

Staff Meeting Bulletin
Hospitals of the » » »
University of Minnesota

Perthes' Disease
Knee Injuries

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William A. O'Brien, M.D.

I. LAST WEEKDate: Feb. 14, 1941Place: Recreation Room
Powell HallTime: 12:15 to 1:05Program: Movie: "Boat Builders"Child Psychiatry and Pediatrics
Reynold A. Jensen

Discussion

Arild E. Hansen
Burtrum C. Schiele
Eric K. ClarkePresent: 154Gertrude Gunn,
Record Librarian

- - -

II. MOVIETitle: "Donald's Better Self"Released by: R-K-O

- - -

III. ANNOUNCEMENTS1. STAFF MEETING ASSIGNMENTS

February 28	Neurosurgery
March 7	Surgery
March 14	Surgery
March 21	Out-patient Medicine
March 28	Holiday
April 4	Internal Medicine
April 11	Holiday
April 18	Student Health Service
April 25	Radiation Therapy
May 2	Pediatrics
May 9	Obstetrics and Gyne- coloty
May 16	Physical Therapy
May 23	Laboratory Service
May 30	Holiday
June 6	Anesthesiology
June 13	Administration

- - -

2. CENTER FOR CONTINUATION STUDYMarch 3-5, 1941 - The Anemias
March 6-8, 1941 - Care of Newborn
and Premature Infant
March 13-15, 1941 - Obstetric
and Pediatric Nursing

- - -

3. AMERICAN COLLEGE OF SURGEONSRegional Meeting,
March 10, 11, and 12, 1941,
Nicollet Hotel, Minneapolis.

- - -

4. SIGMA XI"Meeting Middle Age"
William A. O'Brien,
Friday, February 21,
Northrop Memorial Auditorium.

- - -

5. MINNESOTA PATHOLOGICAL SOCIETYMarch 4, 1941 -
"Hemolytic Anemias"
Dr. W. B. Castle,
Harvard Medical School

- - -

IV. LEGG-PERTHES' DISEASE

F. G. Rosendahl

The syndrome variously known as Legg-Perthes' disease, osteochondritis deformans juvenilis, or coxa plana, to mention three of its more common appellations, has been the subject of frequent discussion in the literature during the past thirty years. However, since investigations into its obscure etiology have made up the bulk of material published, together with rather widespread acceptance of the theory that the disease is self-limited and therapy therefore nonessential, little has been said in regard to methods and results of treatment. It is for the purpose of clarifying this latter situation somewhat that this paper has been prepared. More particularly, an attempt has been made to compare results of the type of treatment used here with the published result of treatment elsewhere. Before proceeding to that specific discussion, it might be well to review briefly the history of the disease, together with mention of the chief theories of etiology and a description of the clinico-pathologic picture. No attempt will be made to evaluate the various theories of causation.

History

Earliest descriptions of the entity which we now know as Legg-Perthes' disease appeared in studies published in 1909 and 1910. At that time, only two types of hip disease were recognized as occurring peculiarly in children - tuberculosis and arthritis deformans juvenilis.

It is interesting to note that of some half dozen papers published in a comparatively short period of time, and in which the condition is described, only two recognized the disease as a separate entity. In February, 1910, it was described by Legg, who spoke of "an obscure affection of the hip joint," while Calve made similar observations published in July, 1910, in which he coined the term "pseudocoxalgie." Other early writers described the condition, but interpreted

it as a form of tuberculosis or of arthritis deformans. Waldenstrom considered it to be a special form of tuberculosis of the head of the femur which did not involve the hip joint, while Perthes' description appeared in a paper on arthritis deformans juvenilis. By 1913, however, Perthes had changed his conception of the nature of the disease and had introduced the term "osteochondritis deformans juvenilis," a designation now generally taken to include rarifying disease of various centers of ossification throughout the body. (Osgood-Schlatter's disease of the tibial tubercle, Kohler's disease of the tarsal navicular, Haglund's disease of the os calcis, Freiberg's (Kohler's) disease of the head of the second metatarsal, Scheuermann's disease of the spine, Calve's disease of the spine.)

Clinical Picture

The disease is chiefly one of childhood and early adolescence and thus conforms in general to the period of ossification of the proximal femoral epiphysis. The majority of cases described have had their onset between the ages of five and nine years, but there is considerable variation. Our series of cases includes age at apparent onset (i.e., age at first examination minus approximate duration of symptoms) ranging from $3\frac{1}{4}$ years to $11-1\frac{1}{3}$ years, the average age of onset being 6 years, 11 months. It should be stated here that this apparent age of onset is of course but an approximation and not necessarily a good one, since cases in which degeneration is far advanced have been discovered within a very few weeks of the onset of symptoms.

Males are much more frequently affected than females; a figure of from 85 - 90% boys has been commonly cited. Our series is comprised of 31 boys and 2 girls, a percentage ratio of 94 to 6. The condition is usually unilateral; however, many bilateral cases have been reported and 4 are noted in the present series.

Symptoms and Signs

A limp is the most commonly present symptom. This may or may not be associated with pain, and pain, when present, may occur either in the hip or knee or in both. Both pain and limp are often intermittent and frequently disappear following rest; pain is often but a transient early symptom, and a painless limp has been considered one of the classical symptoms of the disease.

At examination, a variety of inconsistent findings may be noted. Moderate shortening may be present. If pain is one of the symptoms, there is frequently an associated spasm with slight flexion and adduction at the hip. Range of motion may be limited, particularly as regards abduction and internal rotation. A slight but firm antero-posterior thickening may be present; this is considered an almost constant and diagnostic sign by some. (Gill)

History

The history is frequently of help by its very insignificance. Many cases relate absolutely no prodrome prior to the onset of symptoms. In some instances, there is a history of trauma, often negligible in nature. A few cases are characterized by an acute febrile onset, or the symptoms may follow shortly after fever of specific or non-specific origin.

Course and Roentgenographic Findings

The disease is characterized by a definite sequence. Waldenstrom speaks of four stages based on the roentgenographic appearance of the femoral head:

1. Evolutionary period, three to four years.
 - a. Initial stage one-half to one year.
 - b. Fragmentation stage, two to three years.
2. Healing period.
3. Growing period.
4. "Definite" stage - final form.

Gill also describes the course as cyclical and divides it into a "degenerative" stage lasting approximately one and one-half years and a "regenerative" phase of two to three years.

It may be noted here that the time intervals mentioned are not in complete accord, but that the description of the general course is similar.

It is now generally agreed that the disease usually involves the femoral neck as well as the head, and some investigators also describe involvement of the acetabulum. Gill states that the metaphysis is always involved and considers this the primary site of the disease; Waldenstrom believes in primary involvement of the epiphysis.

The course, as shown by serial roentgenograms, consists in the initial stage of little or no change in the appearance of the head; later, slight flattening of the head is apparent, followed by irregular changes in density of the bone of the head and neck. In the fragmentation stage, the head appears to break up into scattered islands of dense bone separated by rarified areas. During this phase, the characteristic deforming changes are instituted, and consist of a progressive flattening and broadening of the head, usually accompanied by shortening and broadening of the neck, which, in fact, may be one of the earliest changes. An increase in the space between the roof of the acetabulum and the head of the femur is characteristically present. In the healing stage the fragmented look gradually disappears and the bone assumes what appears to be a homogeneous structure. The growing period is that interval between resumption of normal structure and the time of closure of the epiphyseal line; during this stage, the bony contour changes gradually until at its termination the final or "definite" form is attained.

Pathological Anatomy

A certain number of observations have been made in regard to anatomy and histology. In some cases this has been

done at operation; in others, material has been removed for the purpose of biopsy alone. Autopsies have been performed in a few instances where death has resulted from intercurrent disease.

The joint cavity usually contains a slightly increased amount of synovial fluid. The synovial membrane may be normal or may show inflammatory change as evidenced by slight thickening or presence of synovial tags. The head of the femur shows changes in form corresponding to those indicated by the roentgenograms. As a general rule, the cartilage is smooth and is normal in appearance.

Cross section reveals variation in the relative thicknesses of cartilage and bone. The bone shows areas of necrosis and hemorrhage. Hemorrhagic areas are often triangular in shape, giving rise to the theory of infarction as a cause of the necrosis. Necrosis involves subchondral bone and marrow; granulation tissue surrounds the necrotic areas and cystic changes may occur. The necrotic bone and marrow are gradually replaced by fatty fibrous tissue which in turn gives rise to osteoid tissue in varying amount. In the stage of recovery, new bone is laid down in this osteoid and also proliferates from pre-existing trabeculae.

Theories of Etiology

The controversial subject of etiology will be touched on but briefly here; no attempt will be made to do more than list the various theories advanced in regard to the causative factors of the disease.

Congenital or developmental

This theory presupposes primary deformity or defect in the acetabulum, giving rise by purely mechanical forces to the changes found in the femoral head.

Infection and General Toxemia

In some cases, there is a history of an acute febrile onset; there may be diseased tonsils or other foci of infection, or onset may be preceded by other

disease. A few positive cultures have been reported from material removed at biopsy or operation. In the earlier history of the disease, many investigators considered it tuberculous in origin; this view has been generally discarded.

Metabolic and Endocrine Disorders

Rickets has been suggested as a cause, and in some cases variations of blood calcium and phosphorus have been noted; the relationship is by no means constant however. Cases have been reported in connection with various endocrine disorders; hypophyseal infantilism and hypo- and hyper-thyroidism.

Trauma

Many cases give a history of antecedent trauma, usually slight in nature, however. Direct injury as such is seldom now considered an etiological factor, but is believed by many to be of importance as one of the means of producing the fifth etiological factor, namely,

Interference with the Vascular Supply

This is the most widely accepted theory of etiology of Legg-Perthes' disease. Infarction on an embolic basis has been suggested. Disruption of the blood supply by injury or vascular occlusion caused by swelling secondary to inflammation or injury, is also mentioned.

It is apparent that the etiology of Legg-Perthes' disease is an unsolved problem; in fact, it is the opinion of many investigators that no single agent is responsible, but rather that the disease is a syndrome whose symptoms may be produced by a variety of factors.

TREATMENT

In comparison with the plethora of material published on etiology, little has been written on the treatment of Legg-Perthes' disease. In the view of many investigators, especially in the earlier state of knowledge as to the course and end results of the condition, treatment was neither indicated nor successful. The disease was considered

self-limited, of spontaneous recovery, and never completely incapacitating.

Legg, in 1927, stated his belief that while theoretically relief of weight-bearing was probably indicated in an attempt to prevent deformity, in practice, no change in the course of the disease was effected by treatment. This opinion has been shared by many, but there is a growing belief in both the necessity and efficacy of treatment; this will be discussed presently.

The aim of treatment, as stated by Eyre-Brook, is twofold: (1) Clinically, to maintain a full range of motion with no disposition to osteoarthritis from a misfit in the acetabulum, and (2) Radiologically, to produce a round head, adapted to the acetabulum, approximating as closely as possible to the normal.

He continues that the radiological aim when attained is sure to result in good permanent function, while in many initially clinically good results, deformities shown to be present by x-ray may lead to late arthritis changes, causing late symptoms of greater or lesser severity.

It is fairly well agreed that two factors are important in prognosis - age at onset, and stage of the disease at the beginning of treatment.

Age at onset

It has been demonstrated that in cases in which onset occurred in early childhood (at or prior to seven years - Eyre-Brook), there is a higher percentage of favorable outcome both clinically and radiologically, in both treated and untreated cases. This may be because of a longer or more favorable period in which reparative forces may act; there is also the consideration of greater deforming forces (weight-bearing) with the increasing age of the child.

Stage of disease at beginning of treatment

It is obvious that the prevention of deformity is far simpler than restoration of normal contour. Conser-

vative treatment can accomplish only the former, and operative methods in regard to the latter have been neither widely used nor particularly successful.

Methods of Treatment

These fall naturally into two groups - the radical or operative, and the conservative.

Operative Treatment

Operative treatment is not widely used or recommended. Most investigators feel that the condition responds favorably to conservative treatment and for that reason alone believe surgery contraindicated; others argue that in addition to the above, there is real danger of further damaging the blood supply to the femoral epiphysis by operative interference.

Kidner, in 1916, working on the assumption that the disease was a low grade hematogenous infection (i.e., a localized osteomyelitis), advocated drilling down to the cavity and evacuating its contents. He describes a case which recovered rapidly following this treatment and incidentally reported cultures of a staphylococcus aureus of low vitality from the material removed.

Ferguson and Howorth, in 1934, recommended their procedure of placing multiple drill holes thru the femoral neck into the head to provide new channels for revascularization of the head. They followed operation by a period of several months of bed rest and stated that in sixteen cases operated between 1928 and 1932 recovery was hastened and end results were excellent.

Bozsan, in 1932, and again in 1934, reported a similar procedure of drilling the femoral neck and head for use in Legg-Perthes' disease and in fracture of the femoral neck.

Whitman, in 1928 and 1929, advocated his reconstruction operation (i.e., removal of the head of the femur with remodeling of the neck and downward transposition of the greater trochanter with its muscle attachments) for the 20% of cases in which he says disability may persist indefinitely and in which disorganization of the joint is progressive.

Recently, Steele has described an operative treatment in which he has curetted out the cystic necrotic material within the head and packed the cavity with bone chips. Healing without deformity is said to be hastened by this method. It is of note that he has stated that in all cases operated by him the cartilage was found to be normal in surface appearance; there was no flattening of the normal dome-shaped contour in the early cases as described by others.

Conservative Treatment

Conservative treatment is more widely advocated. This is easily understood, as it would seem logical to try to treat the condition (i.e., prevent deformity from occurring) by the relief of weight-bearing. Means to accomplish this end have been of two general types—absolute bed rest with or without fixation, and ambulant treatment in which weight-bearing is avoided by means of appliances.

Bed rest with or without traction or fixation in plaster.

In many cases, bed rest alone is used to provide relief of weight-bearing. In cases where pain and spasm are prominent plaster or skin traction may be advisable; this has been used over long periods by some who feel that more or less immobilization is necessary. The use of plaster carries with it the obvious disadvantages of restricting motion of the joint with consequent stiffness and muscle atrophy. Traction

allows motion while limiting excessive activity and relieving muscle spasm. One of the chief objections to this form of treatment is the enforced inactivity of growing children, most of them of school age, for long periods. For this reason the ambulatory treatment has been used here, and it is for the purpose of comparing results of these two types of conservative therapy that this investigation has been carried out.

Ambulatory treatment.

This may be accomplished by several methods. The simplest is the use of crutches. Crutches may also be used in combination with the use of a spica jacket, but this is accompanied by the same disadvantage of plaster as mentioned previously.

A further method is to build up the shoe on the unaffected side. Crutches may also be used with this form of treatment.

The use of braces is the commonest form of ambulant treatment. A simple Thomas ring caliper which transfers weight-bearing to the pelvis rather than to the head of the femur probably finds the widest application, and is the method which has been followed here and at Shriners' Hospital for several years. Other forms of braces consisting of walking traction apparatus have been used. Combination of the use of crutches and/or lifts with braces has been used, but has not been found necessary or practical here.

Our purpose in preparing this paper is not an attempt to prove that the use of the caliper is a better means of avoiding weight-bearing than bed rest, but to show that essentially the same results can be obtained without the long period of enforced inactivity.

A basis of comparison between the two

types of conservative treatment is difficult to choose. Relatively early clinical results cannot be used as a criterion since they do not reveal the exact extent and nature of the deformity. X-ray results illustrate the degree of deformity or recovery but do not lend themselves readily to statistical analysis. The only readily available means of evaluation is a direct comparison of x-ray results themselves. For this reason, we have chosen two papers from literature, each consisting of a review of cases treated by extension in bed, and each accompanied by suitable reproduction of radiographs illustrating the cases. A comparison of plates from our series treated by means of calipers has been made with these illustrations. Further comparison has been made by use of the "epiphyseal index," a statistical form introduced by Eyre-Brook. This consists of a quotient, $\frac{\text{height of epiphysis}}{\text{breadth of epiphysis}} \times 100$,

which gives some idea of the amount of flattening produced in the head. While this is not an accurate method of comparison, as it does not reflect the entire picture of the deformity, nor take into consideration the changes in the femoral neck, it nevertheless gives one of the few concrete figures which may be used for analysis. We have also followed the same investigator's method of dividing cases into two groups according to age - Group I, under seven years, and Group II, seven and above. Each group is further divided into three stages:

- I. Original x-ray shows little or no flattening of the femoral epiphysis.
- II. Typical flattening, fragmentation, and cervical thickening.
- III. More advanced, with recalcification.

Eyre-Brook states that the normal epiphyseal index for children under seven ranges from 45 to 55; under seven, from 35 to 45. His figures are given together with a comparable set computed from measurements taken from illustrations in a recent article by Gill. These are compared with results compiled from our series.

The accompanying tables summarize the study of thirty-three cases of Legg-Perthes' disease observed at Shriners' Hospital in the past eighteen years. The majority were treated by the use of ring calipers, a few by other methods.

Clinically, results were almost uniformly good, as indeed they have been in most reports published, no matter what the method of treatment.

On the basis of roentgenographic evidence, we believe our results compare favorably with other series studied. This point is difficult to illustrate, but we have made use of the "epiphyseal index" of Eyre-Brook, and find that our results for a series of 22 cases treated by use of ring caliper are almost identical with those of 22 cases (24 hips) treated with extension by him.

The average duration of treatment by extension in Eyre-Brook's cases was eighteen months; the average treatment by the use of the caliper in our series (fifteen completed cases) has been twenty-six months. However, it should be remembered that during treatment by extension the patient must be hospitalized and kept continuously in bed, whereas with the caliper he may carry on an almost normal amount of activity.

Our findings agree in general with those of others who have stated that the best results are obtained in the younger age group, and further, that less deformity results when treatment is begun early in the course of the disease. It would seem that treatment is definitely of benefit, in that almost none of the treated cases show marked deformities, such as are often present in untreated cases.

Three bilateral cases were treated; all were in the younger age group. Two were treated by strict bed rest during the stage of bilateral activity; this was followed by use of a caliper on the still affected hip when the first had healed. Both cases gave excellent results from a clinical and roentgenographic viewpoint. The third case was treated by means of a spica for three months, followed by bed rest for seven

and one-half months. The patient was symptom-free four years after the beginning of treatment, but x-rays showed rather marked deformity.

Summary and Conclusions

1. We believe Legg-Perthes' disease to be benefited by treatment.
2. In general, the younger the patient, the more likely is treatment to be successful.
3. Treatment begun in the earlier stages of the disease is most successful.
4. We believe conservative treatment to be satisfactory, and on the basis of present knowledge, see no indication for operative treatment.
5. Conservative treatment can be most easily carried out by the use of the Thomas ring caliper; results are equal to those of extension and the necessity of prolonged bed rest is obviated.

Table I

Case #	Age Onset (Yr.:Mo.)	Symptoms	Duration of Symptoms (Yr.:Mo.)	Previous Treatment
1	3:3	Limp	0:2½	Spica 1 mo., Thomas splint 3 wk.
2	4:0	--	--	Body case
3	4:2	Limp, pain (knee)	0:4	--
4	4:6	Pain (knee), Inversion (foot)	2:0	--
5	4:6	Limp	0:6	Drilling, spica and bed 1 yr.
6	5:0	Limp, sl. pain (hip)	1:0	--
7	5:5	Limp (painless)	0:7	--
8	5:7	Limp	0:5 (1 no post measles)	Bed rest, massage
9	5:8	--	--	--
10	6:0	Limp, pain, shortening	2:0	Diet (for Tbc.)
11	6:0	Limp (painless)	0:8	--
12	6:0	--	--	--
13	6:0	--	--	--
14	6:3	Limp (painless)	0:3	Bed, extension, crutches
15	6:4	Limp, pain (hip & knee)	0:11	Cast - 4 mo.
16	6:6	Limp, general malaise	0:6	Cast
17	6:8	Limp, pain (hip)	1:0 follow- ing fall	--
18	7:0	Limp (hip)	1:2	Cast - 6 mo.
19	7:1	Limp (following fall)	0:11	Spica, 6 mo.
20	7:2	Limp (painless)	1:4	--
21	7:6	Limp, pain	2:0	Cast
22	7:11	Limp, sl. pain	1:1	--
23	7:11	Limp, pain (hip)	0:7	Cast 4 mo., crutches
24	8:0	Limp, pain (hip)	1:0	Cast, crutches
25	8:0	Limp, pain (hip)	2:0	Traction 5 wk., spica, 15 mo.
26	8:3	Limp, pain (knee)	1:6	Cast, 5 mo., traction splint
27	8:6	Limp	0:1½	--
28	8:8	Limp, pain	0:6	--
29	9:0	Limp, pain	1:0	Ultraviolet, tonic
30	9:4	Limp, pain	0:8	Chiropractic
31	10:2	Limp, pain (knee & hip)	0:10	--
32	10:10	Limp, pain (groin)	0:8 (febrile onset 2 wk)	Bed 3 wk.
33	11:4	--	--	--

Table IITreated Cases

I. By caliper alone, no previous treatment (except short bed rest) - completed

<u>Case #</u>	<u>Duration of treatment (Yr.:Mo.)</u>	<u>Last seen: Time since beginning treatment</u>	<u>Clinical Result</u>	<u>X-ray Result</u>
7	2:0	2:4	Symptom free	Almost perfect
17	1:8	2:7	Symptom free	Almost perfect
20	2:8 $\frac{1}{2}$	4:5	Symptom free	Mushroom
22	2:0	5:6	Sl. limp	Marked cap deformity
28	3:2	4:3	Symptom free	Moderate mushroom
29	0:8	1:3	Occasional weakness in hip	Mushroom
30	3:2	4:0	Sl. pain hip & thigh	Moderate cap.
32	1:5	2:6	Sl. pain on heavy exercise	Moderate mushroom

II. By caliper, but with some type previous treatment - see Table I

8	1:6	4:7 $\frac{1}{2}$	Symptom free	Perfect
14	2:0	2:0	Symptom free	Moderate Mushroom
15	3:0 (intermittent)	3:0	--	Intermediate (cap)
18	3:4	3:4	Symptom free	Moderate mushroom
19	1:8 $\frac{1}{2}$	1:8 $\frac{1}{2}$	Symptom free	Moderate mushroom
24	4:0	4:4	Symptom free	Moderate mushroom

III. By caliper - treatment not completed when last seen

*2	--	2:3 $\frac{1}{2}$	Symptom free	Almost perfect
6	--	0:8	Symptom free	Healing, cap.
10	--	1:1	Symptom free	Intermediate (cap)
11	--	3:9	--	Cap.
*16	--	0:10 $\frac{1}{2}$	"Improved"	Moderate mushroom
*21	--	1:1	Symptom free	Intermediate (cap)
*23	--	1:0	Symptom free	Mushroom
31	--	0:7	Symptom free	Mushroom (healing)

*Had previous treatment - see Table I

Table III

IV. Treatment by methods other than caliper:

<u>Case #</u>	<u>Treatment</u>	<u>Clinical result</u>	<u>X-ray result</u>
1	Spica 1 mo.) Prior to Thomas splint) admission 3 wks.) Bradford frame - 6½ mo. Calipre - 2 yr. Recurrence of pain 2:6 Calipre reapplied 1:4	Symptom free 8:2½ after beginning of treatment	Perfect, bilaterally E.I. R - 29 L - 29
3	Calipre 1:5; pain develop- ed in opposite hip Bradford frame 7 mo. Calipre (opposite side) 3:2	Symptom free 6:1 after beginning of treatment	Sl. mushroom - good result bilaterally E.I. R - 20 L - 29
4	Bilateral spica 3 mo. Bed rest 7½ mo.	Symptom free but with marked lordosis - 4 yr.	Moderate cap, bilat- erally. E.I. R - 16 L - 14
5	Drilling plus 1:3 bed (spica 1:0) Calipre 1:0 (when last seen)	Symptom free	Moderate cap E.I. - 10
25	Treated elsewhere Traction 5 wk. (1:6 after onset) Spica - 1:3 (following above)	"Improved"	Moderate mushroom E.I. - 20
26	Cast 5 mo. traction splint. No treatment 6 mo. prior to adm. Calipre - 7 mo.	Symptom free at discharge	Moderate mushroom - Not changed by treatment E.I. - 30
27	Spica 2 mo. Crutches 6 mo.	Sl. painless limp, Inversion, 2:6 after beginning treatment	Cap. E.I. - 28

V. Cases untreated or with no follow-up:

<u>Case #</u>	
12	Untreated - Onset 6 yr., Stage II; not seen for 3½ yr., in which time marked cap deformity had developed.
9)	
13)	- Did not return after first examination.
33)	

Table IV

Comparison of Results of Treatment
Epiphyseal Index

		Caliper-Present Series			Eyre-Brook		Gill-extension followed by ap- pliances (computed)				
		Case #	E.I.	Average	Extension	Other (caliper, etc.)					
Group I (Onset under 7 yr. Average normal E.I. 45-55)	Stage I	8 16*	43) 30)	2 cases 37	6 cases 39	1 case 26	3 cases 31				
	Stage II	2* 6*	30) 22)	8 cases 28	6 cases 27	7 cases 22	4 cases 27				
		7 10*	31) 23)								
		11* 14*	28) 31)								
15 17		23) 35)									
Stage III		None						3 cases 19	None		
Group II (Onset over 7 yr., Average nor- mal E.I. 35-45)	Stage I	24 32	30) 19)	2 cases 25	3 cases 23	2 cases 21					
	Stage II	18 19 20	22) 22) 22)	7 cases 19	6 cases 18	8 cases 18					
		22 28 29 30	18)- 15) 16) 18)								
		Stage III	21* 23* 31*					15) 23)- 16)	3 cases 18	None	4 cases 6.6

*Treatment not completed

$$\text{Epiphyseal index} = \frac{\text{Height of epiphysis}}{\text{Breadth of epiphysis}} \times 100$$

- Stage I - Little or no flattening.
 II - Flattening fragmentation and cervical thickening.
 III - Advanced changes - recalcification.

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V. KNEE JOINT INJURIES

R. C. Brown

In spite of the superabundant literature accumulating on injuries of the knee joint, one is convinced that certain aspects of these are not yet solved, either with respect to the mode of injury, or the treatment of them. For some time past it has been the impression that those seen on the orthopedic service presented some features which did not follow the conceptions thus far recorded. For that reason all of the arthrotomies performed during the period of 1930 to 1940 were reviewed.

In searching the records one is impressed with the frequency with which the term "Internal Derangement" is used as diagnosis. This originated with Hey⁷ in 1784, has been so far reaching in its influence that we frequently find it used as a diagnostic designation in numerous different conditions, occurring not only following trauma, but also in others. It has been found to cover such affections as loose bodies; fracture, rupture of ligaments both intrinsic and extrinsic, extoses, foreign body, hypertrophy of the infrapatellar fat pad, recurrent dislocation of the patella, muscular wasting and incoordination, tumors of bone and soft tissues, lesions of the menisci, and others. Specific diagnosis is to be encouraged.

The present material was selected from one hundred and twenty patients on whom surgical procedures were undertaken for "Internal Derangement." It has been noted that there were a large number of tears of the cruciate ligaments and in order to evaluate the findings only cases due to trauma are included and only the ones of these which presented at operation concurrent lesions of the menisci.

Dynamics of the Knee Joint

While any lengthy consideration of the anatomy of the knee joint is out of place here, nevertheless some points present themselves in any study of this

region.

There is little unanimity of opinion of the operation of the different parts of the knee joint; however, in certain portions agreement exists. Numerous attempts have been made to assign particular functions to special parts. Considering these we find the balance of authority to support the following.

The knee joint is the largest of the body, has hinged and gliding motions, combined in some positions with rotation. Powerful muscles propel large bones thru wide ranges. The greatest of these are bi-articular and most operate from cephalad. There is a normal valgity of the joint of 12°, the axis of the femur with its superior articulation is 6° to 9° both in the saggital plane, the latter being 12° in the anterior mid frontal and the lower tibial being 20° to 25° outwardly rotated axially²⁰. The greatest cubic displacement is at 20° to 30° flexion and the greatest laxity of the joint is between 30° to 50°. ^{2,20} Supporting structures of the joint may be conveniently listed as six in number, including muscles and their tendons, capsule, lateral ligaments, the menisci, cruciate ligaments, the contours of the condyles of the femur and the tibial plateau. It is safe to say that with one exception there is no most important structure, that the exception stands only under specific conditions.

Maximum stability obtains at full extension, for in this position the lateral ligaments are taut as are also the cruciates and the capsule, the greatest portions of the condyles, menisci and tibial plateau are in contact.^{2,9,20} At the beginning of flexion rocker action exists, between the tibia and the femur, but as this proceeds, gliding motion comes into play, and rotation also, the axis being near the medial condyle, with the menisci moving backward, the medial less than the lateral. The external lateral ligament becomes more lax and the posterior portion of the internal lateral also, but only a little. The Cruciates remain taut throughout the range but are tense in extension.^{2,9,20} The menisci cushion both hyperextension and hyperflexion.²

The lateral meniscus is more loosely bound both intrinsically and extrinsically and is quite mobile. The internal is more closely attached internally, and if not bound by attachment to the internal lateral ligament is at least markedly less mobile.^{2,9,13,20,25} Two points of patho-physiology bear mentioning. First, that the ligaments, if having undergone any serious disruption, do not heal spontaneously and second, that the menisci do so only at the periphery.^{1,9,10,16,18} Contusion of the menisci occurs.

Incidence

Injuries occurred to patients fifty-nine times in this series with damage to the semilunar cartilages, and cruciate and lateral ligaments in some instances, and to the articular cartilage and fat pad in others. The preoperative diagnoses were: Lesion of the semilunar cartilages, 32; internal derangement of the knee joint, 15; dislocation of the meniscus, 1; osteochondritis dissecans, 4; rupture of the cruciate ligaments, 4; traumatic arthritis, loose body, 1; fracture of the intercondyloid eminence, 1; Hoffa tumor, 1. The right side of the body was affected 38 times or 65%^{**}; others, Fisher 56%, MacAusland 50% had similar findings, but in one only of the references consulted²¹ nearly the opposite.

There were 50 males or 84% showing close grouping with Henderson 83%, Fisher 73%, Bennett 76% and Ferguson 82%. The youngest of this group was 14 and the oldest 60, 44% occurring in the third decade of life: One per cent less than Henderson and coinciding with MacAusland.

Athletes were in the majority, which has been true since the time of Hippocrates: 52% here, which is the exact relation determined by Ferguson. Twenty-two per cent were laborers, such as farmers, truck drivers, etc., and 15% occurred in domestics, such as housewives and their servants. The remainder were non-athletic university students, one of

which was involved in an automobile accident.

The medial meniscus was involved in 43, or 86%, the lateral in four, and both in three patients. Bennett's experience was closely parallel as was also Henderson's and Jones' and Bristow's. All others consulted showed this marked preponderance of the medial. One is prone to explain this on the basis of the operation of this cushion, it being, as mentioned, less mobile than the other and the axis of rotation is closer to it. The mode of onset demonstrates that certain criteria obtain: namely, that flexion, rotation and weight-bearing in valgus are present at the time of injury. Another interesting observation is to be recorded in that these injuries occur in athletes at times when the victim is either tired or "loafing."¹¹ Three of this series are otherwise remarkable, one was hit on the head with a maul, one fell thirty feet from a ladder, and one knew of no injury.

One patient received his injury while skiing, this being evidently a common cause in Continental Europe, the lesion being most often accompanied by a tear of the internal lateral ligament and is there widely known under the appellation of "Swiss Kiss." It seems likely that this will become increasingly operative in this country.

At this point this series appears to conform closely with the experience of others. It is for this reason that the findings with respect to the cruciate ligaments are rather significant.

Rupture of the cruciates occurred 14 times, 13 times in athletes, or 41% of the athletes of this group, and making 23% of the whole series. The only other report found comparable was that of Ferguson who found it to be 27%. Others consulted reported not over 4%.^{14,22} The collateral ligaments were affected four times, on the two sides equally. Hypertrophy of the fat pad occurred once, and osteochondritis dissecans four times.

^{**}All decimals dropped in percentages.

Diagnosis

Locking is the most constant symptom or sign, but this must be determined, so that unlocking in the history or on examination is much more reliable. Other conditions than tears of the menisci must be ruled out. They include fracture, especially of the intercondyloid eminence, fat pad interference, loose or foreign bodies. Pain is always present in some degree, especially at the initial injury, and usually there is some degree of effusion, though this may be entirely absent. It must be remembered also that effusion of itself can cause an apparent locking of the joint, as when the synovial space is filled with fluid, it seeks the position of 20° to 30° flexion. Brantigan and Voshell in their observations of fresh joints injected plaster of Paris, and found that upon setting this was the position assumed unless forcibly held in some other. Clicking and snapping within the knee are pathognomonic. Repetition of injury is almost universally diagnostic, especially when interspersed with periods of freedom from disability. Diagnosis of cruciate lesion is particularly difficult. Some positively state that there is forward gliding of the tibia on the femur in flexion, when there is injury to the anterior, and correspondingly posterior gliding when that one is affected. This was not invariably the experience here, and Bennett denies it is of much value except that it may be elicited under anesthesia. It may be stated, however, that if this motion exists there is then lesion of the ligaments, though not necessarily of the cruciates, but this is most likely.² Other signs are chiefly tenderness, and this may on occasion be on the side of the joint opposite to the meniscus involved. Palpation of the cartilages throughout the range of motion may better disclose the tenderness and may at the same time give aid by eliciting clicking or actually discernible abnormal mobility of them. Parenthetically, it may be said of locking that this may be so temporary that it actually constitutes a "clicking." It is this which frequently precipitates "throwing" or "giving away" of the knee, so often complained of by the patient. Explana-

tion of this phenomenon is perhaps to be found in the well-known speed of the reflex of the knee joint.

Roentgenographic examination is axiomatic, but the ordinary plates are most often valuable for the negative evidence that they supply. Laxity of ligaments may be demonstrated, and with certain techniques occasional meniscus lesions may be seen.⁷ Installation of gas prior to examination is contraindicated in some cases and is not always diagnostic in others.

Arthroscopy is not reliable, as it does not give positive results except in a small number of cases, and the cruciate ligaments are more often obscured than not. Preoperative manipulation intra-articularly is also an invitation to trouble; the risk isn't in proportion to the information one is likely to obtain.

Treatment

There are numerous recommendations of conservatism to be found.^{8,14,23,26} This is recommended only if no definite diagnosis can be proven. But this should not be directed towards a long immobilization, but rather towards early use and a constructive regime of muscle training and exercises, especially with respect to the quadriceps. Untreated cases are open to further damage in regard to the articular surfaces, as this was observed in the long untreated cases even in the younger individuals. This is frequently mentioned by others. Where mode of life does not predispose to further active recurrence in a knee only slightly troublesome, one may temporize.

The operation is not a formidable one, the Jones incision being used in the cases here. Infection was seen once, quite compatible with the group reported by Milch, who found four in a series of 250 cases and stated in his opinion that this was in direct proportion to the length of time the knee joint was open. The average number of postoperative days was 16.1, the shortest being 7, the longest 57. The infected joint was

later fused. There were twelve of the number who participated in one or more years of athletic competition following the operations, only two finding accessory apparatus necessary, and in one of these several years of professional football were later played without the apparatus. The cruciate ligaments were in no instance repaired in the original operation. One case had subsequent extra articular fascia lata stabilization with complete rehabilitation. This will be reported at a later meeting.⁶ A further word may be said concerning the musculature. Simon states his experience with a change of coaching staffs at a large university wherein a regime of daily limbering up exercises reduced the number of injuries to a negligible degree. It is the observation here that adequate strapping by a competent trainer has materially reduced the number of injuries among the supervised athletes.

Conclusions

This group of cases was found to cover a well related number of years compared to other groups.

Cruciate injuries constituted a very high percentage of this group. This suggests that either football and other such intra- and extra-mural activities are either more strenuous here or are becoming so generally. Cruciate ligament injury alone or in combination with surgical removal of the meniscus does not constitute any marked degree of disability, and this is especially true if the muscle development is good and is maintained; and the internal lateral ligament is relatively intact.

Operation should be undertaken as soon as the diagnosis is made and conservative therapy is not recommended in place of it, if participation in the more vigorous activities is to be undertaken.

Cruciate ligament injury is not easily diagnosed and may be present more often than recorded.

Fracture of the medial meniscus is most common in knee joint injuries re-

quiring surgery, and is most common on the right extremity.

The injury is more common in the male, although domestics constituted a large percentage of this series.

Repair of the cruciates or plication operation is not indicated in the absence of complicating lesion of the lateral ligaments, and should be postponed until future rehabilitation procedures directed to restoration of the muscle support have failed.

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VI. GOSSIP

In Chicago at the Palmer House to attend the midwinter meetings on Medical Education and Medical and Hospital Service. For many years the Council on Medical Education and Hospitals of the American Medical Association has sponsored a midwinter program. Year by year various organizations have used this opportunity to assemble before and after the council meetings to discuss various special projects. The meetings this year included the National Conference on Medical Service, the various specialty boards, the hospital associations, nurses' groups, the state boards of medical examiners, and many others. Some of the meetings were held at the Stevens Hotel, which also housed the annual meeting of the Chicago Dental Society, which in size and program is as large as the American Dental Association. Chicago has been filled with one business conference after another since January 2, according to the hotels. Even during the medical and hospital gathering, there were meetings of business associations, an unaffiliated medical technology group, an individual who has queer ideas on pathology, and some of the osteopathic groups. Minnesota was well represented on the Medical Service Conference with a presentation of our plans for continuation study for physicians and hospital personnel, and the medical care of social security clients. Other discussions of this group included Voluntary Group Medical Care Programs, Medical Preparedness, and Legislative Problems. At the Council on Medical Education Meeting there was much discussion of how prospective medical students who have been accepted by medical schools, medical students, interns, and residents were to be handled in regard to deferred military training. No one felt that they should be exempt, but all felt that their training period should be deferred until their educational program had been completed. Apparently this is a matter for the local draft authorities to decide. In Milwaukee they used medical school faculty, students, and equipment to do physical examinations on prospective candidates for military training. Two evenings a week are devoted to this purpose during which time nearly 600 examinations are made. The primary purpose

of this arrangement was to help staff members who had been appointed to Examining Boards. It later proved to be an effective means of allowing the students to learn the procedure. As far as faculty persons are concerned, the old plan of deciding who could be spared is still in effect. In each instance, the man's associates, as well as his chief are allowed to make suggestions. Final decision is to be made by the administrative authority of the medical school. After many years of meeting to hear ways and means of improving medical education, the method of conducting the conference remained as antiquated as ever. One paper after another, usually completely unrelated, is read to an audience which constantly tends to get smaller. I felt sorry for the last one on the Monday afternoon program who had to speak on "Graduate Educational Opportunities for Negro Physicians." The place is teeming with ideas and many persons have a great deal to offer, but no meeting time is permitted for such discussions. The Professor of Surgery at Yale told us of his ideas on "Objectives of Medical Education," which included the elimination of all lectures on material which could be found in print, the development of discussion groups, and the case method of presenting subjects. More attention is paid to the development of the principles involved in present and future learning techniques and less to course content. This method is employed by the Law School and to a certain extent by the Business School of our own University and is a plan which has much in its favor. There was a continuation report on the new developments in standard nomenclature, a wierd report about the new course in dentistry and medicine at Harvard, and again much talk of medical preparedness. The Palmer House is an ideal place for such meetings with its many interesting rooms and places for gatherings. Its central location is also a great advantage. Everyone tries their special pancake, which resembles a monster crepe suzette. It is ten inches in diameter, and after it has been baked, the surface is covered with lemon juice, sprinkled with sugar and rolled up. The top is next covered with butter, and their special blend of syrup. No visit to Chicago is complete

without a stop at the Empire Room where Eddy Duchin is now holding forth. Their \$3 cover charge includes a wonderful dinner; a special tip is to select the Shore Dinner which for inland sea food is second to none. The floor clerks get to know their customers very well so that individuals stopping there frequently ask to be put on a certain floor. Our clerk was gorging herself with Tootsie Rolls because the manufacturer happened to like the service provided on her floor. She knew many of the medical men from this section of the country. At the hotel I saw many former Minnesotans including Dr. William Anding Lange, who graduated from Minnesota in 1935. He had his charming bride with him, who up until their recent marriage had been the widow of the heir to the Dodge millions, who was killed in a motor boat explosion shortly after their wedding up in the north country. She had met Dodge while she was a telephone operator in the section where he used to vacation. I also saw the B. A. Watsons of Battle Creek (society item). Les Schroeder and his brother from Screen Magazine in Hollywood were having a reunion, and the Hollywood side of the family brought many stories of Minnesotans in California. The Stevens Hotel was full of dentists who were busily engaged in attending a few large sections and many small ones. Like other specialty organizations the dentists have learned the importance of small sectional teaching with group limitation as to size and a special fee for attendance. These ideas could be used by the Council on Medical Education and Hospitals with profit. Obviously, educators should not be charged a fee, although in some instances this might be all right, if the right person was charged. The staff will be interested to know, in presenting the continuation study program, the staff meeting program, and the monthly study packet program, that everyone interested in graduate medicine was most impressed by the way we conduct our staff meetings. You should be proud of yourselves. On Monday night I went to Cedar Falls, Iowa to visit the Iowa State Teachers College. At noon I addressed the Faculty Luncheon Club on "The Significance of the Student Health Service Movement." This institution has a beautiful Commons which is used jointly by the students and faculty. Iowa has only one institution of higher learning in education, this one. Their athletic representatives are well-known, and wrestling is one of their major sports. They captured the Conference Title in football last year, the group including the two state schools in North Dakota and South Dakota, and others. Dr. Max Durfee who trained at Michigan, is now the director of the health service. His associate is Dr. Coramin, who interned at Asbury Hospital. In the evening I spoke to the Black Hawk County Medical Society in Waterloo on "What Student Health Means to the General Practitioner." The medical society combined its meeting with that of an interprofessional group consisting of physicians, dentists, pharmacists, nurses, and veterinarians. I discovered that many of the physicians, dentists, nurses, and others did not know much about the scope and purposes of the student health service movement. This is not surprising as it is not uniformly well-developed, and many colleges still lack a program. With our own institution as a model, it is interesting to note how much has been contributed. They have developed the case finding method of tuberculosis, the routine use of the serological test for syphilis, and immunization of young adults. Their method of entrance physical examination and the periodic check-up is now being adopted by industry. The health services have clearly revealed the deficiencies of our health program for children in grade and high schools. They have demonstrated the importance of hospitalization for minor illness, e.g., respiratory infections, and minor infections and injuries (hands, etc.) As soon as the people obtained access to hospital service through the hospital service association membership, they asked for hospitalization for minor illness. A former mayor of St. Paul told me that he was firmly convinced of the importance of hospitalization for minor injury, feeling that it was a saving for everyone, including the patient. Health services have also demonstrated the importance of teaching patients significant facts about illness. The record for appendicitis mortality is second to none. Health services have also shown the possibilities of special diet table, advisability of studying in further detail albuminuria, glycosuria, hypertension, heart murmurs, and other diseases..