Surgery of the Knee Joint

EDITED BY
J. P. Jackson FRCS

and

W. Waugh MA, MChir, FRCS

Surgery of the Knee Joint

EDITED BY

J.P. Jackson FRCS

Emeritus Consultant Orthopaedic Surgeon
Queens Medical Centre
Nottingham

and

W. Waugh MA, MChir, FRCS

Professor of Orthopaedic and Accident Surgery
Medical School
Queens Medical Centre
Nottingham

With illustrations by
G. Lythe BAMAA
Medical Illustrator
Queens Medical Centre
Nottingham

LONDON
Chapman and Hall

First published 1984
by Chapman and Hall Ltd
11 New Fetter Lane, London EC4P 4EE

Printed in Great Britain
at the University Press, Cambridge

ISBN 0 412 23930 2

British Library Cataloguing in Publication Data

Surgery of the knee joint.
1. Knees—Surgery
I. Jackson, J.P. II. Waugh, W.
617'.582 RD561

ISBN 0–412–23930–2

List of Contributors

P. M. Aichroth MS, MB, BS, FRCS	Consultant Orthopaedic Surgeon at Westminster Hospital, Westminster Children's Hospital, Queen Mary's Hospital, Roehampton and Honorary Consultant to the Hospital for Sick Children, Great Ormond Street and Honorary Research Fellow to the Institute of Orthopaedics, London.
D. J. Dandy MA, MB, BChir, FRCS	Consultant Orthopaedic Surgeon at Newmarket General Hospital and Addenbrookes Hospital, Cambridge.
J. W. Goodfellow MB, BS, FRCS	Consultant Orthopaedic Surgeon at Nuffield Orthopaedic Centre and Clinical Lecturer to Oxford University Medical School, Oxford.
J. P. Jackson MB, BS, FRCS	Emeritus Consultant Orthopaedic Surgeon to Harlow Wood Orthopaedic Hospital, Nottingham General Hospital and Nottingham University Hospital, and Clinical Teacher to Nottingham University Medical School, Nottingham.
F. Johnson BSc, MASc, PhD, MIEE, MBES	Formerly Lecturer in Bioengineering, Nottingham University Medical School, Nottingham. Now with Oxford Medical Systems.
J. K. Lloyd Jones MA, MB, BChir, FRCP	Consultant in Rheumatology and Rehabilitation, Harlow Wood Orthopaedic Hospital and Mansfield District General Hospital, and Clinical Teacher to Nottingham University Medical School, Nottingham.
B. J. Preston MB, BS, FRCS, FRCR, FFR, DMRD	Consultant Diagnostic Radiologist, Nottingham University Group Hospitals, Nottingham.

Mrs M. Tew
MA
Statistician, Nottingham University Medical School, Nottingham.

E. L. Trickey
MB, BS, FRCS
Consultant Orthopaedic Surgeon at Royal National Orthopaedic Hospital and Edgware General Hospital, and Dean of Institute of Orthopaedics, London University, London.

W. Waugh
MA, MChir, MB, BChir, FRCS
Professor of Orthopaedic and Accident Surgery, Nottingham University, Nottingham.

J. N. Wilson
ChirM, MB, BS, FRCS
Consultant Orthopaedic Surgeon at Royal National Orthopaedic Hospital (London) and National Hospital for Nervous Diseases (Queens Square), and Surgeon-in-Charge of Accident Unit, Royal National Orthopaedic Hospital (Stanmore), and Consultant Orthopaedic Surgeon to Garston Moor Medical Rehabilitation Centre.

Foreword

The timeliness of this book on arthritis of the knee is unquestionable. In the last decade, the diagnosis and treatment of knee disorders have been brought into a new era, principally by knee replacement and arthroscopy. Both are beautifully covered in the text.

Further, the book is outstanding because Peter Jackson and William Waugh have been a unique team – a partnership – for these many years. Their combined efforts have greatly improved our knowledge of the knee and they have published numerous papers on this joint. Their pioneering procedure of upper tibial osteotomy for degenerative arthritis, first reported in 1968, is a classic.

The material in this book is written by experts in the subject who have achieved international reputations in their respective fields. A complete review of all knee replacements available in the world today would require a two or three volume work. Rather, this book deals with selected topics based on the authors' personal experience and the evaluations are the result of intensive, controlled studies. Among the chapters are unexpected pearls, such as one on restoration of knee flexion. Another on the evaluation of results points out how easily we can be led down the primrose path of false assumptions and false deductions to false conclusions.

This is an extremely readable text. Although it may be presumptuous for an American to comment on the literary style of a book by English authors, the reader will appreciate that the sentence structure is uncomplicated and that, in essence, the book is written in 'plain English'. The

language of the text is direct and to the point, devoid of meaningless superlatives and unnecessary additives. When one is so assailed today by needless technicalities and euphemisms, it is reassuring to see that the patient is fat, not 'obese' or 'overweight'; that he walks, not 'ambulates'.

Jackson and Waugh, the team, have thus put together their own experiences and the personal experiences of their chapter contributors. This makes a text which, as they emphasize in their preface, is basically a collection of essays or monographs. It is not just a summary of the literature, but a report of personal knowledge by the authors of each chapter. It is gratifying that the references cited are up-to-date in a book which has taken much time to prepare.

I recommend this book to all physicians interested in the knee joint. While admittedly written primarily for the orthopedic surgeon, it has great appeal for the clinical orthopedist, the internist, rheumatologist, family physician, and the accident surgeon – in short, for all who strive for medical understanding of the knee as an important functioning unit of the musculoskeletal system.

Mark B. Coventry
Emeritus Professor of Orthopedic Surgery, Mayo Clinic, Rochester, Minnesota, U S A

Preface

During the past five or ten years, orthopaedic surgeons have become increasingly interested in the function of the knee joint and its disorders. In the 1950s there was little successful treatment which could be offered to sufferers from arthritis of the knee and knowledge of the management of athletic injuries was relatively limited. At this time, many considered meniscectomy to be a trivial procedure, although since then an awareness of the importance of the meniscus has gradually developed. The knee is certainly a complex mechanism, but greater understanding has altered the approach to the management and treatment of many of its disorders. Many papers are published and there are now a number of new books (as well as new editions of old favourites) available for the edification and instruction of orthopaedic surgeons.

What then have we to offer? First, our own long-standing interest in osteoarthritis and meniscectomy. Second, the collaboration of a group of colleagues who, although they would not make the claim themselves, have an international reputation for their knowledge of particular disorders of the knee. Although written primarily for orthopaedic surgeons, we hope that this book will also be of value to others interested in the knee joint (for example, rheumatologists, radiologists and bioengineers). The subject matter deals with topical and controversial problems which are relevant to orthopaedic practice in North America and other parts of the world as well as in the United Kingdom.

Many of the chapters have been produced by those who have worked with us at Harlow Wood Orthopaedic Hospital and in Nottingham. We

have, however, also been fortunate that colleagues in other centres in the United Kingdom have written about aspects of the knee of which they have a special interest and experience. It is also a particular privilege to have a foreword written by Dr Mark Coventry of the Mayo Clinic, USA, whom we have known for many years.

Arthroscopic surgery, the management of ligamentous injuries and knee replacement are all subjects of current interest and development. These as well as other related topics, are fully discussed; but we have excluded fractures as outside the scope of this book.

We have, however, not attempted to produce a comprehensive text book but we would like each chapter to be regarded as an essay or monograph which expresses the author's individual opinion. Nonetheless, we intend that the book as a whole should give a coherent and up to date account of methods of diagnosis and management of the most important disorders which affect the knee joint.

We are grateful to other authors and publishers who have given permission for their illustrations to be reproduced, and who are acknowledged at the appropriate places in the text. Most of the diagrams have been drawn by Mr Geoffrey Lythe of the Audio-Visual Department in the Medical School at Nottingham. His experience, clarity of line and, above all, his ability to produce work of a high standard at short notice, have made life a lot easier for us.

Finally, we must thank our contributors, some of whom have put up with a good deal of pressure and badgering. Our publishing editor, Dr Barry Shurlock, and his staff have smoothed out path and imposed a literary house-style of a high standard.

Our two secretaries, Mrs E. Morris and Mrs D. Harrap, have been responsible for all the typing and retyping and have shown admirable patience in the face of the demand for better and better versions to send to our publishers.

J.P. Jackson
W. Waugh

Contents

PART ONE

Anatomy, Biomechanics and Diagnosis

PART ONE

Anatomy, Biomechanics and Diagnosis

CHAPTER 1

Surgical Anatomy

J. P. Jackson

1.1 Limb alignment

An accurate knowledge of what is normal in the anatomy of the knee is necessary in order that abnormalities can be properly assessed. The bones forming the joint have a definite relationship to each other and any departure from this produces alteration in function and leads to secondary changes, which may be progressive if uncorrected. Because of the arrangement of ligaments and muscles, the joint is essentially very stable, but the length of the bones involved leads to considerable magnification of any deforming forces and as a result it is more liable to injury than any other joint in the body.

1.1.1 CORONAL TIBIOFEMORAL ANGLE (CTF) (FIG. 1.1)

The anatomical axes of the femur and tibia are represented by lines drawn down the centre of the diaphyses. These will normally be set at an angle to each other which varies between 4–9° and is known as the coronal tibiofemoral angle (CTF). The higher values occur in the female as a result of the wider pelvis. Variations occur due to abnormalities caused by trauma, disease or dysplasia.

1.1.2 MECHANICAL AXIS (FIG. 1.1)

The mechanical axis is represented by a line joining the centre of the head of the femur to the centre of the ankle joint. Normally this will pass through the centre of the knee joint. In those knees in which there is a lateral deformity, the mechanical axis will be deviated to one or other side of the centre.

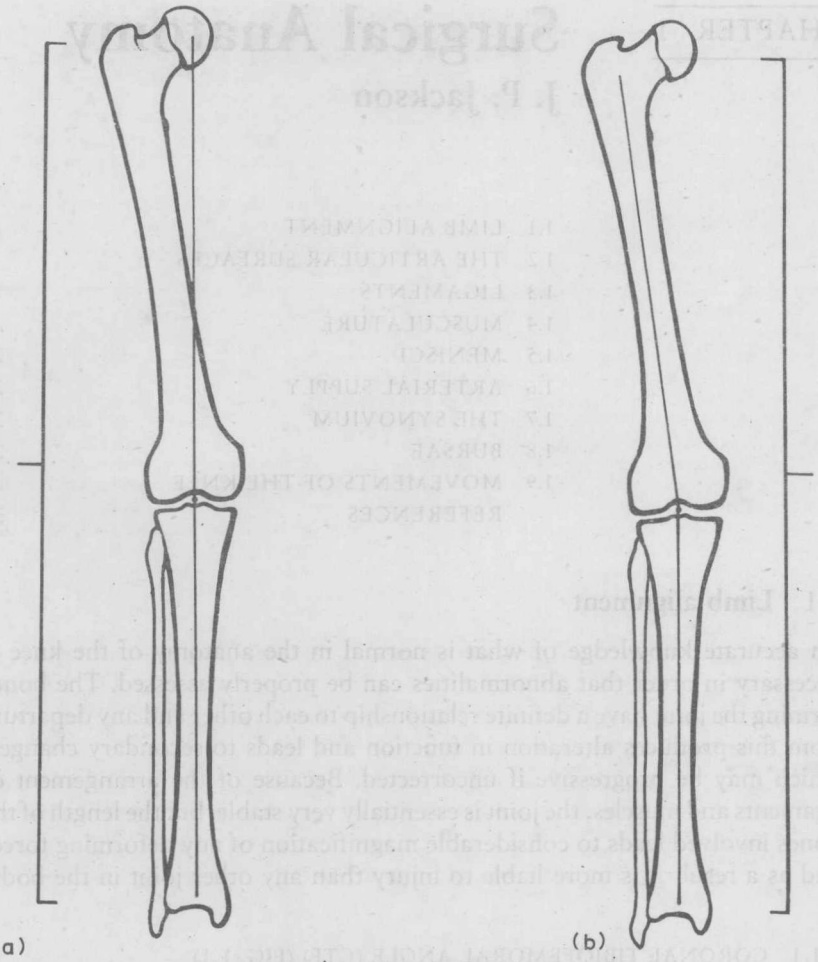

Fig. 1.1 The mechanical axis (*a*) and the coronal tibiofemoral angle (CTF) (*b*).

1.2 The articular surfaces

(a) Femur

The articulating part of the femur consists of two condyles. Posteriorly they are circular and parallel to each other. Anteriorly the two condyles flatten out and the medial inclines towards the lateral side, so that in effect it is the longer of the two condyles (Fig. 1.2). The patellar surface of the lateral condyle is normally rather more prominent than the medial. This prominence varies in size. It may be underdeveloped in patients who suffer from subluxation or habitual dislocation of the patella. On the peripheral surface of the medial

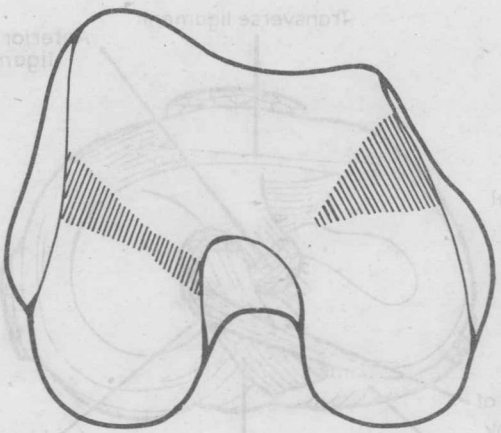

Fig. 1.2 The lower end of the femur showing the V-shaped indentation on the medial femoral condyle and the strip shape on the lateral condyle.

condyle there is a V-shaped indentation. On the lateral condyle the groove is strip-shaped. These indentations are situated at the anterior end of the part of the condyle that articulates with the tibia. Into these indentations the anterior horns of the appropriate meniscus fit when the knee is in full extension. If for some reason there is a fixed flexion deformity of the joint so that there is no contact between these areas and the menisci, then the articular cartilage undergoes degeneration (Tasker and Waugh, 1982). It has also been noted that it is eroded much earlier than the rest of the articular cartilage in inflammatory joint disease (Waugh *et al.*, 1980).

(b) Tibia

The upper surface of the tibia presents two rounded condyles, though the medial is rather more oval in shape (Fig. 1.3). It is also slightly concave from side to side and anteroposteriorly. The lateral condyle, which is more nearly circular, is concave from side to side but has a slight convex contour when viewed anteroposteriorly. It is this convexity which accounts for the fact that rare cases of osteochondritis dissecans occur at this site. Both condyles are covered by articular cartilage and this is further prolonged on to the posterior surface of the tibia towards the medial side.

(c) Patella

The patella articulates with the upper part of the articular surface of the femur to a varying degree, depending on the amount of flexion. It is a sesamoid bone developed in the quadriceps tendon and has the function of making the quadriceps muscle mechanically more efficient. It may also have a secondary role in protecting the front of the joint. There are two facets

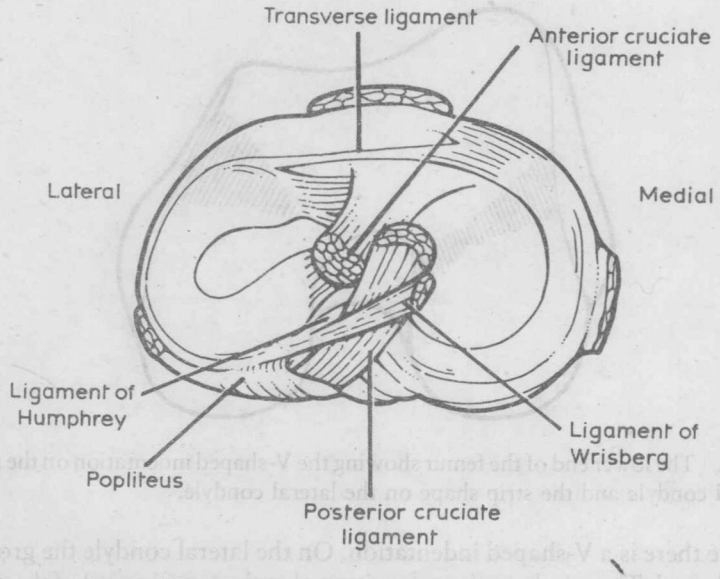

Fig. 1.3 The upper surface of the tibia, showing the menisci, the ligaments of Wrisberg and Humphrey embracing the posterior cruciate ligament. (After Heller and Langman, 1964.)

divided by a median ridge into lateral and medial. The size of these varies in relation to each other. Depending on the ratio between them, Wiberg (1941) classified them into three groups (Fig. 1.4). Reider *et al.* (1981), who investigated a series, found that in the first group (type I), of which the lateral and medial facets were approximately equal, there were 24% of cases. The second group (type II), which is the most common and in which the lateral facet is significantly larger than the medial, was found to be present in 57% of cases. In the third group (type III), in which the lateral condyle was considerably greater than the medial facet, which was almost vertical, there were 19%. Wiberg was of the opinion that chondromalacia was much more common in type III, though this has not subsequently been confirmed. On the medial side of the patella there is a small facet which comes into contact with the femoral condyle only in the last part of the flexion range (the occasional medial facet). It is very probable that the characteristic shape of the patella varies with the forces acting on it and it may be modified in those patients who suffer from congenital dislocation (Green and Waugh, 1968). The patella is further subdivided into an upper, middle and lower facet by transverse ridges running across the articular cartilage and roughly dividing the surface into three equal areas (Fig. 1.5). The lower articulates with the femur only in full extension. As flexion proceeds, the middle facet comes into contact at about 30°. Finally, at about 90° and beyond, the upper facet lies in contact with the femur.