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Internal derangements of the knee joint in sports and recreation

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INTERNAL DERANGEMENTS OF THE KNEE JOINT IN SPORTS AND RECREATION

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PART I

INTRODUCTION

Remarks

The writer wishes to call attention to the clinical group that is in a great part responsible for acute and chronic disabilities of the knee joint. These are classified as Internal Derangements of the Knee Joint. It is our desire to give the relationship of this group of afflictions to injuries in sports and recreation.

The interest in sports among old and young is world wide. It has been estimated that over eight million participate in school, college, and professional sports in this country alone. Furthermore, over a million sport lovers indulge informally in golf, tennis, mountain climbing and skiing. Last year followers and spectators of organized sports in United States reached the remarkable total of: basketball, ninety million; softball, seventy million; baseball, sixty million; football, fourty-five million. This is not peculiar of our country for in the European countries where organized training both military and sports are practiced by the nations as a whole, many more take part.

Most players experience some injury, usually minor,

But occasionally serious in nature. Our interest has not been focused sufficiently on simple strains, sprains, and contusions. Furthermore, the treatment such injuries receive at the present time is inadequate. Knee joint traumata has been selected to emphasize adequate diagnosis and treatment of all types of injuries in order that recurrent or additional more serious injuries may be prevented later in life.

Even the orthopedic surgeon has considered some of the lesions a rare condition in the past. Today we know that many lesions have been looked upon as medical curiosities because they have not been recognized. However, a knowledge of the so-called uncommon conditions does much to clarify the common clinical entities in the everyday practice.

It has been my purpose to consider in a general way the anatomy, functions, and pathological conditions of the knee joint as they are related to internal derangements seen in sports and recreation. The common injuries as well as the unusual clinical lesions will be briefly reviewed.

The lesions will be considered under the following groups: (1) lesions of the semilunar cartilages (meniscus); (2) rupture of the internal and external lateral ligaments (collaterals); (3) rupture of the cruciate ligaments; (4) injury to the tibial spines;

(5) loose bodies; (6) hypertrophy and pinching of the infrapatellar fat pad and synovial membrane; (7) exostoses.

Definition

An internal derangement of the knee is commonly applied to those intra- and extra-articular affections of the knee, most often of traumatic origen, which are the results of lesions of the semilunar cartilages, the joint surfaces, the ligaments, and the fat pads or the synovial membrane (Shands [87]).

History

Ambrose Pare, in 1558, successfully removed a loose body from the knee. It was not until 1877 that Annandale operated upon the first case that was due to a lesion of the semilunar cartilage (meniscus). Monroe in 1758, recognized the fact that loose bodies might be derived from the articular ends of the long bones. John Hunter, one year later, learned that these could also arise from hypertrophic exostoses. Kolliker, in a later generation, found cartilage cells in the synovial villi. These three men Monroe, Hunter, and Kölliker outlined the three main sources of loose bodies.

William Hey, in 1784, of Hunter's own hospital, originated the term "Internal Derangement". In his own words, " The complaint may be brought on by any such alteration in the state of the joint, as will prevent the condyles of the os femoris from moving truly in the hollow formed by the semilunar cartilages, and the articular depression of the tibia". Anatomic studies initiated in 1836 further clarified the problem. Due to the fear of sepsis, surgical treatment was slow in progress, a nd for some time certain unqualified practitioners (bone-setters) subjected every knee available to manipulation, no doubt with disastrous consequence to the patient.

Derangements of the knee joint were known to Hippocrates and other surgeons of by-gone days, but were eroneously interpreted as true dislocations of the knee.

PART II

ANALYSIS OF CONDITION

In attempting to elucidate mechanical derangements of the human body, one must advert to the basic normal conditions. It is therefore necessary that we know the basic function of the organ studied. Similarly, it will be necessary in this case that we know the anatomic and functional relation of the joint which predisposes it to derangement.

In the following discussion we shall consider the anatomic, functional and pathologic situation of internal derangement of the knee.

Anatomy

The knee is the largest and most complicated joint of the body. Its peculiar anatomic construction meets the static and dynamic requirements, namely: adequate stability combined with unrestricted motion to the face of great weight-bearing stresses. A point to be emphasized is that in such an intricate joint as the knee in which all the structures are of necessity so harmoniously related. All its separate parts are equally im-

portant both functionally and anatomically.

The femoral, tibial and patellar articular surfaces offer an extensive area to disorganization. The lack of exact anterior symmetry of the condylar surfaces superinduces rotatory deviations at the completion of extension and beginning of flexion. Because of their further incongruity with the tibial articular surfaces, there are interposed with the two semilunar cartilages. The posterior half of the medial one is intimately attached to the medial lateral ligament. This explains its predelection to trauma and attending ligamentous symptoms. The semimembranosis and the vastus medialis are partially inserted into the medial lateral ligament, and may strain the latter by muscular action alone, or involve it in pathologic processes peculiar to them. The anterior portion of the medial cartilage is sometimes attached by a bifed process which precipitates the longitudinal tear or fracture so commonly noted clinically. Furthermore, these semilunar cartilages are partly fibrous, and, therefore, more prone to tear longitudinally in their substance than they are to fracture transversally. The relationships of the tibial spine and the crucial ligaments to the internal semilunar cartilage makes them subject to injury by the same mechanism.

Attachment of the posterior crucial ligament to the antero-lateral surface of the medial condyle subjects this portion to continuous strains. The importance of the capsular structures may be further emphasized when it is noted that the lateral ligaments of the knee are really only thickened portions of the capsule and that the capsule's chief function is the support of the synovial membrane.

These two structures are most intimately related and cannot be anatomically differentiated, in most instances, at operation. Both crucial ligaments are also developed from thickenings of the capsule in the intercondyloid notch. They thus prevent anterior and posterior subluxation of the tibia.

The reflections of the synovia and the capsule in the intercondyloid notch would divide the joint into medial and lateral space were it not for the complications of the patellar articulation which unites these two anteriorly into one great compartment. The posterior part of the joint, however, is separated clinically from the anterior by these same reflections.

The capsular reflection from the lower pole of the tibia excludes the patellar ligament from the joint. The fat pad is in the space between the patellar ligament

and the joint. It pushes the synovia backward between the two articular facets of the tibia in a cone-shaped mass, and forms the ligamentum mucosum which is usually attached to the anterior crucial ligament. The ligamenta alaria are peculiar fringe-like lateral extensions of the ligamentum mucosum which rests on the anteromedial surface of the semilunar cartilages.

The patella tends to displace laterally in extension and so the vastus internus passes well down on the inner side to counter-act this. The femur is also built up on the outer condyle. The capsule includes so much of the juxta-articular epiphysis of the femur that lesions of the latter, in certain instances, find expression in the joint.

The thigh muscles are the most important structures in maintaining stability of the knee joint. Maintainance of their tone should be aimed at before operation and resumed as quickly as possible afterwards. This is best accomplished by active use (Darrach [33]).

PATHOLOGY

To understand the result of trauma to the knee joint a thorough knowledge of the pathologic picture is essential. Little emphais has been placed on this point, but much should be. When a tear or loosening of the menisci and capsule takes place certain definite events follow in quick order. This may result from either joint or bursa contusion, muscle (vastus medialis) contusion, sprain, or partial luxation of the joint surface. In each and every one of these types of injury, there is always comcomitant hemorrhage from torn areolar tissue, blood vessels, and capilaries, whether within or without the synovial membrane (Thorndike [95]). In otherwords, this subject is commonly applied to those intra- and extra-articular affections of the knee, most often of traumatic origen, which are the result of lesions of the semilunar cartilage, the joint surfaces, the ligaments, the fat pad, or the synovial membrane (Moorehead [75]).

Hemorrhage promptly takes place in addition to the tearing of the specialized tissue. During the process of repair one expects in sequence: hematoma formation, hematoma absorption, and healing by fibroblastic repair. The problem is to estimate promptly the extent

of the lesion or lesions and institute immediately the appropriate and adequate measures to control and protect, first, the tissue torn and, second, the hemorrhage and hematoma.

Chatterton [24] divides the lesions into two large clinicale groups to discuss the type of pathology. This is on the basis of locking of the knee. It must be remembered in discussion that the majority of these knees have more than one lesion.

Contusion and contusion-sprains are the most common injuries of the knee joint. Next in order are common synovitis, bursitis, loose bodies, tears of cruciate ligaments, fractures of patella and margins of the tibia or femur, fractures of tibial spines, and dislocation of the joint.

Disabilities Causing Locking

1. Lesions of the semilunar cartilages (menisci). Aside from the more or less rare type of cystic degeneration associated with the external cartilage in almost all cases. The lesions here are due to injuries that result in tears, fractures, and loosening or even complete avulsion of the cartilage.

Cysts result from a mucoid degeneration of the

connective tissue at the point where the tendons of the popliteus crosses the lateral meniscus. The cartilage itself seldoms shows any evidence of actual involvement. Pathologically this may be classified as a ganglion. The golgi apparatus of these cells is hypertrophic and extremely complex in structure and this strongly supports the view that cytological changes are due to cellular activity rather than retrogression (King [61]).

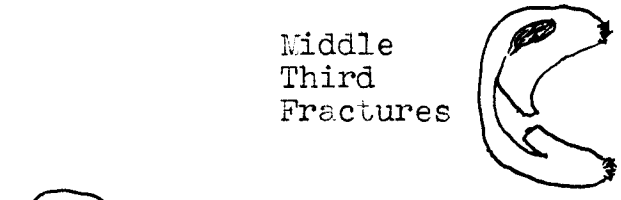
Injuries to the semilunar cartilages are predominant among all the derangements of the knee. In the work of Shands, Hutchinson & Ziv [88], they report that injuries to the semilunar cartilages constitute seventy-five percent of all derangements. The semilunar cartilages are not the only cause of internal derangements and many other conditions may give thesame clinical picture. A majority of these knees have more than the meniscus injuried.

The only blood supply to the semilunar cartilage is through the coronary ligament so actual repair does not take place as the rule. The most common type of injury results in the "bucket handle" fractures or tears (so-called because of its resemblance to the old English leather bucket). There are many different locations of

these fractures. In the most part the following illustrations will show the more common.

Loop or Bucket-Handle Fractures

Middle Third Fractures



Anterior Tip Fractures

Anterior Third Fractures

Posterior Third Fracture

The following charts will give the most common types of tears and their locations. Bristow [13] summarizes the lesions of 956 operations of the knee joint.

Iesions of Menisci Found at Operation of 956 (Bristow [13])

Findings (Type of Tear)	Internal Cartilage	External Cartilage
Longitudinal tears	650	140
Cysts	22	27
Congenital complete disc	0	3
Loose posterior end after removal of anterior two-thirds	5	0
Indefinite, old tears, scarring	25	4
Fibrosis of fat pad, complication of anterior tear	22	1
Normal and hypermobile	62	15
	766	190
Total	956	

Analysis of 791 Longitudinal Tears or Fractures of Menisci Found at Operation

Type of Tear	Internal	External	Total	Percent
Complete	356	41	397	48
Posterior	182	69	251	31
Anterior	112	31	143	21
Total	650	141	791	100

(Bristow [13])

Rotation strains injury the semilunar cartilage if the foot is firmly gripping the ground, as with the heavily studded shoe of the modern footballer, with the weight on the leg and the body twisted. The muscles caught at a disadvantage can not check the movement, and the strain falls on the second line of defense, the ligaments. The injury to the cartilage is a longitudinal tear or split in the substance of the cartilage. The direct compression or grinding action of the femur on the tibia because of a rotation force causes the injury.

2. Loose bodies. We must remember in this connection that we are dealing with connective tissue of low differentiation in the knee joint. These connective tissue cells may, under favorable conditions, revert to embryonic activity, and form bone or cartilage with e-

qual facility. The joint cartilage in childhood is simply a portion of the cartilaginous epiphysis, and may be viewed as essentially on embryonal tissue doomed to eventual ossification.

Rainey's theory as to etiology of free bodies are pieces of detached cartilage or cartilage and bone which continues to grow in new locality and are independent of their source though adhering to their original character. Study shows they are nourished by the synovial fluid.

In extreme flexion of knee joint, in which there is slight abduction with rotation of the leg on the thigh, trauma may cause nipping of cartilage and bone from condylar surfaces of the femur, and bodies so broken off grow to considerable size. Undue pressure causes detachment of small portions of the semilunar cartilage (Lamson [65]).

The loose body itself expresses an end result process subsequent to some pathologic reaction, usually an aseptic necrosis. Loose bodies all tend to approach a common morphology and are grouped under the common heading of copora libera articulorum or "joint mice" (corpora orysoidea, unorganized tissue, or rice bodies). Necrotic and degenerative, but no inflammatory changes, are noted in the bodies themselves. The primary under-

lying pathology may involve either the bone, cartilage, or synovial membrane, alone or combined. In general, they are classified as either organized or unorganized (Kulowski [63]).

The unorganized types are composed of unorganized fibrin or necrotic portion of synovia. The organized class is composed of organized tissues such as bone, cartilage, organized fibrous tissue, alone or multiple combinations. Loose bodies may be single or multiple, pedunculated or free. Some of the bodies are laminated and some are not. Trauma and possibly some hereditary constitutional factors are the etiologic elements underlying this localized tendency to aseptic necrosis.

Usually when a foreign body enters a joint it is either removed early or it carries pyogenic infection into the joint so that a pyogenic arthritis develops. When occasionally permitted to remain a low grade arthritis may develop. In this condition the results may simulate any condition. (Key [59])

The conditions under which loose bodies are found in the knee have been known for many years. They are:

a. Osteochondritis Dissecans: This forms the classical free or loose body. It was first discribed by Konig in 1888. It is composed of bone and cartilage and arises, as a rule, from the anterolateral border

of the medial condyle which usually presents a corresponding defect after the body has become completely liberated. The body is usually single, and any other joint pathology present is secondary. It is generally circular or oval and about the size of an almond. Its free surface is convex and of cartilagenous consistancy. The former site of attachment is flattened and rough. It may require a secondary adhesion to the synovial membrane. Heredity, as an etiologic factor, has received some support.

b. Osteoarthritic osteophytes: Typically these are osteoarthritic outgrowths but may arise from the cartilage or synovia. They are associated with general arthritic changes in the joint and lipping of the borders, which are peculiarly exposed to injury in certain situations. If incompletely detached they are found adherent by pedicles of varied thickness to the joint. margins. As a rule, they are multiple. Microscopically they are differentiated from other loose bodies by their characteristic three layers. The middle layer is of well developed fibro-cartilage with spherical cells, which is invested by a perichondrium of fibrous tissue with flattened cells, and the inner cancellous bony layers in which the cells are dead. The underlying pathology is an inflammatory response of the joint to

an irritation of low grade intensity which may be mechanical or toxic.

c. Osteochondromatosis (chondromatosis): This was first discribed by Reichel in 1900. In this condtion there are noted multiple cartilagenous bodies in the synovial and also loose in the joint ranging greatly in size and number. They arise from the deeper layers of the synovial membrane which is made up of very low differentiation. Originally, in early embryonic development, all the tissues of the knee joint arise from the same layer of the blastoma. The bodies are smooth on the joint side due to pressure. Sometimes mucinoid degeneration is centrally present.

3. Patellar pathology. This condition may be the result of congenital or distructive lesions. Such as:

a. Slipping of the patella is not classed as a true derangement but produces similar symptoms. It is a condition seen more often in children. The patella assumes a position on the outer side of the knee-joint and is followed by locking, swelling, and pain (Chatterton [24]).

b. Chondromalacia of the patella was first recognized by Budinger in 1906. The primary pathologic changes

consist of circumscribed swelling of the articular patellar cartilage with fissuring and erosion of the bone. Free bodies are finally formed. Secondaryily, there is hypertrophy of the synovial membrane and fat pad. The latter sometimes clinically obscures the primary lesion.

4. Damage to the Retropatellar Fat pad: Signs and symptoms of injury to the retropatellar fat pad will simulate a cartilage injury but are generally less severe. There may be a history of pseudo-locking, but there will be no history of unlocking. Local tenderness on pressure is often experienced on the joint line. The trouble with the fat pad is more common in patients over thirty or fourty years of age. Diagnosis usually made on operation when the pad is found to be abnormally shaped, inflammed, thickened and in position to cause interference of normal joint movement.

5. Fracture of the anterior tibial spine: Fractures of the anterior tibial spine or anterior portion of the tibia may lock the knee joint and prevent extension. Either the internal tubercle, the external tubercle or the whole tibial spine may be involved in the fracture. The whole spine or internal tubercle is avulsed by the anterior cruciate ligament, and the mechanism of the lesion is the same as that of rupture of the ligament.

As a rule, the spine is displaced anteriorly after avulsion and then acts as a block to full extension. This block can be distinguished from that caused by a torn anterior horn of the meniscus or by an enlarged fat pad by the bony sensation it imparts when an attempt is made to extend the knee fully. The external tubercle of the spine is fractured by the impingement of it on the external condyle of the femur during an injury similar to that which produces a lesion of the internal meniscus. X-ray examination clears up the diagnosis.

6. Xanthoma of the knee joint: This is a very rare condition in which a giant cell tumor develops from the synovial membrane. The condition does not tend to become malignant nor is there always history of trauma or is the blood cholesterol necessarily elevated. There is an accompanying hydrops of the knee and pain from the distension.

Disabilities Not Causing Locking

1. Rupture of lateral ligaments; Both sets of lateral ligaments, the external (tibial) and the internal (fibular), are placed distinctly to the rear of the bones to which they are attached that they act as check ligaments when the knee is hyperextended. This is in addition to their main function of preventing undue lateral mobility. The lateral ligaments are the most important structures of the knee joint from the stand point of stability. Injuries to the lateral ligaments are usually caused in these days by football accidents such as clipping and tackling. They are also caused by the bumpers of automibiles driven at low speeds (higher speeds tend to cause fractures). The principle etiologic factor is direct force with the knee in the position of extension or slight flexion with the foot firmly fixed. The blows to the outer side of the knee are the most common type of injury. In this respect the one leg protects the other from blows to the internal surface of the leg.

The internal lateral ligament is most commonly injured. There are all grades of injuries from simple tearing of deep fibers to complete rupture with a rent extending transversely through the capsule. Rupture us-

ually takes place just above the internal meniscus (semilunar cartilage).

This leads to other complications such as fractures or dislocations of the meniscus. The external ligament has no attachment to the external meniscus. Other complications are bloody effusion with increased pressure. These traumatic injuries also may lead to intra- and extra-articular fractures.

Since these ligaments are relaxed when the knee is flexed, they are usually injured only when the knee is in full extension.

2. Rupture of the Cruciate Ligaments: Rupture of the cruciate ligament is frequently associated with fractures of the tibial spine. It is caused by an injury in which there is a combination of twisting and hyperabduction or hyperadduction. The ligaments aid in prevention of anterio-posterior movement of the tibia and the femur.

Following rupture there is increased movement and instability of the knee. There is also tenderness of the tibial spine found on the outer and inferior side of the patella on flexion when the posterior is involved.

Milch [74] concludes that contrary to the general opinion, the anterior cruciate ligament is not a vitally

necessary structure and its loss is thoroughly compatable with relatively normal function. According to Brantigen and Voshell [11] in their recent work of the mechanism of the knee, they conclude that the tibial collateral (internal Lateral) ligament and the anterior cruciate ligaments probably add greater stability to the knee joint than do the external lateral (fibular collateral) and the posterior crucial ligaments.

3. Fractures of the Patella: Because of its prominent position on the knee, the patella is frequently fractured by direct trauma. It is a sesamoid bone in the quadriceps tendon and is subject to constant strain during walking, running, or jumping. Fractures occasionally occur as a result of violent contraction of the quadriceps muscle with the knee in flexion. Fracture of this bone is most common between the ages of thirty and fifty and rarely occurs under the age of twenty. It is a frequent injury in automobile accidents and occurs then when the knee strikes the steering post or dash board.

Compound fractures are relatively infrequent, but when they do occur, they are serious as the articular cartilage is almost always fractured, and there may be direct contamination of the joint.

4. Genu Recurvatum: Derangements of the knee can also be the result of malformation either congenital or acquired. In this respect, the condition is known as genu recurvatum. It is generally recognized as existing in the weakness of paralysis of the musculature of the knee and in the stretching of the ligaments. However, it may be due to bony deformity of the anterior tibial or femoral surfaces. This condition may also be caused by the tipping of the articular surfaces of the tibia, either by fracture or growth. All of these conditions lead to a hyperextension of the knee (backward bending).

5. Traumatic Synovitis: This condition is the result of injury to the synovial membrane, and it is recognized by the enlargement, warmth and tenderness of the joint. There may be soft crepitation on movement with pain and resistance before normal limits of flexion and extension. This condition is found with all the other types of injuries.

PART III

CLINICAL DISCUSSION

The symptoms of internal derangements are chiefly subjective and are due, primarily, to mechanical obstruction and, secondarily, to the reactions in and about the joint. In many instances an exact diagnosis is impossible without actual operative exploration of the joint. However, in a general way, the symptoms typify the mechanical obstructive lesions, and the basic diagnosis of internal derangement may be made with a certainty that few other conditions or diseases permit.

A. EXAMINATION OF THE PATIENT

History

A careful history is the first essential. The importance of an accurate and exact description of the patient's symptoms, and an orderly account of the various details from the time of the very first symptom can not be over stressed. In a vast majority this is the most important part of the examination. It may well take fifteen or twenty minutes to piece together the story of the original injury and the immediate after happenings in order to get a clear and accurate picture of the mechanism and sequence of events.

The points in the history which must be carefully weighed are many. First, consider the details of the original injury. There are three main types of injury to the knee which are distinct as regards mechanism.

Lateral Strain: Commonly caused by external violence forcing the patient's knee into abduction, and so tearing part of the internal lateral ligament. The femoral attachment of this ligament is almost always the part which bears the brunt of the trauma. The reverse force, when the knee is forcibly adduction, is less common. The external lateral ligament will then be torn and is not infrequently combined with avulsion of bone from the head of the fibula.

Rotation Strain: These are most commonly results of a twisting force. This will result in a tear of ligaments. The ligament which suffers is the coronary which attaches the semilunar cartilage to the head of the tibia. This injury is common and failure to recognize its results will render the surgeon liable to open many knees unnecessarily. In practice, it is seen most often in an aggravated form as the result of a fall or twisting injury. These same rotation strains may also cause injury to the semilunar cartilage if the foot is

firmly gripping the ground. The muscle, caught at a disadvantage, can not check the movement and the strain falls on the second line of defense, the ligaments. The primary injury to the cartilage is a longitudinal tear or split in the substance of the cartilage. This is caused by a direct grinding or compression action of the femur on the tibia.

A consideration of the history of a primary injury which has given rise to a torn semilunar cartilage will usually be found to contain these three factors--the flexed knee, rotation, and weight-bearing at the time. This triad is not necessary for a second or subsequent displacement, for, as is well known the cartilage may then easily become displaced. This can even take place while the patient is lying in bed.

Hyperextension Strain: The knee is forced beyond the normal 180° extension. This may result in a tear of the anterior cruciate ligament. Alternately the ligament may tear away its tibial attachment, "avulsion of the tibial spine".

The phenomenon known as locking is often regarded as diagnostic of a displaced cartilage of a loose body--but locking, which means inability to extend the knee, may be a symptom of even severe sprain. A patient with a torn internal lateral ligament may be unable to straigh-

ten the knee which is held semiflexed by the protective muscle spasm.

Therefore, the less well appreciated UNLOCKING is diagnostic. If the knee, as a result of an injury will not straighten, and if the patient or friend or a doctor takes hold of the leg and manipulates it and it quite suddenly straightens, then the cause of the flexion must be mechanical. This means in practice that a torn cartilage which is displaced has blocked extension, or a loose body is jammed between the bearing surfaces.

The typical history of internal derangement caused by a torn cartilage is characteristic. A patient states that his knee was injured at football a year or two previously and since that time has given away on four or five definite occasions; that he fell because his knee gave away and not because he was tackled; that the knee would not straighten and that he was assisted off the field limping with the toe (but not the heel) on the ground; that someone pulled his leg straight and he felt something move in the joint; and that he was then able to straighten and bend his leg, and that evening the leg swelled. From such a story a diagnosis of recurrent torn cartilage is simple.

Etiology

Since the game of football has evolved into one of the nation's major sports the treatment of injuries of the knee joint has become a very important problem. There has been a material increase in the number requiring surgical treatment for this same reason. The most frequent cause of disability undoubtedly results from trauma to the medial semilunar cartilage.

There are only two ligaments in which rupture is of frequent occurrence, the internal lateral ligament and the anterior cruciate ligament, and in some instances both are ruptured. The former is most commonly a result of external violence. This violence most frequently results of the patient being tackled or blocked from the side. The injury to the anterior cruciate is most commonly caused by hyperextension injuries of the knee. This may result of being tackled on the anterior surface of the leg when the foot is fixed on the ground.

The trauma to the semilunar cartilage is the result of a rotation strain which causes direct compression or grinding action of the femur on the tibia when the knee is flexed. The ligaments are commonly ruptured by the same mechanism which injuries the medial cartilage--that is, sudden hyperextension of the knee with the foot fixed, as in stepping into a hole in the ground.

Ruptures of the external lateral ligament and posterior cruciate ligament are rare and are usually brought about by a mechanism which is opposite to that causing trauma to the medial cartilage. This would necessarily be a flexion with adduction and internal rotation of the tibia on the femur. Such a mechanism is obviously of rare occurance.

Osteochondritis of the knee has its eteology according to many from the following factors: Mechanical stress and strains, infection, thrombosis of end vessels leading to aseptic thrombosis and trauma of the articular cartilages and endocrine disturbances (Bertheiser [6]).

The etiology of cysts of the semilunar cartilage is unknown. Trauma plays an important role. About fifty percent of the cases viewed by (Bennett [4]) gave history of trauma. The age period is twenty to thirty years. Others believe it to be a mucoid degeneration of a hematoma or the result of wear and tear.

Fractures of the patella and about the knee are due to direct trauma to the knee. The most frequent etiologic cause is the striking of the patella on the dash board of an automobile (Brown [16]).

The etiology of free bodies is believed to be detached pieces of cartilage or cartilage and bone which continue to grow in new localities and are independent

of their source though adhering to their original character.

In extreme flexion of the knee joint in which there is slight abduction with rotation of the leg on the thigh, trauma may cause nipping of cartilage and bone from the condylar surface of the femur, and bodies so broken off grow to considerable size. Undue pressure causes detachment of small portions of the semilunar cartialges. Synovial membrane becomes hypertrophied because of disease, infection, or chronic irritation, and they undergo fibrous tissue and calcareous formation.

Signs & Symptoms

A great many of these patients present themselves to the surgeon complaining of symptoms which are due to injury of the medial semilunar cartilage and unless care is exercised an associated ligament injury may be overlooked even at operation for the removal of the cartilage. This undoubtedly accounts for many of those cases in which symptoms persist after excision of the injured cartilage. The most outstanding single symptoms of cartilage injury is swelling. This is almost always associated with pain, slipping, giving away of the knee, or catching in the flexed position. According to

Shand, Hutchinson & Ziv [83] over 96 percent reported swelling at different periods; there was partial or complete locking in 84 percent of the cases. The injuries are predominate in men (three to one woman). The average age noted was 23.4 years but 90% were between the ages of 17 and 29 years. The left knee was predominant over the right two to one.

In the acute injuries the symptoms are of sudden onset. Immediately following the accident the patient has acute pain and, in cases of anterior or anterolateral displacement, finds himself unable to extend the leg completely. This pain is usually localized over the point of injury. The loosened edge may be felt before the acute effusion begins. The sudden filling up of the knee joint usually occurs within the first hour and is due to the extravasation of both blood and synovial fluid as well as edema.

Symptoms of a subacute or recurrent derangement are, as a rule, less severe. The pain is not so great, the effusion is less, and the replacement of the cartilage is sometimes done by the patient himself by simply twisting and extending the leg. Neoplasms such as cystic disease or partial ossification of portions or all of the cartilage are occasionally found.

B) Fractures of the lateral ligaments. There have been three clinical forms. (1) Laceration at the ends of the ligament with the following symptoms: contraction of the ligaments by the quadriceps is difficult and painful; the patient suffers when he leans on his limb or when he tries to flex the knee; it is not possible to obtain lateral mobility, but palpation with the finger produces a sharp pain in a fixed and localized point of the ligament. (2) Rupture in the body of the ligament without associated lesions always produces pronounced articular symptoms. Active and passive movements are very painful, especially the former which is nearly impossible. The principal sign is that it is possible to obtain abduction (when the ligament torn is the internal) or adduction (if the ruptured ligament is the external). (3) Rupture of ligaments combined with an intra-articular lesion. In these cases, the trauma has been severe. There is no active movement, but there is great swelling with edema, ecchymosis, and intra-articular collection of fluid. If there is a dislocation outwards or inwards accompanied by lateral movement, we may find instability, rupture of the semilunar cartilage, of fracture of the tibial condyles and the head of the fibula, etc..

Although this is a very schematic division, it cor-

responds closely to the clinical pictures to which we refer to as slight, medium, and serious. The "slight" cases show ecchymosis, some infiltration of the soft tissues, slight hemarthrosis, limitation of flexion, and extension pain in the torn ligament or over its insertions, and a few millimeters of lateral mobility, never more than one centimeter.

The "medium" cases show bloody infiltration of the soft tissues, large lateral hematoma, extensive hemarthrosis, pain over the torn ligament and its surroundings, great limitation of movements and excessive lateral mobility which reaches two to three centimeters or more.

The "serious" cases are those which may have had dislocations of the knee and other associated lesions, that we see after severe accidents. In these cases there is very pronounced external mobility.

C) Ruptures of the Crucial Ligaments: This condition is associated with injuries of the lateral ligaments. The most diagnostic point is the anterio-posterior movement of the tibia on the femur. There is debate as to the degree of instability the rupture of the crucial alone will allow. There is also tenderness of the tibial spine found on the outer inferior side of the patella on flexion when the spine is involved. Milch [74] and

many others are of the opinion that the anterior cruciate ligament is not a vitally necessary structure and its loss is thoroughly compatible with relatively normal function. There are others who recommend that when this ligament is ruptured that it should be repaired to restore the normal anatomical situation.

D) Osteoarthritis: The symptoms of arthritis are usually a bilateral limitation of motion with pain. There is crepitation beneath the patella while passive motion is very painful. The patient locates the pain and tenderness in the anterior knee region, usually centered about the patella. The other findings are, in general, essentially those of loose bodies. There may be a persistant flexion contraction, while the limitation of normal flexion is due to pain and to swelling of the soft parts.

We must not forget that when a penetrating injury occurs about the knee joint the foreign body must be removed relatively early after the accident. It may carry a pyogenic infection into the joint, but when a portion is allowed to remain near the joint, it may cause degeneration of the disc and fusion of the bodies and eventually distruction of the knee.

E) Slipping Patella: This condtion may develop

from either of the three etiological types of this condition: (1) congenital, (2) rhachitic, and (3) traumatic. The congenital type may develop normally and walk at the normal age. No abnormality of gait is noted until the age of six or seven when they begin to walk with difficulty and fall frequently. Genu-valgum (knock-knee) is usually an accompanying codition.

Rhachitic slipping of the patella may be only another manifestation of the condtion. Traumatic slipping may be caused by various mechanisms but usually is manifested by a tearing pain followed by a marked effusion into the joint. There are usually recurring attacks.

F) Injury to the Fat Pad: Injuries to the fat pads is seen practically only in the presence of osteophytes in the osteoarthritic knee. The main symptom is an occasional stabbing sensation during exercise when the hypertrophied pads become nipped on extension of the joint. If the disorder is allowed to persist, the symptoms are more pronounced, synovial effusion occurs, there is stiffness, and at times a painful 'giving way' of the knee. The enlarged pads can be seen and palpated and are harder than normal; there is a fine crepitation confined to the sites of the pads on movements of the joint, and the latter may be limited in extension as with a lesion of the anterior horn of the meniscus.

G) Simple Synovitis: The signs of synovitis are transient hyperemia, swelling of the synovial membrane, increase of synovial fluid, muscle atrophy, and increased local temperature. The first two are difficult to estimate so the other three must be relied on for diagnosis. Clinically, the chief symptoms vary from aching discomfort to severe binding pain in the knee region, often associated with intermittant effusion to the knee joint. There is a moderate to marked degree of disability.

This condition is related to the posterior hernias of the knee. This is a herneated synovial sac which appears as a cystic swelling found in the popliteal space and particularly located in the mid-line. The sac may occasionally dissect its way distally to the mid-calf region, lying on the gastrocnemius muscle and beneath the deep fascia.

H) Intra-articular Fractures: Fractures in and about the knee joint occur almost exclusively in adults. The most common intra-articular fractures occur in the tibial tuberosities. If there is much displacement the symptoms will be much like loose bodies, but if little displacement, the symptoms will be very much like lesions of the meniscus. The swelling is over one side or the

other of the upper end of the tibia along with tenderness over the area. Needless to say, radiological examination is the final arbiter. The typical 'T' fracture of the shaft of either the tibia or femur may extend into the joint. In dealing with the crucial ligaments the tibial spine often is displaced to cause difficulty. In lack of displacement the symtoms will simulate those of ruptured crucial ligaments.

DIFFERENTIAL DIAGNOSIS

Simple Synovitis

The signs of synovitis are transient hyperemia, swelling of the synovial membrane, increased synovial fluid, muscle atrophy and increased local tenderness. The first two are difficult to estimate, so the last three must be relied upon for diagnosis.

It is quite easy to appreciate that synovitis may mask other conditions. It also accompanies more serious lesions. For example, it will be seen with a tear of the meniscus or in the presence of a loose body.

It is quite easy to appreciate also, that the swelling of a joint within the first few hours of an injury is due to hemarthrosis while synovitis takes twelve or more hours to appear. This fact is most commonly overlooked. This point is quite important, for hemarthrosis means that there has been severe damage to some other structure within the joint. That is something has been torn or one of the articular surfaces has been broken.

Chronic synovitis is generally a sign of some underlying condition although it can occur as the direct outcome of an untreated simple acute traumatic synovitis. It ismore likely to be due to infection or absorption of toxins.

Ruptured Lateral Ligaments

The degree of rupture varies considerably from a severe strain to complete detachment. In the minor degree of injury there are pain and swelling on the inner side of the joint, with at times ecchymosis. The tenderness is confined to either the femoral or the tibial attachment of the ligament and is never found over the joint line itself. Abduction of the leg on the thigh will cause pain and may even reveal some laxity of the ligament, similarly, forcible external rotation of the leg will cause pain on the inner side of the joint. There is generally a synovial effusion. If there is a complete tear of the ligament it is almost certain that the anterior cruciate ligament will be torn as well. With these combined lesions the internal meniscus is bound to be damaged. The instability of the joint is very apparant and hemarthrosis will usually be present. It is only in cases in which the lesion is of minor degree that the condition is mistaken for a disorder of the internal meniscus. But the diagnosis is readily made on the signs mentioned above.

Tears of the external lateral ligament of the knee do occur, but they are very rare. Injuries likely to cause such a lesion generally result in rupture of the biceps tendon.

Disorders of Menisci

a) Internal Meniscus: This is by far the most common of the two semilunar cartilages to be injured. The various lesions to this structure was listed under the pathology.

i. Anterior horn lesions are caused by an internal rotation strain of the femur on the fixed tibia with the knee slightly flexed. There is a feeling that something has given way in the joint. The patient is unable to completely extend the knee, which is the seat of great pain. Locking usually occurs with the second injury. But after displacement has once taken place even turning over in bed may result in locking. There are many variations in symptoms but in the absence of locking and unlocking the diagnosis should be made with caution. A history which contains the statement that the knee gradually unlocks should be viewed with gravest suspicion, it usually means adhesions. Pain is usually present over the anterior end of the joint line and in many cases there is resistance to full extension.

The following method of proving the presence of a loose anterior horn is effective. The patient is asked to place the affected leg about eighteen inches in front of the other. Then lunge forward and turn the body as

far as he can to the affected side. With his hands on his hips he swings his body rapidly in the opposite direction as far as he can without moving the leg and foot of the injured limb. If the surgeon places his hands so that they encircle the knee he will feel a click during the rotation of the body. This maneuver merely repeats the type of injury which causes a lesion of this part of the meniscus.

Posterior horn lesions are caused by an external rotation strain of the femur on the fixed tibia. Swelling of the joint behaves in the same way as in other lesions. There is no locking of the joint. The tenderness is confined to the posterior part of the joint line and there may be a block of full flexion of the joint. The diagnosis depends entirely on the production of a 'click' on manipulation of the knee while the patient is lying on the table. The joint is flexed as much as possible, then the leg is externally rotated and abducted at the knee. With the leg held in this position, the heel is grasped (the right hand being used in the case of the right knee) from the inner side of the foot. Thehip is used to increase the leverage so that the external rotation will be maintained. The knee is gradually extended. As the torn part of the meniscus is caught between the tibia and femur a definite click is felt with the other hand

on the joint.

Sometimes the click can not be produced by external rotation of the leg, but is easily felt when the leg is internally rotated. In other cases the click is nost easily felt when the leg is freely rotated while the knee is being slowly extended.

ii. In every case of posterior horn involvement the diagnostic click will be felt when one or the other of these three manipulations is used. It is necessary to point out that this click can be produced in knees that are not the seat of any lesion to the menisci, but this does not interfer with the efficiency of the test. In these latter cases the click is painless, whereas in the presence of the torn meniscus it is painful and produces a sensation of something slipping in the joint-- a symptom of which most patients complain.

iii. Bucket-handle lesions are caused by the same type of injury that produces a tear of the anterior horn, but of greater severity. The symptoms are those of an anterior horn lesion.

b) External Meniscus: The lesions of this structure is less common but no less in importance.

i. Anterior horn lesions are not as frequent as are posterior, but when they do occur they are the same

as tears of the anterior horn of the internal meniscus. The localization is to the outer side of the joint. The tears of the external meniscus is generally accompanied by a loud clunk on active extension of the knee. This latter sign is very evident in the presence of congenital discoid menisci, which are practically confined to the outer side of the joint.

ii. Posterior horn lesions are produced by the same type of injury that produces a tear of the anterior horn of the internal meniscus. Locking of an indefinite type is sometimes seen in these lesions. This is due tothe fact that the external meniscus is very much more mobile than that of the internal meniscus. This allows it to ride forward and project between the bones in the front of the joint. In all posterior horn lesions, however, a click can be felt on manipulation of the joint. The click is invariably felt with the leg in internal rotation at the knee joint as the leg is gradually extended. Otherwise the procedure is the same as for the detection of similar lesions of the internal meniscus.

iii. Bucket-handle lesions of the external meniscus are similar to those of the internal meniscus. At times when the patient extends the knee joint a loud click, which originates in the hip joint, is heard. It has a deeper note, with a musical sound, than that emitted by a torn internal meniscus. It is best called a loud clunk.

Rupture of the Crucial Ligaments

Rupture of the curciate ligaments are frequently associated with fracture of the tibial spine, but will be dealt with spearately. If, after a severe injury to the knee, the tibia can be displaced backwards or forwards on the femur with the knee flexed to a right angle a tear of one or both cruciate ligaments can be diagnosed. Compair the injured knee with the other to rule out the existance of a hypermobile knee. The state of the ligaments, however, can be more easily gauged if the to-and-fro movement is tested with the knee at a right angle. In this position a torn anterior cruciate ligament will allow the tibia to be displaced forwards, while a rupture of the posterior cruciate-ligament will allow it to be displaced backwards.

Rupture of the anterior is more common in those conditions of severe abduction strain at the knee joint. These are the most common. Ruptures of the posterior ligament is caused by striking the upper anterior end of the tibia on the back of the front seat or on the dash board of an automobile. This same mechanism may lead to a fracture of the patella as stated before. This injury also is frequently found with rupture of the internal and external lateral ligaments.

Fractures of the Tibial Spine

Either the internal tubercle, the external tubercle or the whole tibial spine may be involved in a fracture. The whole spine or theinternal tubercle is avulsed by the anterior cruciate ligament and the mechanism of the lesion is the same as that of ruptures of that ligament. As a rule the spine is displaced anteriorly after avulsion and then acts as a block to full extension. Differentiate this lesion from meniscus tears and fat pad by the bony sensation it imparts when an attempt is made to extend the knee fully. The external tubercle is fractured by the impingement on it of the external condyle of the femur. There is some displacement of the fragment to the inner side, which also causes a block to complete extension. Both instances the fractures can be seen in the skiagram.

Loose Bodies

Loose bodies are a common cause of wrong diagnosis in disorders of the knee joint. The classical symptoms are sudden attacks of severe pain accompanied by synovial effusion and momentary locking. If multiple loose bodies are present the locking is more frequent but not so painful. Another feature of the locking is that it occurs in

different parts of the joint. If the loose body should become attached to the synovial membrane the classical symptoms will cease. The subsequent size of the body will make its presence felt. These bodies can be palpated in many cases, and in some instances the patient has discovered it himself. The diagnosis is helped by means of skiagram when ossification has occurred. Frequently these are discovered only after the joint has been opened for the removal of a supposedly torn meniscus.

Slipping Patella

If a patient complains that he or sheis conscious of something slipping in the knee joint, it is a good plan to make sure that it is not the patella being displaced laterally during flexion of the joint. The condition is diagnosed by seeing and feeling the patella's displacement laterally during flexion of the joint. In some cases a synovial effusion is present, while in others, changes take place in the bone and it never becomes completely reduced.

Osteoarthritis

There should be very little difficulty in diagnosing osteoarthritis. It is never seen before middle age,

except after a fracture near or into the knee joint. There is typical grating feeling which occurs on movement of the joint. All movements of the joint will be limited to some sense. The pain is aggravated by excessive use of the joint and also by resting the other leg on the joint even in bed. An x-ray picture will be very helpful in the great majority of cases, for the characteristic radiographic changes of osteoarthritis are present by the time the disease causes symptoms.

Exostoses

Sometimes exostoses attached to the lower end of the femur or to the upper end of the tibia interfere with the action of the tendons in the vicinity. As the tendons ride over the exostoses they make a noise suggestive of a tear of the external meniscus. To rule out the presence of exostoses it is essential to place the hands all around the joint for palpation. X-ray is also very important.

Intra-Articular Fractures

The commonest intra-articular fractures are those of the tibial tuberosities. If there is much displacement of the fragments the diagnosis will not present

much difficulty. When there is little or no displacement the symptoms may be very suggestive of a lesion of the meniscus. The swelling over one or other side of the upper end of the tibia, along with the site of maximum tenderness over the bone rather than the joint. Radiographic examination will be the final arbiter.

Injury to the Fat Pad

Injury to the fat pads are seen practically only in the presence of osteophytes in the osteoarthritic knee. The main symptom is an occasional stabbing sensation during exercise. This occurs when the hypertrophied pads become nipped on extension of the joint. If the disorder is allowed to persist the symptoms are more pronounced, synovial effusion occurs, and there is stiffness, and at times a painful giving-way of the knee. The enlarged pad can be palpated and are harder than normal. There is never the true locking and typical unlocking of the joint as in the meniscus lesion. The limitation of extension has not the same 'rubbery' resistance.

Adhesions

The failure on the part of the medical profession to recognize the occurrence of adhesions in and around

joints has been the greatest asset to the bone-setter and his kind. Adhesions follow any injury in which repair has to take place or which causes edema. They invariably accompany infective processes and apparently can occur as the result of toxemia.

The diagnosis of this type of adhesions are likely to be confused with a torn meniscus. The patient will state that the knee becomes 'stuck' at frequent intervals. He will always say that the knee gradually becomes 'unstuck'-- there is never the sudden unlocking which is encountered in lesions of the menisci. Sudden unguarded movement will cause a severe pain in the joint which lasts only a few minutes at the most. There is always the final test of manipulation of the joint under anesthesia. If the diagnostic symptoms are permanently relieved, the diagnosis was abviously that of adhesions. With attention to the symptoms and signs enumerated above this latter method of diagnosis will rarely, if ever, be needed.

X-RAY EXAMINATION

It seems hardly necessary to emphasize the importance of x-ray examination in all cases of internal derangements of the knee joint. There is a typical picture for many of the lesions encountered. It must be remembered that a film of the other knee is very helpful in those conditions which suggest a congenital lesion to be present. This will aid in the differential diagnosis for the derangements are usually uni-lateral in nature. In cartilage injuries the only change noted in uncomplicated cases is a narrowing of the joint space on the affected side. Air, oxygen, and iodized oil injections into the knee joint have been described as an aid to diagnosis (Quaintance [81]).

These are not without dangerous consequences, and the arthroscope (an instrument devised for the direct visualization of joints and based on the principle of the cystoscope) may gain a wider clinical application (Mayer & Burman [72]).

Free bodies are visualized depending upon the amount of calcification or ossification present in them. In osteochondritis disseccans, the loose body with its corresponding defect is usually outlined, but one must be on the watch for it. In some of these cases only a faintly delineated infarct-like area may be visible upon the med-

ial condyle following a history of trauma, and the subsequent loosening of the body may be predicted (Bertheiser [6]).

The patella in chondromalacia is distinctly fuzzy and shows partial fragmentation which may or may not be associated with loose bodies in the anterior part of the joint. From this must be differentiated patella biparte (congenital malformation due to an excessary center of ossification of the patella) and fracture.

A transverse fracture of the patella is self-evident. In longitudinal fractures, which are seldom encountered, the outer fragment is larger than that seen in the congenital malformations.

Furthermore, in patella biparte, the fissure is seen in the upper outer quadrant of the patella, and is generally bilateral and symmetrical. Above all, these latter two lesions are not associated with the pathological changes noted in chondromalacia. What constitutes an abnormally high patella is a moot question, but in general, it may be stated that it is one whose lower pole is above the joint when the knee is fully extended. It is generally felt that the lesions causing internal derangements are unilateral.

It may be said that there are both advantages and disadvantages in the determination of meniscal injury by

the arthroscope. The essential disadvantage is the inability to visualize the entire meniscus. It may yet be possible to visualize the anterior part of the meniscus if a suitable retractor were built into the instrument. The posterior part of the meniscus can not usually be adequately inspected. The important advantage of arthroscopy is its simplicity. Increasing experience gives increasing frequency of correctness of interpretation. The important difference in the post-operative course between arthroscopy and arthrotomy can only recommend arthroscopy over the exploratory arthrotomy. Arthroscopy should, of course, be limited to those cases in which clinical examination leaves no definite conclusion of internal derangement within the knee.

Pneumoarthrography: Because of the inability to demonstrate changes in the menisci of the knee joint or presence of non-radiopaque loose articular bodies with ordinary technique, the injection of air into the knee joints (after the fluid has been removed) has recently attained considerable vogue. The pathology can be shown when the process has been succesfully carried out so that the joint, in a semi-flexed position, is moderately distended with air, and no air has escaped through the puncture wound intothe surrounding soft structures. The situation and integrity of the menisci and their attach-

ment to the bone, as well as the condition of cruciate ligaments and the presence of radiolucent loose bodies in the joint, can be easily determined. No reaction follows the procedure and valuable information may be gained (Harrison [48]).

Calcification of one or both menisci of the knee is occasionally seen in roentgenogram. Loose bodies can not be seen unless they are calcified.

Cysts of the semilunar cartilage and the so-called 'Bakers Cysts' due to the protrusionof the synovial membrane through gaps in the capsular ligament or cysts due to distension of the bursal sac, can be demonstrated by the injection of air, though they may show no evidence of their presence on the flat film.

TREATMENT

In the discussion of the treatment the author will endeavor to show the most widely used and most successful methods of handling injuries to the knee. We are forced by two schools of thought to divide the discussion into non-surgical or conservative and the surgical. However, we desire to show that a combination of these two is the better method of attempting treatment.

Under both schools the treatment of the knee joint injuries can be divided into three different periods of time: (1) early treatment, (2) convalescent, and (3) prophylactic. Rarely is the opportunity presented to see these injuries immediately after they take place, which would be the optimum moment to start treatment (Thorndike [95]).

Non-Surgical (Conservative)

The early reduction of an acute cartilage injury with locking is quite necessary to deminish the ampunt of damage. This may be done by the patient or a friend, but if the locking is persistant definite manipulations may be necessary to reduce it. The joint should accurately be reduced by manipulation to full extension and retained there. An anesthetic may or may not be required. With

the patient in a supine position, the surgeon stands on the outer side of the leg and grasps the foot while he steadies the knee. The knee is flexed, and the leg rotated inward and outward to release the cartilage. Pressure is maintained over the meniscus, and with the leg adducted or abducted, depending upon which cartilage is affected, the knee is now sharply actively or passively extended. An audible snap and full extension spells a successful reduction, and full flexion and extension is now possible, actively or passively. Following the period of immobilization, an elastic bandage, physiotherapy, and gradual weight-bearing is resumed. To relieve any residual ligamentous strain, the heel on the inner or outer border is built up about three-sixteenths of an inch (Kulowski [63]).

The immediate treatment of contusions and sprains should be directed toward the control of hemorrhage and the minimizing of the hematoma. There are three steps which most practically will accomplish this: (1) the application of cold, preferably ice water for one hour, followed by (2) the application of a compression bandage utilizing plenty of padding, and (3) rest.

The first and third steps are self-explanatory, but the second should be clarified somewhat. Compression must not be so firm that it shuts off return circulation, nor

will a loosely applied bandage be effective. The use of thick sea sponges is very frequently found desirable because of their ability to fit the joint. These sponges are placed about the knee and bandaged tightly causing compression of the injuried vessels and this cuts down the hematoma. A modified Schanz cotton dressing may be very practical but will be described more fully under later treatment. These immediate measures are used to control the subsequent fluid and blood accumulation in or about the joint.

When these measures are carried out promptly one rarely sees 'water on the knee' as an accompanying complication in sprains and contusions. When the bandage is first removed, twenty-four hours after its application, ecchymosis is evident at the margins of the rubber pads. This represents deep hemorrhage controlled and forced by compression from deeper tissues to the skin. Once brought to the superficial tissues, its absorption can be more effectively treated by massage. The hematoma is decreased, and there is little or no fluid in the joint. Therefore, the joint capsule is not distended the day following injury.

Recent work has been done with the use of procaine in sprains. They explain the use of this drug on the

following basis. A sprain is defined as a temporary subluxation in which the articular surfaces have returned to their normal position and in which some damage has been done to the ligaments, tendons, and muscles around the joint. The injury is always accompanied by intense pain which may be localized to the site or spread to involve neighboring parts. An anatomically slight injury to a very sensative nerve endings in the neighboring joint tissue starts a reflex which begins with centripetal impulses from the joint to the central nervous system. A vasomotor response follows with local edema and rise in temperature, pain, and limitation of movement. The disturbance in the local vasomotor equilibrium gives rise to continued impulses and a vicious circle is established.

The recent treatment of sprains by injection of procaine into the injured ligament is, as far as can be judged at this stage, a definite advance on the old treatment. The centipetal impulses are cut off and abolished by the action of local anesthesia. Thus the local vasomotor response is deminished or prevented altogether and somehow does not appear to reoccur to any marked extent, even after the action of procaine has worn off.

The technique is to prepare the skin for sterile entry and locate the most tender point. In the moderate

cases inject 3 to 5cc of 2 percent solution of procaine and in the severe cases 5 to 10cc are injected. With sterile instruments, etc. no risk is noted (Frankel [38]).

In the most severe primary injuries with tears of the ligaments and capsule when more than ten degrees of abnormal mobility is elicited in the first examination, the early treatment is instituted as usual. However, a light cylindrical cast is applied outside the compression bandage, and the patient hospitalized with the leg elevated on three pillows for fourty-eight hours.

The Schanz Dressing is very effective and easily applied in this condition. It consists of: (1) a stockenette covering the leg from the ankle to upper thigh; (2) two rolls of heavy cotton eight inches by five yards snugly placed outside the stocking; (3) bind the cotton down with a four inch elastic bandage; (4) palce a soft pliable wood splint to the sides of theknee the full length of the cotton; (5) bind with another elastic gauze; (6) tape the gauze into position. This allows a small amount of flexion and extension but no lateral movement. This gives compression over the swollen part and can be left on for several days (Shands, Hutchison & Ziv [88]).

Convalescent Treatment: The convalescent treatment is aimed to promote the absorption of the hematoma and

waste products of the hemorrhage and to hasten the tissue repair. The two agents used for stimulation of the lymphatic absorption are HEAT and MASSAGE. At first these are applied proximal to the site of trauma and on about the fifth to seventh day actually on the site of trauma. Vigorous massage is always contraindicated, and only gentle stroking and efflurage ahould be tolerated. Between treatments a compression bandage should be worn. After the above treatment effusion should no longer be a complicating factor, and no longer is withdrawal of fluid by needle and syringe necessary.

A patient should not be permitted to return to sports or recreation until all tenderness in the ligament or contused tissue involved has disappeared, and then only with a restrictive adhesive strapping and padding to prevent recurrent injury.

Prophylactic Period: The prophylactic period of treatment is most important and should continue always, particularly in sprains. Ligament tissue heals by fibroblastic repair and always remains weak or brittle. This fibroblastic tissue can not withstand the stress or strain of the normal ligament.

Therefore, prophylactic strapping or protective braces are indicated from then on in future strenuous activities. The extent to which the extra protection is needed neces-

sarily depends on the degree of injury, the type of treatment, and lastly, the end results of the treatment.

It has been the practice of many college and professional groups to require those individuals who have had previous injuries, however remote, to wear supports.

A modified Jones Knee Cage has been the most commonly used brace, but adhesive strapping willin many instances be the only support available. In the latter, adhesive is applied by a criss-cross strap beginning laterally and as high as possible and extending across the lower leg. Several layers are placed on both sides of the knee and then anchored above and below by circular straps. The knee is then covered with an elastic bandage or support.

The Jones Brace consists of a soft leather base with two lateral stell bars which have a free hinge joint. This fits snugly to the knee allowing free flexion and extension but limited lateral or antero-posterior movement. A heavier type has a posterior calf and thigh band. All exposed steel is covered with felt. This brace has been used very satisfactorily to support the knees of football players who return to the game following injury.

The light type is advised for the backs and ends, who have more running to do. The heavy type is advised for the guards, tackles, and centers who have more contact

work than running. In no cases where these measures were followed were reinjuries reported.(Shands, Hutchison & Ziv [88]). It is believed that any football player or athlete, who has had the semilunar cartilages removed, should have his knee supported when playing for at least six to eighteen months after the operation. The length of time depends on the post-operative results.

Many high school boys with sprained knees have been carriedthrough college athletic careers without recurrent injuries, and the more serious internal derangements of the knee are becoming less frequent.

Surgical Treatment

The treatment called for in any particular patient depends on the estimation of the pathology in the joint condition. The old dictum that a knee joint should be opened with caution still holds good. Infection after operation is a surgical catastrophy usually resulting in ankylosis. The treatment must, therefore, be symptomatic giving the joint a chance to heal. It should be a rule that knees should be operated before repeated injuries have occurred. This will test ones diagnostic acumen to a great degree.

Surgical procedures must be undertaken only after the proper preparation. The optimum time should be a-

waited because most operations on the knee are operations of election and not emergencies. The should be a twenty-four preparation by shaving, scrubbing, painting with antiseptic, and a sterile towel should be wrapped around the area until operation.

The anesthesia used in operative procedures depends on the individual operator. Both general and local anesthesias have been used with good success. Ether or pentathol sodium are the most commonly used general anesthesia. Novacaine has been used both locally and as a spinal.

Nothing should enter the joint except instruments and unhandled gauze. Never induce a gloved finger into a joint.

The choice of incision necessarily depends on the operation expected. A long incision through the synovial membrane should be avoided. If a good diagnosis is made only a small incision is necessary. In some instances greater exposure is necessaryand this may be accomplished by multiple small incisions (West 98). It is foolish to cramp oneself by not having a sufficient exposure, but the big incision-- either the split-patellar or the para-patellar incision--is not necessary. Although these long incisions may be useful in searching for a loose body or for operation on an avulsion fracture of the tibial spine, they give poor access for the removal of the semilunar cartilage. Big scars in synovial membrane are to

be avoided. If necessary, multiple incisions can be used and may be needed to remove loose bodies, or a second incision may be required to remove the posterior horn of the cartilage (Bristow 13).

The operation should be carried out under a tourniquet after careful preparation and with rigid aseptic, non-touch technique. Extreme gentleness must be insisted upon and no bruising of tissue or pulling with heavy retractors is to be permitted. The skin incision is a matter of individual preference. An operation which avoids injury to the most nerves and vessels is desirable. The patellar branch of the saphenous nerve may give troubleand become involved in the scar.

A small curved incision lateral to the patella gives wonderful exposure of the anterior knee compartment, while the posterior exposure of Henderson and others will expose the posterior compartment. The surgeon must be prepared to explore the back of the joint, although this should not be part of the routine operation as it is unnecessary and has certain obvious disadvantages. The objection to the posterior approach is that the view of the joint is restricted and that the incision, necessarily longitudinal, has a tendency to become keloid. As with the anterior approach, the view seems to vary according to the individual patient--some knees are fairly

lax, and some are tight. This approach is most often needed for the removal of loose bodies in the posterior compartment of the knee (Bristow [13]).

In the previous literature the contraversal questions have been discussed. The necessity for repair of the various ligaments frequently discussed. There are many investigators who are of the belief that if the ruptured collateral ligaments are repaired, there is seldom need to repair the crucial ligaments (Dickson & Lawrence [35]; Cotton & Morrison [28]; Bosworth & Bosworth [9]; Henderson [50]; Mauck [71]; Ryerson [84]; Darrach [33]; Horwitz & Davidson [56]; and Bennett [3]).

Likewise there are just as many who believe that repair of the ruptured crucial ligaments is usually necessary (Cubbins, Conley, Callahan & Scuderi [32]; Campbell [20]; Stickler [93]; Lee [66]; Hey-Groves [53]; Gallie & LeMesurier [40]; Robson [82]; Smith [89]; Pringle [80]).

There are some who go further to state that it is important to repair the collateral and the cruciate ligaments if they are both ruptured (Campbell [20]; Smith [89]; Hey-Groves [53]).

One can see from this that there is no unity of opinion as to the repair, but it has been the conclusion from this study that the degree of trauma should have much to do with the decision as to how much surgery should be done.

In discussion the advisability of repairing only the anterior cruciate ligament or only the tibial (internal) lateral ligament when both are ruptured, it is probably safe to state that both should be repaired. In the knee joint there is a very close inter-relationship among the functions of the lateral and crucial ligaments and the capsule. It is hardly possible to give one or separate and distinct functions to any one ligament. When the capsule is incised and sutured, it is intentionally or un-intentionally tightened. If either the tibial lateral ligament or the anterior crucial ligament is repaired when both are ruptured, then there is restored to normal all but one of the five important stabilizing structures of the knee joint (disregarding muscular support). Therefore, the repair of either the tibial lateral or the anterior cruciate ligament gives a satisfactorily functioning knee joint. The close inter-relationship of the ligaments is the important factor in restoring stability, and not the greater importance of one ligament over the other.

There are only two ligaments in which rupture is of frequent occurrence, the internal lateral (tibial collateral) and the anterior cruciate ligament. In some severe instances both may be ruptured as stated above. These ligaments are commonly ruptured by the same mechanism

which injures the medial cartilage--that is sudden hyperextension of the knee with the foot fixed. Therefore, considerable of the surgical studies have been limited to the repair of these three conditions, namely: (1) fracture or rupture of the internal lateral ligament; (2) rupture of the anterior cruciate ligament; and (3) injury or fracture of the semilunar (meniscus) cartilage.

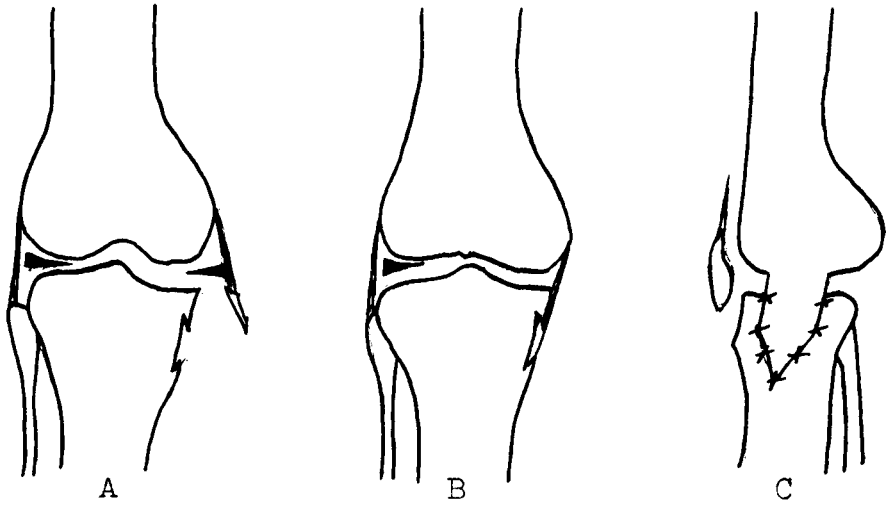
The procedures applied to one of the paired ligaments or cartilages can easily be applied to its partner with few alterations in technique which will be listed with each procedure.

A general rule may be stated that operative repair of the ligaments of the knee is indicated only in patients with continued disability and increasing symptoms which are obviously the result of ligamentous instability. It too should be remembered that it is better to prevent too many recurrances of the injury. In this respect our diagnostic acumen will be tested. In carefully selected cases with the use of the more modern operative procedures uniformly excellent results will be obtained. Even in long neglected cases the end results are usually gratifying.

Repair of the Internal Lateral Ligament: There are many operations for repair of the internal lateral liga-

ment of the knee, but that described by Mauck [71] is used extensively. The Mauck technique is especially adaptable for the repair of the relaxed internal lateral ligament. A slightly curved incision with its convexity anteriorly, is made on the medial aspect of the knee from the adductor tubercle of the femur to four inches below the articular surface of the tibia. The distal attachment of the internal lateral ligament is removed with a triangular section of bone two inches long and one-half inch wide at its proximal end. (Diagram A) At the joint surface the capsule is split upward for one inch at both the anterior and the posterior margins of the bone flap providing ample exposure for removal of the internal meniscus, if necessary, or the correction of any other internal derangement. The ligament and bone flap are drawn downward, and the point to which the articular edge of the flap reaches is marked by a chisel cut. At this point a notch is made in the side of the tibia forming an overhanging shelf of bone under which the lower end of the bone flap is morticed. The inner surface of the ligament is placed in contact with the denuded area of the tibia so that the ligament may be firmly adherent to the bone when healing is complete. (Diagrams B and C) The capsule is plicated if necessary and the subcutaneous tissue and skin closed. Mauck then applies a plaster

bandage with the knee in full extension for six weeks, and this is hinged at the knee at the end of two weeks to allow early flexion and extension.



This technique is best employed in the treatment of proven anterior crucial ligament tear, torn internal meniscus, and marked relaxation of the internal lateral ligament. The procedure seems most applicable for this type of the cases because it permits an excellent exposure of the interior of the knee joint without unduly disturbing its capsule-ligamentous envelope. The removal of the internal meniscus, deranged or normal, permits a close approximation of the tibia to the femur. It is a direct attack by actual shortening of the internal lateral ligament rather than a substitution by fascia or tendon.

Edwards [36] describes a procedure for the repair when

the ligaments have been ruptured and uses fascia to reconstruct the tendon. His technique consists of: (1) A medial incision is made exposing the sartorius muscle to its insertion. (2) Separate the tendon from the condyle and expose the gracilis and semitendonosis (blunt dissection is best). (3) The tendons of the latter two are divided at the level of the medial condyle, then dissected from their attachment and pulled well forward--hold up in pressure forceps, which also have been applied to the proximal ends of the tendons. (4) A groove is made in the medial condyle about $\frac{1}{4}$ inch deep and $\frac{1}{2}$ inch long in the verticle axis of the limb. (5) The distal parts of the tendon is stitched together firmly overlapping in a parallel plane. (6) After separating it well to the insertion on the tibia the distal portion is pulled wellforward in the verticle axis of the limb. (7) The proximal end of the distal protion is placed in the groove and stapled. It is then stitched to the surrounding tissue. (8) The proximal gracilis and semitendonosis tendons and muscle is sutured to the sartorius so that the active contraction function will not be lost. (9) The deep fascia is also sutured to the sartorius. (10) The subcutaneus tissue and the skin is closed and a posterior splint applied (Edwards [36]).

A third operation which has become quite popular in the past few years is described by Campbell [21]. In his operation he makes use of the fascia lata, and the same procedure can be used to repair either or both sides when indicated, but as the internal ligament is more frequently involved, we shall describe the treatment as applied to it.

A skin incision is made parallel with the quadriceps tendon, the patella, and patellar tendon, from two to three inches above the patella to just below the tibial tubercle. The deep fascia is incised and the capsule exposed. A curved incision parallel with the patella and the upper surface of the tibia is made into the knee if internal impairment is suspected and such attention given as may be required, after which the joint is closed. The repair of the ligament is accomplished by dissection from the inner aspect of the fascia lata a strip about 0.5 inch in width and 4 inches long. It is turned from above down to a point about apposite the center of the inner aspect of the internal condyle of the femur. Two parallel incisions about one inch in length and about 0.5 inches apart are next made through the deep fascia and periosteum, about one inch below the upper extremity of the tibia and parallel with the joint line. An artery forceps is then passed through the lower incision close to the knee

emergin from the upper incision. The upper end of the fascial flap is grasped by the forceps and brought through the tunnel in the dense fascia and periosteum. After this the ligament is drawn tight and stitched as high as possible to the margin of the fascia lata from which it had been dissected. The limb is held in extention and forcibly adducted during the operation. By passing the fascia through the tunnel a very accurate pully action can be made which permits very effective tightening or tautness of the capsule.

This operation has been used when there has been undue laxity of the ligament associated with injury of the cartilage and also when there has been no cartilage impairment. Excellent results have been obtained (Camp bell [21]).

Repair of the Cruciate Ligaments: Rupture of the cruciate ligaments is a rare occurrence as compared with the other internal derangements of the knee, and almost 100 percent of the cases are due to rupture of the anterior ligament.

Technique: A longitudinal curved incision about six inches in length is made parallel with the quadriceps tendon, the patella, and the patellar tendon for complete exposure of the knee joint. Dissection is made into the

joint cavity throughout the entire incision and the interior of the joint inspected. The cartilage is excised, if impaired. The anterior cruciate ligament is repaired by selecting a long pedicle strip of fascia, capsule, and tendon. This strip is about one-third inch in diameter and eight inches long. Dissection of the strip is made downward to the attachment of the capsule to the tibia.

This strip contains very strong tendonous tissue from the medial border of the quadriceps and patellar tendons. A six milimeter drill hole is then made from a point on the anterior internal surface of the inner tuberosity of the tibia about 1½ inch below the joint, and emerges in the joint at the normal lower attachment of the anterior crucial ligament just anterior to the spine of the tibia.

The same drill is then inserted into the intercondylar notch through the posterior portion of the external condyle of the femur, emerging under the skin above and posterior to the external condyle. A three inch incision is then made over the point of the drill with dissection down to the bone at this point. A Macy carrier or rustless steel wire loop is passed from above downward through the drill hole in each bone and the end of the pedunculated flap brought through to the superior exit of the tunnel in the external condyle of the femur.

The flap is now drawn very taut with the knee in about 140 degrees flexion. About three inches of the strip should extend beyond the tunnel and this is stitched to the periosteum and fascia lata. Both wounds are now closed in routine manner, and a posterior splint applied with the knee in same flexion. The fascia replaces anatomically the anterior crucial ligament, and there should be no undue anterior gliding of the tibia when the ligament is attached above. (Hey-Groves [52])

This procedure can be carried out quickly and when desirable can be combined with the repair of the internal lateral ligament. A longer fascial strip is used and the portion redundant after being threaded through the tunnel is used to construct the lateral ligaments.

The posterior cruciate ligament is repaired with a segment of the quadriceps and patellar tendon and capsule eight inches long. As in the operation for repair of the anterior cruciate ligament, a $\frac{1}{4}$ inch drill is passed through the tibia just below the articular surface. It enters from its anteromedial to the posterolateral aspect, and the drill point is exposed by blunt dissection through a posterior incision. The strip of tendon is drawn with the wire through the tibia and its free end pushed through the posterior capsule at the normal attachment of the ligament into the anterior compartment of the knee. A drill

hole is then made through the medial femoral condyle at the normal anterior attachment of the posterior crucial ligament, and the free end of the new ligament is drawn through and sutured to the upper border of the internal lateral ligament through a third small incision.

Combined repair of the anterior and posterior crucial ligaments may be carried out by the technique described by Gallie & LeMesurier and Cubbins [32]. However, such extensive surgery is seldom indicated or advisable.

Combined repair of the internal lateral and the anterior cruciate ligament is at times indicated and desirable. Smith [89] modified the Hey-Groves operation by dissecting down a longer strip of fascia lata than that necessary to replace the anterior cruciate ligament and reflicting the redundant portion upward on the medial aspect of the knee to form a new internal lateral ligament.

Excision of the Semilunar Cartilages: In recurrent lesions of the semilunar cartilages surgical intervention is indicated. The offending cartilage should be totally excised, and any other associated pathology dealt with. A tournequet facilitates the exploration of the joint. The operator sits on a stool and steadies the foot between

his knees. In the uncomplicated case a small curved incision over the junction of the anterior and meddle thirds of the cartilage is sufficient, but in doubtful cases it is best to employ the 'general utility' medial patellar route. The patella is then dislocated laterally, and the entire anterior compartment of the joint may easily be inspected.

Great care must be exercised to avoid injury to the articular surfaces as well as the ligamentous structures. The cartilage is freed anteriorly and grasped with a strong toothed forceps. The border attached to the medial lateral ligament is carefully removed with long curved scissors. The posterior attachment offers some difficulty, and a tonsil type of snare will facilitate its removal with little danger to the posterior crucial ligament.

Careful apposition of the synovial and capsular structures is essential in the closure of the wound. Synovial and subcutaneous layers are closed with cat gut and interrupted dermal sutures is used on the skin. No drainage or postoperative immobilization is necessary in uncomplicated cases, although a posterior plaster splint is usually advisable for several days. Active motion is ordinarily begun as soon as the patient can tolerate it. Weight bearing and physiotherapy is instituted after the wound has healed--from seven to ten days

as a rule. Both cartilages may be removed if indicated (Kulowski [63]).

Removal of Loose Bodies: All loose bodies giving rise to mechanical disorders should be surgically removed if the patients's conditon permits. The posterior part of the joint is exposed by Henderson's postero-medial or lateral approaches just above the hamstring tendons. In osteochondritis dissecans and other lesions involving the articular cartilages, the defective areas may require currettage or even partial arthroplastic procedures depending upon the extent and activity of the pathologic process present. Sometimes it may be necessary to remove entirely the articular surfaces, particularly in patellar lesions.

Regional synovectomy and fat pad removal are indicated in many cases. In the osteophytic types the removal of the remaining attached osteophytes should rest upon the following consideration. They should be removed only if they interfere with motion, give rise to nerve pain due to pressure, are themselves subject to pressure pain, or when they are on the point of becoming detached.

Excision of the Patella: The operation is performed under a tourniquet. A vertical incision about six inch-

es in length is centered over the patella. The skin margins are protected by towels. The incision is then carried down to the patella which is enucleated by sharp longitudinal dissection of the tendinous fibers of the overlying quadriceps tendon.

On freeing the anterior surface of the patella, the capsular attachment and synovia at the margins of the bone are easily severed. The longitudinal incision in the quadriceps tendon is then closed with a continuous chromic catgut suture. The superficial tissues are closed in layers without drainage.

On closure of the operative wound the limb is passively extended within the limits of safety. It is noted that the range of flexion is immediately definitely increases. Postoperative immobilization either in a cast or by traction in a Thomas splint is used for a period of one week to ten days for the patient's comfort. Immobilization by massive cotton dressing might be as efficient (Schanz Dressing). (Berkheiser [5]).

Postoperative Treatment

In most operations it is advisable that a tight pressure bandage is put on the knee. The tight bandage is left in situ for twenty-four hours, and it is then cut through without disturbing the underlying dressing. The patient is encouraged to move the leg in bed and to contract the muscles voluntarily. At the end of fourty-eight hours, he should be able to raise the limb from the bed and to tighten and to relax the quadriceps. Electrical stimulation of the quadriceps is commenced on the sixth day or earlier, and on the eighth day the stitches are removed. Physiotherapy also should be instituted and consists chiefly of whirlpool baths and massage, and active exercise without weight-bearing.

The patient is up and walking on the tenth day. His early efforts at walking are supervised by the masseur in order to teach him to take an equal length of stride with each foot and to bear his weight symmetrically. Small details of this kind are worth attention as they hasten convalescence.

The need for postoperative treatment should be emphasized, and it is well to remember that muscles do much to help support the knee. The quadriceps is the only safeguard against rotation strain. If the muscle is much

wasted, it should be built up before operation as this aids in a speedy recovery.

After operation the muscle treatment must be carried out daily as a routine. The recovery of movement is regained by the patient's own voluntary efforts. No passive or forced movements are needed except in so far as the masseur must see that rotation in both directions is assured during flexion.

On the average after a cartilage operation, the patients can return to office work in from two to three weeks and resume active game playing in from six to eight weeks. There is generally some fluid in the joint when they commence to walk again, but this calls for no special care and subsides quickly. If this fluid is excessive, it is advisable to apply a small crepe bandage for a week or two. If the fluid persists, it should be aspirated. Physical treatment, especially electrical stimulation of the quadriceps, aids recovery. Rowing on the sliding seat and bicycle riding are two excellent aids to strengthen the thigh muscles.

The treatment called for in any particular patient depends on the estimation of the pathology of the joint condition. The abuse of absolute bed rest should be alluded. Rest may be needed for a day or two if the injury is severe sprain, but prolonged rest has no place in the

in the treatment of most joint injuries (Bristow [13]). The failure to appreciate this point is responsible for many failures in treatment, as rest and fixation lead to the formation of capsular and intracapsular adhesions.

Postoperative immobilization, either in a cast or by traction in a Thomas Splint, is used for a period of one week to ten days. However, in most cases of excision of patella need very little immobilization. Further discussion of length of time necessary for complete recovery will be discussed under end results.

END RESULTS

In the works of Hopkins & Huston [54] in their work at Springfield College, Massachusetts, the end results of injuries suffered in athletics at their institution was determined on the basis of a questionaire covering every abnormality, even of the slightest degree, that had been noticed since the completion of the treatment. They used the following method or basis of classifying the injury and the results of treatment.

Per-	4a	No further difficulty.
fect:	4b	Recurrent for a year or more but complete recovery subsequently.
	3a	Minor abnormality, such as aches in damp weather or numbness.
Good:		
	3b	Minor pain, but not interfering with athletic activity or requiring support.
	2a	Weakness interfering with or requiring a support.
Fair:		
	2b	Occasional slipping, swelling or severe pain, although athletics could still be continued.
	1	Interference with ordinary use or prevention of athletic activities.
Poor:		

Sprain of the lateral ligaments: The time lost from physical exercise varied from none to 16 weeks. The Average was three weeks. One patient was barred from practice for two years. The time required for recovery varied from one week to five years, with the average of twenty-seven weeks. Omitting three cases in which more than two years were required, the average was 9.5 weeks.

Injury of the semilunar Cartilage Treated without Immobilization: The time lost from physical practice varied from none to fourty-eight weeks, with an average of five weeks. The time needed for complete recovery as stated by twenty-one patients was from two weeks to four years, with an average of eleven months. Of the fourty cases treated only in this manner showed 25 % perfect results, 23 % good, 38 % fair, and 15 % poor.

Questionable Injury of the Semilunar Cartilage: The time lost from physical practice varied from 0 to 24 weeks with an average of five weeks. Thirteen patients gave as the time needed for complete recovery between one and thirty-six months. The average was six months.

Injury of the Semilunar Cartilage Treated by Immobilization: The time lost from physical practice varied from one to fourteen weeks with an average of eight. The

interval to complete recovery as stated by fifteen patients varied from one to twenty-four months with an average of five months. The results in twenty-four cases treated by immobilization alone were perfect in 58 % , good in 8 %, fair in 17 %, and poor in 17 %.

Injury of the Semilunar Cartilage Treated by Operation: An attempt was made to correlate the results with various factors. At first there seemed to be little relation between the time from injury to operation and the end result. However, when the cases were divided into three sub-groups the results appeared to be best in the early cases. Of five operations within one month ofethe injury, four gave perfect results, and one fair. In otherwords, 80 % were perfect. This suggests that prompt operation avoids the annoying complications resulting from repeated synovial irritation.

Traumatic Synovitis: These were treated with elastic bandages and spong-rubber pressure. Only one needed aspiration. Ten were on crutches for from one to twenty days with an average of six days. Time lost from active athletics varied from three days to eight weeks, with a median of seven days. Time required for complete recovery was from one to twelve weeks with the average of four weeks.

Sprain of the Lateral Ligament: The treatment consisted of physiotherapy, ace bandage, and crutches. In four the knee was immobilized and eight supported with adhesive strappings. 32 were on crutches for two days to three weeks. The time lost from athletics was from none to sixteen weeks, with an average of three weeks. One was barred for two years. Time required for recovery varied from one week to five years with an average of twenty-seven weeks. Omitting three cases in which more than two years were needed the average was 9½ weeks.

Summerizing their end results in 193 injuries to the knee, 89% of the cases of simple synovitis and 81% of those with a lateral ligament sprain showed good final results. All the patients were able to continue active athletics. The results of semilunar cartilage injury treated by immobilization (46% good) are sufficiently better than those treated merely by bandaging, rest, crutches, and physiotherapy (36% good) to warrant the use of a plaster cast as soon as the diagnosis can be made. The results of conservative treatment are so satisfactory, nearly half being good, that we believe it should be tried in nearly all cases before resorting to operation. Of the cases that still have disabling symptoms the majority can be cured (66% good), and all have been sufficiently improved by operation to engage

in active athletics (Hopkins & Huston [54]).

PART IV

CONCLUSIONS

From this review and personal observations it has been evident that, for the most part, the evaluation of these injuries have been inadequate. It has been too much the practice to hurry the athletes back into the game before the injury has sufficiently healed to prevent recurrence.

The medial meniscus, internal lateral ligament, and the anterior cruciate ligament (in order named) are the most common injuries found. These structures should be considered equally important in function. All the structures show a close inter-relationship in function.

In general, the lesions can be divided into two great clases based on the symptoms of locking. Those conditions causing locking are: lesions of the semilunar cartilage; loose bodies; degenerative lesions of the patella; damage to the retropatellar fat pad; fracture of the tibial spines and xanthomas.

Those conditions not causing locking are: ruptured lateral ligaments; rupture of the crucial ligaments; fracture of the patella; traumatic synovitis either contusion or sprains; and genu recurvatum.

It should again be emphasized that x-ray examinations should be made of every injured joint. Comparison

of these pictures with those of the other knee will aid greatly in differentiation and identification of lesions.

The results of conservative treatment are so satisfactory that we believe that it should be tried in nearly all cases before resorting to operations. This conservative treatment should , however, consist of adequate immobilization to allow firm union of injured structures. The early application of compression bandages have done much to prevent 'water on the knee' and ultimate adhesions.

Operation should be resorted to in all cases that show a poor response to conservative treatment. Those patients operated before one month has expired show better results than those who are allowed to wait. It is better to operate before recurrence of the injury.

Postoperative treatment should consist of physiotherapy, massage, supervised rehabilitation, and general muscule strengthening. A rowing machine with sliding seat or bicycle riding are very good exercises for building up thigh muscles. Supportive braces or bandages should be worn during all athletic activities or perhaps permanently if injury was severe. With early treatment and supportive measures excellent results have been obtained.

A thorough knowledge of these pertinate facts should greatly reduce the injuries causing permanent disability of athletes.

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