

# Principles of total hip arthroplasty

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**NAS SER EFTEKHAR**

**ILLUSTRATED BY  
ROBERT J. DEMAREST**

# **Principles of total hip arthroplasty**

**NAS SER EFTEKHAR, M.D., F.A.C.S.**

Associate Clinical Professor of Orthopaedic  
Surgery, College of Physicians and Surgeons,  
Columbia University, New York;  
Associate Attending Orthopaedic Surgeon and  
Chief of Hip Service, New York Orthopaedic Hospital,  
Columbia-Presbyterian Medical Center, New York;  
Consulting Orthopaedic Surgeon, Valley Hospital,  
Ridgewood, New Jersey

Illustrated by

**ROBERT J. DEMAREST**

Director of Medical Illustration,  
College of Physicians and Surgeons,  
Columbia University

with **841** illustrations

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To my teacher  
**SIR JOHN CHARNLEY**  
for his  
contributions to orthopaedic surgery

---

# Foreword

I am pleased to write a foreword for this monumental book, *Principles of Total Hip Arthroplasty*, written by one of my most dedicated and successful pupils. Dr. Nas Eftekhar came to me as a postgraduate student to study total hip replacement over eleven years ago and became so immersed in the subject that he doubled his originally proposed stay and evidently has never regretted this.

Eftekhar's book is appearing at a most opportune time; it is a reminder that results of consistently high quality, with a minimum of complications, are obtained only by concentrating on the minutiae of a surgical technique, provided always that the technique itself is well conceived. In this respect it is significant that although total hip replacement has now been "released" for general use for over a decade, many surgeons are still ready to change their methods for the most recent ideas and do this even though no fundamentally new principle may be involved and even though new hazards might lie

ahead. This is the eternal hope for a magic method "which anyone can do."

The reader cannot fail to get the message so well put over by Eftekhar: that success depends on minute attention to originally planned detail. There is no place for mixing different techniques in the hope of getting a hybrid better than the root stock.

But let it not be thought that this foreword is merely complacent. No surgical technique can ever be 100 percent successful, though it is possible that some day total hip replacement might get very near this. We must openly face the weakest aspects of any well-tried technique in efforts to improve in specific directions. Only when we have come to the end of all efforts to improve on specific details will it become reasonable to abandon ten to fifteen years of past experience and submit large numbers of patients to totally new and untried principles.

**Professor Sir John Charnley**

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# Foreword

There has long been a need for a textbook on total hip replacements. Dr. Nas Eftekhar has filled this need. This book is accurately written and includes the history of hip arthroplasty, covering anatomical features, techniques, complications, and follow-up. Dr. Eftekhar has written in a lucid and readable manner. Being meticulous in accuracy, his illustrations are outstanding.

Dr. Eftekhar has limited his work and research to implant surgery and has made several important contributions to the philosophy as well as the biomechanics affecting total hip replacements in the human being. Probably one of the most important contributions is his discussion of the removal of the greater trochanter versus nonremoval. It should be of great interest to all surgeons who do extensive hip surgery. At no

time does Dr. Eftekhar compromise in principle, and his very strong feelings shine through repeatedly in the text.

This book reflects the teacher. Dr. Eftekhar is a very positive, superb, and stimulating teacher both in the clinic and in the operating room. His approach is that of a scholar. I have no hesitancy in stating that this will become a classic text in total hip replacement and will be used by medical students, residents, and hip surgeons.

Dr. Nas Eftekhar is to be congratulated on spending endless hours to present such a fine work, which I believe to be the first comprehensive book on total hip replacement.

**Frank E. Stinchfield**



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# Preface

This text is directed toward the resident in training and the orthopaedic surgeon in practice. It is also intended to provide a reference for the surgeon who is already equipped with an adequate practical apprenticeship in hip surgery.

The title, *Principles of Total Hip Arthroplasty*, is intended to signify a logical basis for "reconstructive hip surgery" rather than to merely describe a method of *hip replacement by prosthesis*. On this ground the patient is treated and not the hip; the patient is considered first, and the hip is reconstructed by individualizing the clinical problem based on anatomical and pathological findings.

Because of the importance of preoperative and postoperative management, eight chapters (Parts two and three) are devoted to methods of evaluation and prophylactic measures with the hope of minimizing complications. Equal importance has been placed on the recognition of postoperative complications, which must be considered thoroughly when recommending elective surgery such as total hip arthroplasty (Part five). In this context, Chapter 8 was constructed to formulate some criteria for patient selection but not with the aim of establishing a "code of practice."

Because of the lack of adequate clinical information at this time, two recent developments are excluded from the text: (1) total hip replacement by the use of porous materials for biological ingrowth and (2) total hip replacement by articular resurfacing. As technology evolves and the long-term clinical findings of these procedures are evaluated, poor results are as likely to be caused by error in the selection of suitable candidates for surgery as by error in surgical technology itself.

This book is based on an unusual large-scale clinical experience. The clinical examples presented throughout the text are from patients I have seen, treated, or consulted, including some patients with prior treatment. No clinical situation is presented or exemplified that did not in fact occur. Good results obtained from total hip arthroplasty are cited throughout the text, but there are also failures that often can be traced to a common cause, that is, patient selection and/or surgical error in technique. It is my hope that this book will in some way help those who are interested in the medical and surgical management of suffering patients afflicted with and handicapped by hip disorders.

Owing to my good fortune and their generosity, a number of outstanding educators, colleagues, and friends graciously reviewed pre-publication drafts of the chapters of this book and gave me their comments and constructive suggestions. The entire text was reviewed by Dr. Frank E. Stinchfield and Sir John Charnley. Chapters 3 and 4 were reviewed by Dr. C. Andrew L. Bassett; Chapters 5 and 9 by Dr. Ralph S. Blume and Dr. Leonard Brand; Chapter 3 by Dr. Vittorio Castelli, Dr. Jorge O. Galante, Dr. Austin D. Johnston, and Dr. Peter Walker; Chapter 7 by Dr. Stuart W. Cosgriff; Chapters 6 and 16 by Dr. Alexander Garcia and Dr. Phillip J. Nelson; the Introduction, "A Historical Note on the Development of Hip Arthroplasty," and Chapters 5 and 9 by Dr. Sawnie R. Gaston; Chapters 7 and 12 by Dr. Thomas Goss; Chapters 13 and 14 by Dr. Hugo A. Keim; Chapters 15 and 17 by Dr. Howard A. Kiernan and Dr. J. Drennan Lowell; and Chapters 1, 2, and 4 by Dr. Charles S. Neer II. It is with great pleasure

## *Preface*

that I thank them for their numerous kind remarks and corrections.

Since the dramatic beginning of the original work of Sir John Charnley, an incredible mass of information, at an almost explosive rate, continues to grow in this challenging field. With newer technology developing and unforeseen problems

arising in clinical situations, innovative solutions are being sought. With this in mind, undoubtedly it will be required that this text be revised in the future.

**N. S. Eftekhari**



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# Acknowledgments

As in all endeavors in life, much help comes from others who contribute but usually are not visible on the scene to receive credit for their efforts.

Foremost among my colleagues I thank my teachers in orthopaedics: Thomas Hunter, F.R.C.S.; Douglas Freebody, F.R.C.S.; Professor Robert A. Robinson, M.D.; Professor Robert D. Ray, M.D., Ph.D.; and Professor Sir John Charnley. It is with great pleasure that I offer my sincere thanks to my teacher, Sir John Charnley, for the encouragement and support he has given me while writing this volume.

With warmest regards I wish to acknowledge my senior colleague, Frank E. Stinchfield, M.D., the former Chief of Orthopaedics at the New York Orthopaedic Hospital at Columbia-Presbyterian Medical Center, for his talent in surgery and his dedication to education and, above all, his devotion to patient care. He will be recorded in the history of surgery for founding two important societies: The Hip Society and The International Hip Society. For his unselfish dedication as an educator, for his guidance, and for his time, despite his enormous work load as president of the American College of Surgeons, in reading this manuscript and making many invaluable suggestions, comments, and constructive criticisms I am indebted.

Among the positive features of this book is the outstanding artwork by my friend Robert J. Demarest. It is my special privilege to thank him for his talent and patience during the long, tireless three years of work that he put into the preparation of the illustrations. He patiently watched, photographed, and sketched many operations

and used much of his extra time in the rendering of the final product by his innovative transparent watercolor technique. He never compromised, he never began to illustrate before mastering the subject, and he never released a work that was not considered perfect. In addition, he supervised the entire artwork of the book by organizing the drawings and x-ray photographs included in the text. I thank him for his superior work. My thanks to Angela Icca LaValle for the graphic art. The photography is by Mr. Renald VonMuchow and Mr. Donald Garbera. Mr. Garbera's outstanding reproduction of radiographs and Mr. VonMuchow's photography of patients, specimens, and histology has added to the visual reproduction in this text. For their excellent work and cooperation I am grateful. Special thanks are due to Cintor Division of Codman & Shurtleff in the United States and Chas. F. Thackary, Ltd. in England for their permission to use the instruments illustrated in this text. My thanks also to Mr. Rudolph Gand for his innovative mind and the technical assistance he has given me in designing and manufacturing the special instruments used in surgery.

I owe a debt of gratitude to Mark G. Lazansky, M.D., and James Pugh, Ph.D., at the Hospital for Joint Diseases for the light and electron microscopy of cement specimens used in Chapter 4. My thanks to my colleague and associate in the Orthopaedic Research Laboratories, Mr. Robert J. Pawluk, who has been extremely helpful to me in my research work and has kindly permitted me to use illustrations of animal experimental work in Chapter 3.

The manuscripts were typed and retyped and

## *Acknowledgments*

edited again and again by Ms. Kathleen (Keen) Bailey. For her talents, grammatical corrections, editing, and hard work, I am grateful. I am also appreciative of additional secretarial assistance by my office secretaries, Mrs. Harriet Miller and Ms. Carrie Wittreich, and part-time assistants, Ms. Maria Voyantes and Ms. Virginia Olsen.

I wish to express my appreciation to the orthopaedic nursing staff and physiotherapists for the excellent care given to the patients both on the floor and in the operating room. Without their dedication and care there would have been no success in surgery. The orthopaedic resident staff and fellows in hip surgery at the New York Orthopaedic Hospital have contributed a great deal to the material presented in this book. They

have assisted me in surgery and have supervised and given superb care to patients. My special thanks to them for their outstanding work. I am equally grateful to the orthopaedic attending staff at the New York Orthopaedic Hospital in asking my opinion in certain unusual cases and allowing me to include some of their cases and results in the studies that have been reported in this text.

I deeply appreciate the love and understanding of my wife, Barbara, and my children, Kimberly and Kirt, in sacrificing so much to allow me to complete this task. Without their support and encouragement this work could never have been finished.

## **Principles of total hip arthroplasty**

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# A historical note on the development of hip arthroplasty

We must welcome the Future, remembering that soon it will be the Past; and we must respect the Past, remembering that once it was all that was humanly possible.

GEORGE SANTAYANA

The philosophies of one age have become the absurdities of the next, and the foolishness of yesterday has become the wisdom of tomorrow.

SIR WILLIAM OSLER

In science the credit goes to the man who convinces the world, not to the man to whom the idea first occurs.

SIR WILLIAM OSLER

Preserved skeletons show that osteoarthritis and rheumatoid disease have afflicted man since earliest times. Half a million years ago, Java man suffered from osteoarthritis of the hip.<sup>20</sup> While a complete citation of historical milestones in the development of surgery of the hip joint is beyond the scope of this book and can be found in other sources,<sup>47</sup> this section briefly explores the groundwork that led to the concept of a movable hip joint and the development of total hip replacement. The history of hip arthroplasty may be considered in five major steps: osteotomy arthroplasty, interpositioning arthroplasty, reconstructive arthroplasty, replacement arthroplasty, and total arthroplasty (bipolar replacement).

## OSTEOTOMY ARTHROPLASTY

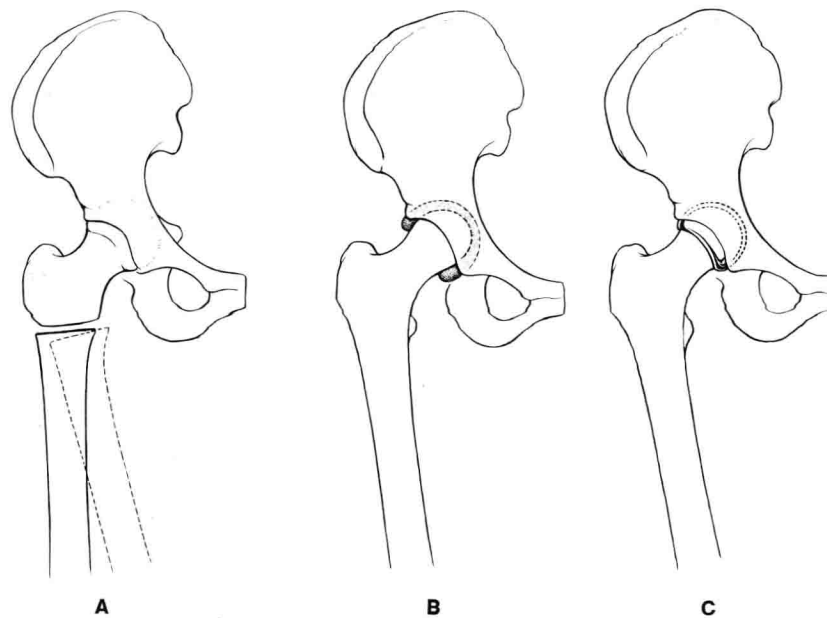
For centuries the problem of rendering an ankylosed hip mobile captured the imagination of surgeons. The first enterprising surgeon of record was John Rhea Barton of Lancaster, Pennsylvania, who performed an osteotomy on an ankylosed hip in 1826.<sup>2</sup> By intertrochanteric osteotomy, he devised an artificial joint that he manipulated 20 days after surgery to maintain

mobility. After 6 weeks the hip joint was mobile, and 3 months later the patient walked with a cane and had functional mobility at the site of the osteotomy. However, 6 years later the hip lost full range of motion. The patient died of pulmonary tuberculosis 10 years later, but it was said that he enjoyed a pain-free functional joint until his death<sup>47</sup> (Fig. 1, A).

In 1863 Sayre<sup>42-44</sup> reported an osteotomy for an ankylosed hip following resection of a bone fragment, which was a modification of Barton's operation.

## INTERPOSITIONAL ARTHROPLASTY

A New York general surgeon named Carnochan used a wooden block between the surfaces of a resected neck of a mandible in 1840,<sup>5</sup> and Verneuil used soft tissue for interpositional arthroplasty in 1860, but it was Ollier's work in 1885<sup>37</sup> that created immense interest in this procedure. By that time, interpositioning materials such as muscle, fibrous tissue, celluloid, silver plates, rubber sheets, magnesium, zinc, and decalcified bone were being used. The interpositioning of these materials between the articulating surfaces was helpful in maintaining



**Fig. 1.** **A**, Osteotomy arthroplasty as first performed by John Rhea Barton, who performed an osteotomy on an ankylosed hip in 1826 in order to maintain motion at osteotomy site. **B**, Example of interpositional arthroplasty performed by Ollier and others in 1885. Numerous interpositioning materials such as muscle, fibrous tissue, celluloid, silver plates, and rubber sheets were used. **C**, First formal Vitallium mold (cup) arthroplasty was performed by Smith-Petersen in 1937.

motion at the site of osteotomy and in preventing recurrence of bone growth. However, continuous motion usually led to ankylosis at the site of arthroplasty.

In the early 1900s Murphy,<sup>35,36</sup> Lexer,<sup>24</sup> and Payr<sup>38</sup> advocated the use of tensor fascia lata muscle for interpositioning arthroplasty, while at the same time Foedral found that pig's bladder was sufficiently strong to withstand the stress of weight bearing and intra-articular pressure. In 1919 Baer<sup>1</sup> popularized pig's-bladder arthroplasty at the Johns Hopkins Hospital.

Skin was used as an interpositioning material in the first decade of this century by Loewe<sup>25</sup> and later by Kallio.<sup>23</sup> During this same period, Sir Robert Jones<sup>21</sup> of Liverpool used gold foil to cover a reconstructed femoral head in femoral arthroplasty.

The popularity of interpositional arthroplasty eventually spread to Italy and Germany. In Italy, Putti<sup>40</sup> used every feasible material available in a large number of patients (Fig. 1, B).

In 1923 Smith-Petersen placed a glass mold in a patient's hip.<sup>48-50</sup> Although it proved too fragile, as did Pyrex and available plastics, the concept of a mold prosthesis had been born and

proved to be a major contribution in the development of hip arthroplasty. In 1937 Smith-Petersen at the suggestion of his dentist, John Cooke, used Vitallium, a cobalt-chromium alloy, as an interpositioning material.<sup>50</sup> This proved to be clinically successful, and the Smith-Petersen mold became a valuable tool in the armamentarium of the orthopaedic surgeon. Thus after half a century of other experimental work, it is Smith-Petersen who must be given credit for proving that the acetabulum will tolerate a foreign body performing a weight-bearing function (Fig. 1, C).

## RECONSTRUCTIVE ARTHROPLASTY

Brackett<sup>3</sup> and Whitman<sup>56,57</sup> described the concept of arthroplasty of the hip joint via reconstruction of the upper femur (Fig. 2, A). Among others, Magnusen,<sup>27</sup> Colonna,<sup>9</sup> Luck,<sup>26</sup> and Wilson<sup>59</sup> modified these reconstructive procedures to suit each individual problem.

Sir Robert Jones<sup>21</sup> popularized a neck osteotomy known as Jones' pseudarthrosis (Fig. 2, B), and Girdlestone<sup>11,12</sup> used resection of the hip joint in order to maintain motion (Fig. 2, C). Charnley's central dislocation-stabilization oper-