to the schools meant for normal pupils and allow them to interact and participate in as many school activities as their disability allows. This advice helped some victims who were treated by the physiotherapists in University College Hospital, Ibadan. Some of them have primary, secondary, and university education and are currently holding higher positions as administrators, computer scientists, teachers, secretaries and others.

6.9 Group participation therapy

Poliomyelitis children are assembled for the purpose of participating in games and receiving instructions on the care of apparatus in the Physiotherapy Department (Fig. 6.12). Ball games and other

Fig. 6.12 Mothers and children listen to instructions on the care of walking aids and on immunisation.

activities like running are encouraged so as to excite motivation and the spirit of competition (Figs. 6.13.1, 6.13.2). In such assembly, instructions are given to mothers and their children on how to apply and look after the appliances so that they can be functional and last longer. They are also advised on the importance of regular attendance at hospital. Health education on immunisation against poliomyelitis for other younger members of the family are emphasised as preventive measures.

A Christmas party is held each year on the Monday before Christmas day for all the disabled children attending University College Hospital, Ibadan for physiotherapy. Over three hundred crippled children attended each time. They were entertained with refreshments and music to which they danced by whatever methods, depending on what muscles were saved from paralysis to permit dancing. Gifts were given to each child by Father Christmas at the end of the party (Figs. 6.14.1, 6.14.2, 6.14.3).

6.9.1 Prevention

Poliomyelitis can be prevented by mass immunization. This requires education of the populace at local level as well as in urban centres. The education should highlight the permanent and irrevocable damage the disease can cause on a child who has not been effectively vaccinated.

Similarly, a child who has contracted the disease should be taken to a health centre or hospital immediately the signs and symptoms manifest. Early rehabilitation will prevent contractures of soft tissues, diminish likelihood of deformities and restore function

Fig. 6.13.1 Ball games indoors - University College Hospital, Ibadan

Fig. 6.13.2 Ball games outdoors (... Centre - Salisbury).

Fig. 6.14.1

Fig. 6.14.2

Fig. 6.14.3

Christmas party for polio-
myelitis and other handi-
capped children in
University College Hospital,
Ibadan.

within the limit of residual muscle power.

In 1964, the World Health Organisation in collaboration with the Western Region Government carried out a mass immunisation campaign against poliomyelitis in Ibadan using the oral Sabin vaccine. The campaign resulted in the low incidence of the cases in late 1964 and early 1965. This was short-lived because no follow up of the immunisation exercise was carried out.

Organisations which are voluntary, medical and others should be involved in campaigns against the disease. The Poliomyelitis Club of Nigeria, based in Ibadan, is one of such bodies which had been engaged in educating the public on the prevention as well as the ravage of the disease among children.

Public enlightenment establishments like the radio, television and the press (Fig. 6.15) should join hands with health authorities to make poliomyelitis a disease of the past in Nigeria.

CAUSES

SYMPTOM

CURE

POLIO

Fig. 6.19 Clipping from the Daily Times (August 14, 1964).
"Immunization of every child can eradicate
poliomyelitis."

CHAPTER SEVEN

CONCLUSIONS

The studies showed that there were distributive patterns of paralysis and deformities in poliomyelitis. Some group of muscles were more affected than others depending on the spinal segments of innervation as well as the activities for which the muscles were put. One or both lower limbs were involved.

The principle of muscle association in paralysis and in escape from it was evident. It, of course, depended on the length and close proximity of the motor nerve cell columns as described by Sharrard in 1955. Male patients and children in the age group of between one and two years were mostly afflicted. There was no evidence of monthly or seasonal occurrence of poliomyelitis. Its incidence was not also affected by excessive rainfall or floods in this study.

Early management prevented the establishment of deformities. Severe deformities were corrected by surgical intervention whilst less severe and mild cases were managed by physical therapy. The advantages of education in regular schools were often stressed to the parents. In the same vein, advice on immunisation was imparted to them during treatment sessions.

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