BEDSIDE CLINICS IN
ORTHOPEDICS
(Ward Round and Tables)

Upendra Kumar

Forewords
DK Taneja
Anil K Jain
Sudhir Kapoor
BEDSIDE CLINICS IN ORTHOPEDICS
(Ward Round and Tables)

Upendra Kumar
D Ortho (PMCH) DNB Ortho (DDUH)
Guru Gobind Singh Government Hospital
New Delhi, India

Forewords
DK Taneja
Anil K Jain
Sudhir Kapoor

The Health Sciences Publisher
New Delhi | London | Panama
Bedside Clinics in Orthopedics

First Edition: 2017
Printed at
A Tribute to Padma Bhushan
Dr (Professor) B Mukhopadhyay
The Pole Star of Orthopedics

Who was the Founder of Orthopaedic Research and Education Foundation (OREF), India

Dedicated to
My wife Dr Jyoti Bala and kid Gunnu
Photographs’ Contributors

Ajay Rajput    DNB (Ortho)
Senior Resident
Saifai Medical College
Saifai, Etawah, Uttar Pradesh, India

Anand Shankar    MS (Ortho)
Senior Resident
Indira Gandhi Institute of Medical Sciences
Patna, Bihar, India

Anurag Sharma    DNB (Ortho)
Consultant Orthopedic Surgeon
Jalandhar, Punjab, India

Chandan Sekhar    DNB (Ortho) D (Ortho)
Consultant Orthopedic Surgeon
Patna, Bihar, India

Dhingra Surgicals
New Delhi, India

DK Taneja    D (Ortho) MS (Ortho) FAMS
Medical Director and Senior Consultant
Arihant Hospital and Research Centre
Indore, Madhya Pradesh, India

Gitika Khanna    MD (Patho)
Incharge
Central Institute of Orthopedics (CIO) Laboratory
Safdarjung Hospital
New Delhi, India

Govind Ballav Joshi    DNB (Ortho) D (Ortho)
Consultant Orthopedic Surgeon
Jaipur, Rajasthan, India

John Mukhopadhyay    MCh (Ortho) (Liverpool)
Director
Orthopedics and Joint Replacement
Paras HMRI Hospital
Patna, Bihar, India

Khuswant Rathore    DNB (Ortho)
Senior Resident
All India Institute of Medical Sciences
Jodhpur, Rajasthan, India

Kumar Kaushik    MS (Ortho)
Patna, Bihar, India

Naresh Chandra    MS (Ortho)
Head
Department of Orthopedics
Guru Gobind Singh Government Hospital
New Delhi, India

Nitesh Rustagi    MS (Ortho)
Ex-Senior Resident
Guru Gobind Singh Government Hospital
New Delhi, India

Ortholine Meditech
New Delhi, India

Piyush Kumar Singh    DNB (Ortho) D (Ortho)
Consultant
Orthopedic Surgeon
Greater Noida, Uttar Pradesh, India

Preeti Goyal Varshney    MD DNB Anesthesia
Consultant Anesthesiologist
Guru Gobind Singh Government Hospital
New Delhi, India

Sant Prakash Gautam    BPO MPO
Rishikesh, Uttarakhand, India

Shailendra Gupta    MS (Ortho)
Head
Department of Orthopedics
ESI Hospital
Rohini, New Delhi, India

Shailendra Khare    MS (Ortho)
Consultant Orthopedic Surgeon
Safdarjung Hospital
New Delhi, India

Surjit Kumar    BPO
Patna, Bihar, India

Taran Solanki    MS (Ortho)
Consultant
Orthopedic Surgeon
Kashipur, Uttarakhand, India
Foreword

The practical examination is a clinical examination starting from bedside manners to history taking, eliciting clinical signs and making a clinical differential diagnosis. Unfortunately, all these aspects are very much lacking in the present set-up of training. After three years, when students face senior examiners who ask basic questions on clinical examinations, the students start fumbling. In spite of the fact that the student has good theoretical knowledge.

In order to bridge this gap, I have been conducting the special course for postgraduate students. It has become very popular and largely students have very much benefited. Dr Upendra Kumar also attended my course, and at present, he is my youngest faculty member too. What we teach and what all is discussed, has been tried to compile very systematically in a book form.

It is a very good effort by a young orthopedic surgeon. It is commendable indeed. After going through the book, I feel that it will prove very handy and useful. It covers all aspects of the examination, and it will help students to clear their practical examination in a single attempt. In the first phase of the book, Ward Round and Tables is in your hand, and its Clinical Methods and Cases unit will be available very soon.

DK Taneja
D (Ortho) MS (Ortho) FAMS
Medical Director and Senior Consultant
Arihant Hospital and Research Centre, Indore
Ex-Dean and CEO, MGM Medical College, Indore
Ex-Professor and Head, Department of Orthopedics
Mahatma Gandhi Memorial Medical College
Indore, Madhya Pradesh, India
Past President, Indian Orthopaedic Association
Past Secretary General, Orthopaedic Association of SAARC Nations
Secretary, Orthopaedic Research and Education Foundation, India
Secretary General, World Orthopaedic Concern
I am extremely happy to write the foreword of *Bedside Clinics in Orthopedics (Ward Round and Tables)*. I have known Upendra Kumar, when he used to attend postgraduate courses for his DNB training. His questions used to reflect the confusion in the mind of orthopedic trainees on getting variable responses to the same question. The practical training in orthopedics includes day-to-day patient care procedures, performed in ward/outpatient/operation theater. It is quite common to get a variable answer to the same question in ward round, practical examinations and viva voce. Through this book, he has tried to crystallize the answers to such practical training issues.

Orthopedics as a subject has grown exponentially. The trainee not only has to learn theoretical knowledge but also to acquire psychomotor skills with a clear understanding of its rationale. There exists a lacuna in the current educational resource material on practical training subjects. The learning resources on the subjects of clinical/practical importance are not being updated and available as one book. The author has attempted to fill the vacuum.

The book is divided into eight sections—Ward Round, Table of Instruments and Implants, Table of Orthopedic Radiographs, Table of Orthosis and Prosthesis, Bone, Joint Model and Specimen, Orthopedic Surgical Approaches, Operation Theater and Sterilization, and Glorious History of Orthopedics. Each section has been broken into multiple subject titles, and each subject title is given a theoretical knowledge, practical application with rationale. This format will not only improve the understanding of practical procedures performed day-to-day by orthopedic trainees but also improve the treatment outcomes.

I am sure this book will not only be useful to all orthopedic trainees but will also be a guide for practicing orthopedic surgeons.

Anil K Jain
MS MAMS FAMS FRCS (England)
Director Professor and Head
Department of Orthopedics
University College of Medical Sciences and Guru Teg Bahadur Hospital
New Delhi, India
Past President, Indian Orthopaedics Association
Ex-Editor, Indian Journal of Orthopaedics
Deputy Editor, Journal Bone and Joint Surgery (Am)
Visiting Professor
The Tamil Nadu Dr MGR Medical University
Chennai, Tamil Nadu, India
The standard of postgraduate education in India, unfortunately, is not uniform. This holds true for both Medical Council of India (MCI) and National Board of Examination (NBE) run courses. Students at few centers are relatively at a disadvantageous position for educational purposes. Though this will is there, but appropriate educational material is not there. I am referring to paucity of basic educational material which is focused for our students in India, to clear their examinations.

The effort, made by Dr Upendra Kumar, in this regard becomes significant in view of the above observations. He has been able to provide a concise compilation in the form of a book for postgraduate students in orthopedic surgery, for their postgraduate exit examination.

I must also appreciate the sincerity of Dr Upendra in this regard. He, though not working on a teaching faculty position in a medical college, has succeeded in bringing out the book because of his sheer devotion to the cause.

I am sure this book, which is focused, well compiled and nicely laid out, would be received well by the orthopedic postgraduate students.

Sudhir Kapoor
MS Ortho
Dean
ESI-PGIMSR and Hospital, New Delhi
Ex-Head
Department of Orthopedics
Lady Hardinge Medical College, New Delhi
Visiting Professor
The Tamil Nadu Dr MGR Medical University, Chennai, Tamil Nadu
Member
Research Board, Aligarh Muslim University and Banaras Hindu University, Uttar Pradesh, India
President, Indian Orthopaedic Association
Rightly said, the most of the useful and valuable things have been invented in difficult and demanding situations. In the same manner, the cornerstone of this book has been laid down during those harsh conditions when orthopedic postgraduates (DNB) students were not getting success even after their 2nd or 3rd attempts of their practical examination in different parts of the country.

By discussing these issues with Dr DK Taneja (Indore), Dr VK Goyal (New Delhi) and Dr VK Sinha (Patna); we started to construct a treatise that can guide our DNBs, masters and diploma students in proper direction and lighten the pathway of success. The preparation of this book is also influenced by Orthopaedic Research and Education Foundation (OREF), India, established by Dr B Mukhopadhyay. This foundation is working continuously for orthopedic education for postgraduates throughout the country. We have prepared the book not for commercial purposes but as contribution in the field of orthopedics.

The book stands up to the mark, which is informative, illustrative, comprehensive and with sufficient content. Although the facts included in the book are obtained from various sources, hence, we are thankful to all orthopedic personnel and publishers throughout the globe, who have given their direct or indirect contribution in this regard. Hence, please do not look this issue as copyright, but treat it as your contribution if any.

The present edition contains ward rounds and tables, instruments and implants, orthopedic radiographs, orthosis and prosthesis, bone, joint model and specimen, surgical approaches along with principle of operation theater and sterilization, and glorious history of orthopedics. We are coming soon with its clinical version including history taking, clinical methods, long and short cases and important viva voce questions. Although this is clinical notes; hence students are requested to always go through standard textbooks.

Despite of meticulous corrections, there might be possibility of human error. Useful critics and suggestions are always invited from teachers, seniors, colleagues and juniors to make it more productive and fruitful. This is also a time to remember the living legends of orthopedics of India such as Dr Shailendra Bhattacharya (Kolkata), Dr Surendra Mohan Tuli (Delhi), Dr GS Kulkarni (Miraj), and Dr Hardash Singh Sandhu (Amritsar). Our generation is fortunate to have such great orthopedicians.

In the last, I express my heartiest gratitude to the Chairman (Dr John Mukhopadhyay) and Secretary (Dr DK Taneja) of OREF, who always provided a back support on this project. I also thank my colleagues of Patna Medical College, Patna, and Deen Dayal Upadhyay Hospital, New Delhi, for their constant support and supply of material for this cause.

Finally, I offer this book to the young buds of orthopedic world with a big salute to my all teachers throughout the country.

Upendra Kumar
The present examination systems are made to judge the clinical knowledge of students, but they are caught in very trivial things. This book serves the purpose of the students, especially for the examination. Every student undertaking the examinations of different levels such as diploma, degree or DNBs must go through this book to get the feel of the examination prior to facing the examiner.

VK Sinha
Head
Department of Orthopedics
Patna Medical College and Hospital
Patna, Bihar, India

For a long time, there was a need for a book which can help our postgraduates in practical examinations when they have gone through ward round and tables and viva voce. Because it needs an exhaustive collection of material from different sources. I would like to congratulate Dr Upendra, who understood these problems and wrote a title over it.

Alok C Agrawal
Head
Department of Orthopedics
All India Institute of Medical Sciences
Raipur, Chhattisgarh, India

Students should learn the proper methodologies of patient examination, ward care and other wings of practical knowledge. This book stands out and provides comprehensive information required for practical examination for orthopedic postgraduates when they gone through ward round and tables viva voce. Students will find this book very useful and informative.

VK Goyal
Former Head, Department of Orthopedics
Deen Dayal Upadhyay Hospital
New Delhi, India

Most of the practical issues of orthopedics such as ward care, interpretations of X-rays, knowledge of instruments and implants, etc. are missed or forgotten by postgraduates. One of the surest ways to recover these lost things is going through this book. Added on to it are some critical insights which would be benefiting to those who aspire more. The way of delivery is very simple in this text, hence, postgraduates can easily reproduce it in their examinations.

Dileep Basu Mazumdar
Head
Department of Orthopedics
Malda Medical College and Hospital
Malda, West Bengal, India
First of all, I would like to congratulate Dr Upendra Kumar, who realized the various practical problems of postgraduates and residents throughout the country. This book will not only introduce the budding orthopedic doctors to basic inpatient management but also help them for their postgraduates practical tables viva voce. It will prove a ready-reckoner for seniors also. I congratulate him for his serious efforts.

RC Meena
Head
Department of Orthopedics
SMS Medical College and Hospital
Jaipur, Rajasthan, India

I am happy to know that Dr Upendra Kumar, a young dynamic orthopedic surgeon, who is my student also, has prepared a treatise *Bedside Clinics in Orthopedics (Ward Round and Tables)*. It is a beautiful collection of various practical materials being used in day-to-day practice. I sincerely hope that this new book will be helpful not only for postgraduate students who want to pursue MS/DNB orthopedic course but also for residents and junior specialists.

S Keshkar
Head
Department of Orthopedics
PGIMSR and ESI Hospital
Kolkata, West Bengal, India

*Bedside Clinics in Orthopedics (Ward Round and Tables)* has been prepared for postgraduates to improve their practical knowledge of orthopedics. It is like a gift by Dr Upendra Kumar for exam-going postgraduates and DNB candidates. Residents may also be benefitted with this treatise.

CP Pal
Head
Department of Orthopedics
SN Medical College
Agra, Uttar Pradesh, India

I would like to congratulate Dr Upendra for lifting such a responsibility on his young shoulder. In the first look, one can say how much time and hard work have been spent to prepare this ready reckoner. The chapters of the book are arranged in a beautiful manner and ornamented with many original photographs. It comes under the category of must-have books. Side-by-side, it is an excellent finisher like MS Dhoni for postgraduates and residents too.

Lalit Maini
Associate Professor
MAMC and LNJP Hospital
New Delhi, India
I passed my DNB (secondary) practical examination held in June 2016. I used the raw material form, which is now in the book form, and answered my examiner confidently. It appears that hardly any important thing has been left that is expected from a postgraduate trainee. It was a game changer for me and I hope it will be a pathfinder for many others. Thank you sir.

K Dinesh
Erode, Tamil Nadu, India

After getting the material what have taken a form of a book now, I got an outlook of a professional preparation. More so, they are presented in such a nice pattern that it was very easy to grasp. I had very little time for practical, so I solely read this material, and surprisingly, I could not only answer most of questions in viva voce but also cleared examination in the 1st attempt. I feel this book is for all DNB and MS candidates. Thanks a lot sir.

Piyush Prabhat
Patna, Bihar, India

It is an ultimate material for postgraduates. My DNB practical result in the first attempt is its proof. I have never seen such kind of practical book where you can find all practical materials in one, which not only helps you in examination but also it increases your knowledge of orthopedics. I say, very thanks to Dr Upendra sir for creating such a valuable book with his hardwork.

Rajiv Munde
Mumbai, Maharashtra, India

Sir, I am thankful to you for such a great collection of material under one cover. Every postgraduate trainee must be acquainted with this basic knowledge. This preparation helped me to crack tough nut, i.e. DNB practical examination. I would like to recommend this book to every orthopedic postgraduate for his/her success.

Amitosh Mishra
Lucknow, Uttar Pradesh, India
I am deeply indebted to Dr Upendra Kumar’s Bedside Clinics in Orthopedics (Ward Round and Tables). It is the most comprehensive and yet concise compilation of orthopedic practical material for postgraduates. It boosted my confidence and helped me to clear my practical examinations in the first attempt.

Naman Wahel
Bikaner, Rajasthan, India

What I am at present is only due to focused guidance of Dr Upendra Kumar and his book prepared for ward round and tables. When I passed that was my third attempt for DNB practical examination and I had a time of only one month for it. I got my success in this hard time only due to Dr Kumar’s effort and guidance.

Afzal
Uttar Pradesh, India
Working in Kuwait

I felt lucky to read this book before its launch and it did wonders for me. This book is very well written, and includes most of the information required to master practical examination. Simple and crisp language makes it very easy-to-read and understand. This is must and best available book needed to clear any orthopedic practical examination.

Rahul Goyal
Alwar, Rajasthan, India

I have used this book before its launch. This book has been nicely compiled with great hard work. It has been judiciously divided into different table viva voce and ward round. It is a collection of almost everything needed for practical examination. It will prove to be a milestone in the journey of orthopedic books.

Sunny Chaudhary
Shamli, Uttar Pradesh, India
Contents

Section 1: Ward Round

1. Casting Materials and Orthopedic Casts
   - Plaster of Paris Bandage
   - Fiberglass Plaster
   - Stockinette
   - Cotton Roll
   - Cotton Roller Bandage
   - Principle of Reduction and Casting
   - Casting in James Position (Radial Gutter, Ulnar Gutter and Volar Splintage with POP)
   - Scaphoid Cast and Thumb Spica
   - Colles' Cast
   - U-slab or Cast
   - Above Elbow Cast
   - Shoulder Spica
   - Below Knee Cast and Boot Cast
   - Cylindrical Cast
   - Above Knee Cast
   - CTEV Cast—a Functional Cast Bracing: (A Sarmiento 1963)
   - PTB cast—a Functional Cast Bracing
   - Walking Heel (Rubber)
   - Walking Iron
   - Pin Plaster Technique
   - Hip Spica
   - Wedging of Cast
   - Making a Window in Cast
   - Bivalving of Cast
   - Slitting of Cast
   - Checklist for Casting

2. Dressing Materials
   - Objective of Dressing
   - Layers of Dressing
   - Cotton Gauze
   - Gauze Roll and Dressing Pad
   - Elastic Bandage (Crepe Bandage)
   - Adhesive Surgical Tape
   - Tincture Benzoin
   - Magnesium Sulfate Cream (Magsulf/Sumag)
   - Paraffin Gauze (Jelonet/Sofra-Tulle)
   - Alginites (Algisite-M)
   - Hydrocolloids (Duoderm)
   - Hydrogen Peroxide (H2O2)
   - Savlon (Tartrazine Yellow Color)
   - Dettol (Light Yellow Color)
   - Surgical Spirit
   - Chlorhexidine Solution
   - Edinburgh University Solution of Lime (Eusol)
   - Oxofrin Solution
   - Silver Ions Solution (Quiron)
   - Placenta Extract (Placentrex)
   - Collagen Granules and Collagen Sheet (Collawound)
   - Antibiotic of Topical Use
   - Dressing Trolley
   - Cut Open Tray
   - Cidex-tray
   - Pus Culture Tube

3. Orthopedic Strappings, Bandages and Slings
   - Finger and Toes Strapping (Buddy Taping)
   - Arm Chest Strapping (Velpeau)
   - Jones Strapping
   - Chest Strapping
   - Bandaging Around Ankle and Wrist
   - Robert Jones Bandage
   - Figure of 8 Bandage
   - Ball Bandaging
   - Sling in Orthopedics

4. Orthopedic Traction and their Equipment
   - Cramer's Wire (Ladder Splint)
   - Bohler Braun Splint (Bohler Austrian Surgeon)
   - Thomas Splint (Robert Jones)
   - Bohler's Stirrup
   - Buck's Pulley
   - Tensionizer/Tensioner/K-wire Strainer
   - Traction
   - Fixed Traction
   - Sliding Traction
   - Skin Traction
   - Bryant's/Gallow's Traction
   - Dunlop's Traction
   - Skeleton Traction
   - Lateral Upper Femoral Traction
   - Distal Femoral Traction
   - Upper Tibial Traction
   - Distal Tibial Traction
   - Calcaneal Traction
   - Olecranon Traction
   - Metacarpal Traction
   - Axial Traction (Cervical and Pelvic)
   - Head Halter Traction
   - Pelvic Traction
   - Cervical Skeletal Traction
   - Special Type of Traction in Lower Limb
   - Boot and Bar
   - Charnley's Traction Unit
   - Ninety-ninety Traction (Obletz
5. Patients on External Fixators

Pin Fixator AO Type Fixator 48 • Limb Reconstruction System 50 • Ilizarov System 50 • Taylor Spatial Frame 53 • Joshi External Stabilization System 53

6. Miscellaneous Equipment

Orthopedic Bed with Balkan Frame or Bim 54 • Air Mattress 54 • Compression Stockings 55 • Pneumatic Compression Device 55 • Triflow Incentive Spirometer 55 • Vacuum-assisted Closure Device: GS Kulkarni Machine for Vacuum-assisted Dressing 56 • Surgical Drain 57 • Foley’s Catheter with Urobag 58 • Intercostal Drainage/Chest Tube 59 • Different Parenteral Fluids 59 • Blood and Blood Products 59 • Intravenous Drip Set 60 • Intravenous Cannula 60 • Syringe and Needle 61 • Segregation of Biomedical Waste 62 • Checklist for Postoperative Round 62 • Checklist for Preparation of Ward Round 62

Section 2: Table of Instruments and Implants

7. Tourniquet and Esmarch’s Bandage

Tourniquet and Esmarch’s Bandage 65

8. General Surgical Instruments

Towel Clips 68 • Bard-parker Knife Handle with Detachable Blade 68 • Artery (Hemostatic) Forceps 69 • Allis Forceps 69 • Rampley’s Sponge Holding Forceps 70 • Cheatie’s Forceps (Sister’s Forceps) 70 • Scissors 70 • Needle Holder 71 • Dissecting Forceps 72

9. Surgical Retractors and Bone Levers

Langenbeck’s Right Angle Retractor 73 • Czerny’s Retractor 73 • Hook Retractors 73 • Hohmann’s Retractor 74 • Lane Bone Lever 74 • Bristow’s Retractor 75

10. Bone Cutting and Related Instruments

Osteotome (Stille Type) 76 • Bone Chisel (Stille Type) 76 • Bone Gouge (Stille Type) 77 • Bone Cutter 77 • Laminectomy Forceps 77 • Bone Nibbler (Rongeur) 78 • Scoop or Curette (Volkmann’s Type) 78 • Corticotomy 78 • Periosteal Elevator (Farabeuf’s Type) 78 • Gigley’s Saw 79 • Amputation Saw 79

11. Bone Holders and Plate Holding Instruments

Bone Holders 80 • Reduction Clamp/Forceps 80 • Heygrove’s Bone Holders 80 • Lane’s Bone Holders 80 • Burn’s Bone Holders 81 • Mani’s Clamp 81 • Lowman’s Clamp 81 • Verbrugge’s Self-centering Bone Holding Forceps 81 • Patella Bone Holding Clamp 82 • Periarticular Reduction Clamp 82 • Pelvic Reduction Clamp: Matta type and Dingman type 82

12. Bone Piercing Instruments and Screwdrivers

Bone AWL: Kuntscher’s Diamond Pointed AWL 84 • Bradawl (Cobbler’s AWL) 84 • Drill Bit 84 • Counter Sink 85 • Bone Tap 85 • Drill Guide/Sleeve 85 • Intramedullar Reamers 86 • Screwdrivers 86
13. SS-wire and K-wire Handling Instruments  87
   Orthopedic Pliers  87 • Wire and Pin Cutter  87 • SS-wire Tensionier  88
   • SS-wire Sleeve (Wire-passer)  88 • K-wire Bender  89 • K-wire Inserter  89

14. Miscellaneous Orthopedic Instruments  90
   Mallet  90 • Orthopedic Drill Machine  90 • T-handle with Jacob’s Chuck and
   Key  90 • Depth-gauge  90 • Bone (Kocher’s)  91 • Bone Graft Impactor  92
   • Bone Filler  92 • Hollow Mill  92 • Wrench or Spanner  92 • Dynamometer  93
   • Allen Key  93 • Femoral Distractor and Distal Radial Distractor  93 • Sequestrum
   Forceps  94 • Cartilage (Martin’s) Holding Forcep  94 • Tendon Stripper  94 • Humby’s
   Knife  95 • Measuring Instruments  95 • Plaster Cutting Instruments  95

15. Special Instruments for Plating and Nailing  97
   Plate Bender  97 • Müller Compression Device  97 • Zig for Locking
   Plate  98 • Intramedullary Nail Introducer  98 • Zigs for Nail Insertion  98
   • Nail Extractors  99 • Broken Nail Extractor  99

16. Key Instruments for DHS and DCS  100
   Guidewire  100 • Angle Guide  100 • Triple Reamer  100 • Direct Measuring
   Device  100 • DHS Tap  101 • Wrench  101 • DHS Screw and Plate Assembly  101

17. Key Instruments for Spine Surgery  102
   Cobb’s Elevator  102 • Self-retaining Spinal Retractors  102 • Rib Retractor  103 • Doyen’s
   Rib Raspatory  103 • Rib Shear  103 • Kerrison’s Rongeurs  104 • Dura and Nerve Root
   Retractors  104 • Discectomy (Codman’s) Forceps  105 • Pedicle AWL  105 • Pedicle
   Probe  106 • Pedicle Sound  106

18. Key Instruments for Hip Hemiarthroplasty  107
   Charnley’s Self-retaining Initial Retractor  107 • Corkscrew (Judet)
   107 • Head Measuring Gauze  108 • Box Chisel  108 • Rasp/Broach with Tommy
   Bar  108 • Murphy Skid  109 • Head Impactor  109

19. Key Instruments for Arthroscopy  110
   Arthroscope  110 • Probe  110 • Scissor  110 • Basket Forceps  111
   • Grasp Forceps  111 • Arthroscopic Knives  111 • Shaver System  111

20. Pins, Wires and Tension Band Wiring  112
   Steinmann Pin  112 • Denham Pin  112 • Screw Eye  112 • Schanz
   Screw  113 • Kirschner’s Wire  113 • Stainless Steel Wire  114 • Tension Band Wiring  114

21. Orthopedic Screws  115
   Screw description  115 • Comparison between AO and Machine Screw  116 • Cortical
   and Cancellous Screw  116 • Lag Screw  116 • Herbert Screw  117 • Acutrak
   Screw  117 • DHS Sliding Screw  117 • Malleolar Screw  118 • Locking Screw or Locking
   Head Screw  118 • Interlocking Bolt  118 • Some Other Functions of Screw  118 • Various
   Screw Types and Drill Bits  119

22. Orthopedic Plating  120
   Bone Plate  120 • Dynamic Compression Plates: (Allgower 1960)  121 • Tubular
   Plates  122 • Locking Plate  122 • Reconstruction Plates  123 • Stress and Strain in
   Relation to Bone and Implant  124 • Various Regional Plates  124
23. Orthopedic Nailing  
Intramedullary Nail 127 • Rush Nail 128 • Talwalkar’s Square Nail 128 • Ender’s Nail 128 • Kuntscher’s Cloverleaf Nail: (Gerhard Kuntscher from Germany) 129 • Kuntscher’s V Nail 129 • Interlocking Nail 130

24. Special Implants Around Hip  
Austin Moore’s Pin and Knowles Pin 132 • Cannulated Cancellous Hip Screw 132 • Dynamic Hip Screw Plate 133 • Dynamic Condylar Screw Plate 134 • Comparison between Short and Long PFN 134 • Angled Blade Plate (130° and 95°) 135 • Identification of Some Historical Implants 135

25. Spinal Implantation  
Steffee Spine Plate and Screw 137 • Hartshill Ring/Frame and Drummond Wire 137 • Harrington Rod with Hook 137 • Pedicular Screw and Connecting Rod 138 • Anterior Spinal Locking Plate and Screw 138 • Spinal Cage 139

26. Osteotomy Fixation and Epiphysiodesis Implants  
Wainwright Plate, Kissel Spline, Tupman Plate 140 • 90° Osteotomy Blade Plate 140 • 120° Double Angle Osteotomy Blade Plate 141 • 120° Double Angle DHS Plate 141 • Coventry Staple 141 • Blount’s Epiphysiodesis Staple 141 • Figure 8 Plate 142

27. Arthroplasty Implants  
Unipolar Hip Prosthesis: Austin-Moore and Thompson Prosthesis 143 • Talwalkar’s Bipolar Prosthesis 144 • Total Hip Arthroplasty Implant 144 • Total Knee Arthroplasty System 146 • Neer’s Shoulder Prosthesis 146 • Total Shoulder Arthroplasty System 147 • Total Elbow Arthroplasty System 147

28. Special Implants for Arthrodesis  
Charnley’s Clamp 148 • Cobra Plate for Hip Arthrodesis 148 • Long Interlocking Nails 148 • Other Implants used for Arthrodesis 149

29. Some Implants for External Fixators  
Components of AO External Fixator Frame: (ME Muller-1952) 150 • Components of Ilizarov’s Ring Frame and Jess Fixator 151 • Components of JESS Frame 151

30. Miscellaneous Materials  
Suture Materials, Needles and Knots 154 • Bone Cement 157

Section 3: Table of Orthopedic Radiographs

31. Radiographs of Fracture  
Preliminary Knowledge for Study of Fracture X-ray 161 • X-ray: Etiological Classification of Fracture 161 • X-ray: Fracture Patterns and Mechanism of Injury 162 • X-ray: Pediatric Fracture 164 • X-ray: Periarticular Fractures 165 • X-ray: Pathological Fractures 166 • X-ray: Peri-implant Fracture 166

32. Radiographs of Tumor  
Description of a Tumor Radiographs 168 • X-ray: Osteochondroma 170 • X-ray: Osteoid Osteoma 170 • X-ray: Enchondroma/Chondroma 171 • X-ray: Simple Bone
33. Radiographs of Infective and Rheumatic Disorders 177
X-ray: Chronic Osteomyelitis 177 • X-ray: Osteoarticular Tuberculosis 178
• X-ray: Degenerative Arthritis 178 • X-ray: Rheumatoid Arthritis 179
• X-ray: Ankylosing Spondylitis 179

34. Radiographs of Metabolic and Osteochondritic Disorders 181
X-ray: Nutritional Rickets 181 • X-ray: Scurvy 182 • X-ray: Osteomalacia 182
• X-ray: Osteoporosis 183 • X-ray: Primary Hyperparathyroidism 183 • X-ray:
Myositis Ossificans 184 • X-ray: Osteogenesis Imperfecta 185 • X-ray: Kienbock’s
Disease 186 • X-ray: Scheuermann’s Disease 186 • X-ray: Osteochondritis Desicans of
Knee 187

35. Radiographs of Special Surgical Procedure 188
X-ray: Total Hip Arthroplasty 188 • X-ray: Total Knee Arthroplasty 189 • X-ray:
Total Shoulder Arthroplasty 190 • X-ray Elbow Arthroplasty 191 • X-ray: Valgus
Osteotomy Proximal Femur 192 • X-ray: Medial Displacement Osteotomy 193 • X-ray:
Proximal Tibial Osteotomy 193 • X-ray: Epiphysiodesis Around Knee 194 • X-ray: Hip
Arthrodesis 195 • X-ray: Knee Arthrodesis 196 • X-ray: Ankle Arthrodesis 196 • X-ray:
Shoulder Arthrodesis 197 • X-ray: Elbow Arthrodesis 198 • X-ray: Wrist Arthrodesis 199

Section 4: Table of Orthosis and Prosthesis

36. Basics about Orthosis 203
Functions 203 • Classification (Anatomical Basis) 203 • Classification (Mechanical
Basis) 203 • Material 204 • Criteria of a Good Orthosis 204 • Complications 204

37. Lower Limb Orthosis 205
Foot Orthosis 205 • Ankle-foot Orthosis Design 208 • Knee Orthosis and Knee
Joints in Lower Limb Orthosis 209 • Knee-ankle-foot Orthosis 211 • Hip-knee-ankle
Orthosis 212 • Special Orthosis for Lower Limb 213

38. Upper Limb Orthosis 218
Hand Orthosis 218 • Wrist Hand Orthosis 219 • Elbow Orthosis 221
• Shoulder Orthosis 221 • Special Orthosis in Upper Limb (Turn Buckle Splint) 223

39. Spinal Orthosis 224
Cervical Orthosis 224 • Extended Cervical Orthosis 226 • Thoracolumbosacral
Orthosis 228 • Lumbosacral Orthosis 229 • Special Orthosis for Scoliosis: Milwaukee and
Boston Brace 230

40. Basics about Prosthesis 232
Prosthesis Definition 232 • Functions of Prosthesis 232 • Classification
of Prosthesis (Anatomical Basis) 232 • Classification of Prosthesis (on the
Basis of Fabrication) 232 • Classification of Prosthesis (on the Basis of Time of
Wearing) • Immediate Postoperative Prosthesis • Material for Prosthesis Fabrication • Criteria of a Good Prosthesis • Complications of Prosthesis

41. Lower Limb Prosthesis
Components of Lower Limb Prosthesis • Prosthetic Foot • Prosthetic Shank • Prosthetic Socket and Suspension • Prosthetic Knee Joint • Prosthetic Socket and Suspension • Stubbies and Leg Extension Prosthesis

42. Upper Limb Prosthesis
Component of Upper Limb Prosthesis • Power System • Terminal Devices • Forearm Section • Prosthetic Socket • Myoelectric Prosthesis

43. Mobility Aids for Patients
Wheelchair (Second Home for Paraplegics) • Standard Walking Frame (Walker) • Rollator Walking Frame (Walker on Wheels) • Axillary Crutches • Elbow Crutches (Lofstrand Crutch) • Gutter Crutch • Walking Sticks • Tripod and Quadripod Walking Aid • Crutch Gait

Section 5: Table of Bone, Joint Model and Specimen

44. Basics about Bones and Joints
Composition of Bone • Parts of Bone • Blood Supply of Long Bone • Periosteum of Bone • Developmental (Microscopic) Classification of Bone • Adult Bone Classification • Growth Plate (Physis): Conventionally Called Epiphyseal Plate • Types of Epiphysis • Bone Formation and Growth Pattern • Normal Bone Turnover • Fracture Healing • Joint • Classification of Joint • Functions of Joint

45. Bones and Joints of Upper Limb
Clavicle • Scapula • Humerus • Radius and Ulna • Bones of Wrist and Hand • Shoulder Joint • Elbow Joint • Wrist Joint

46. Bones and Joints of Lower Limb
Pelvic Bone • Femur • Patella • Tibia and Fibula • Bones of Ankle and Foot • Hip Joint • Knee Joint • Ankle Joint

47. Bones and Joints of Spine

48. Specimen Section
Proceeding for Specimen Section • Dissected Specimen of Elbow • Dissected Specimen of Wrist and Hand • Dissected Specimen of Knee • Dissected Specimen of Ankle and Foot • Specimen of Bony Sequestrum • Specimen of Pott’s Spine • Specimen of Menisci • Specimen of Loose Bodies • Specimen of Osteochondroma • Specimen of Giant Cell Tumor • Specimen of
Section 6: Orthopedic Surgical Approaches

49. Shoulder and Arm
- Shoulder: Anterior Approach (Deltoidectomy Approach)
- Arm: Anterior/Antero-Lateral Approach of Arm

50. Distal Arm, Elbow and Proximal Forearm
- Elbow: Posterior Approach of Elbow
- Elbow: Lateral Approach (Kocher’s Approach)
- Elbow: Anterior Approach
- Elbow: Medial Approach

51. Forearm, Wrist and Hand
- Forearm: Anterior Approach to Radius (Henry’s Approach)
- Forearm: Posterior Approach to Radius (Thompson Approach)
- Forearm: Posterior Approach to Ulna (Boyd’s Approach)
- Wrist Joint: Volar Approach for Scaphoid
- Wrist Joint: Dorsal Approach for Scaphoid

52. Spine
- Cervical Spine: Anterior Approach to Cervical Spine (Southwick and Robinson Approach)
- Dorsal Spine: Transthoracic Approach
- Dorsal Spine: Costo-Transversectomy

53. Pelvis, Hip and Thigh
- Pelvis: Anterior Approach (Ilioinguinal Approach)
- Pelvis: Posterior Approach (Kocher-Langenbeck)
- Hip: Anterior Approach (Smith-Peterson Approach)
- Hip: Posterior Approach (Moore’s or Southern Approach)
- Hip: Lateral Approach (Hardinge Approach)
- Thigh: Lateral Approach

54. Distal Thigh, Knee, and Proximal Leg
- Distal Femur: Lateral Approach
- Distal Femur: Medial or Anteromedial Approach
- Knee: Posterior Approach
- Knee: Anterior Approach (Medial Parapatellar Approach)
- Proximal Tibia: Posteromedial Approach

55. Leg, Ankle and Foot
- Leg: Anterior or Anterolateral Approach
- Leg: Posterolateral Approach (Henry)
- Ankle: Anterior Approach
- Ankle: Anterolateral Approach
- Talus: Medial Approach
- Calcaneum: Lateral Approach
- Mid Foot: Anterior Approach (Olier’s Approach)

Section 7: Operation Theater and Sterilization

56. Operation Theater Structure, Equipment and Drugs
- Structure of Operation Theater
- Zoning Plan of Operation Theater
- Sub-areas of the Operation Theater Complex
- Essential Services
• Safety Hazards in OT 346 • A Brief Overview about Equipment Inside OT 346 • Operation Table 346 • Anesthesia Machine and Gas Connections 347 • Anesthesia Equipment Kit 347 • Defibrillator 349 • Drug Cart 349 • Electrical Surgical Cautery Unit 350 • Suction Machine 350 • Tourniquet 351 • Fluid Compression Bag or Pressure Infusion Bag 351 • Warming Device 351 • OT Trolley 352 • Sterilized Drums and Boxes 352 • Arthroscope Trolley 352 • Resuscitation Trolley 352 • Image Intensifier (C-arm) 353 • Waste Disposal Unit 353 • Miscellaneous Equipment 354

57. Principles of Sterilization 355
Classification of Items and their Decontamination Techniques 355 • Cleaning 356 • Chemical Disinfection and Pasteurization 356 • Steam Sterilization (Autoclaving) 358 • Ethylene Oxide Sterilization 360 • Some other Methods of Sterilization 361 • Sterilization of Operation Theater 362 • Sterilization of Different Materials 364 • Orthopedic Infection Rate 364

58. Before Starting the Surgery 365
Goals of Patient Care before any Procedure 365 • Preparation before Admitting the Patient 365 • On Admission to the Ward 366 • Principle of Operative Site Preparation 366 • Guidelines for Discontinuation of Drugs 367 • Checklist Regarding Patient Preparation 367 • After Taking the Patient in OT 368 • Patient Positioning 369 • Surgeon Preparation 370 • Surgical Site Preparation by Surgeon Before Surgery 370 • WHO Surgical Safety Checklist 373

Section 8: Glorious History of Orthopedics

59. Era before Roentgen 377

60. Era after Roentgen 384

Bibliography 391

Index 393
Various types of traction can be seen in orthopedic wards. They may act as a temporary immobilizer or as a definitive method of treatment. It may be surface type or invasive, it may be very simple to complex one.

**Cramer’s Wire (Ladder Splint) (Fig. 4.1)**
- These are ladder like splints made-up of metallic wires.
- **Use:** Temporary immobilization during transportation.

**Bohler Braun Splint (Bohler Austrian Surgeon) (Figs 4.2A and B)**
- Designed by Braun, modified by Bohler.
  - Only one lower most pulley was there in Braun’s design.
  - Bohler added two more pulley.
  - *Four pulley sets also available.*
- **Uses of pulleys:**
  - 1st pulley in the line of leg—for calcaneum and distal tibial traction.
  - 2nd pulley
    - In line of supracondylar area of femur—for upper tibial traction.
    - In the line of femur shaft—for distal femoral traction.
  - 3rd pulley—to change the angle of traction and prevent equinus deformity at ankle.
- **Advantages:**
  - Changing the angle of traction as required.
  - Multiple traction can be given simultaneously.
  - Note: In four pulley sets, the function of 2nd pulley is separately done by two pulley, i.e.
    - 1st pulley in the line of leg—for calcaneum and distal tibial traction.
    - 2nd pulley in the line of supracondylar area of femur—for upper tibial traction.
    - 3rd pulley in the line of femur shaft—for distal femoral traction.
    - 4th pulley—to change the angle of traction and prevent equinus deformity at ankle.
Chapter 4 Orthopedic Traction and their Equipment

THOMAS SPLINT (ROBERT JONES) (FIGS 4.3A TO D)

- Designed by Robert Jones for immobilization of tuberculosis of knee, but Jones proposed its name as Thomas Splint in honor of his maternal uncle Hugh Owen Thomas. This splint is also known as Thomas bed knee splint.

Components of splint:
- Well padded circular or oval ring.
- Outer bar with proximal angulation- angulation clears the greater trochanter.
- Inner bar.
- W-shaped joint of two bars.

Measurement of splint:
- Length of splint (inner bar): Length between crotch to heel and add 6”–9” to it.
- For circumference of splint
  - Oblique circumference is taken below gluteal fold and ischial tuberosity.
  - With normal thigh: Oblique circumference of thigh and add 2 inches to it.
  - With affected thigh: Oblique circumference equal to internal circumference of padded ring.
- Angle between plane of ring and inner bar-120°
- Proximal angulation in outer bar at 5 cm from ring.

Wrapping and padding of splint:
- Wrapping of splints in U manner with 6” roller bandage
Master pad of Henery: A gamgee/cotton pad of size 6” x 9” and 2” thick is placed under the lower part of thigh to maintain the anterolateral angulation of femur.

- Uses:
  - For transportation of fractured lower limb.
  - For traction (fixed or sliding) in pediatric fracture shaft femur.

**Tobruk Splint**

Fixed traction of lower limb on Thomas splint with plaster cast over it. It is used for first aid and transportation.

**Fisk Splint**

Thomas splint with knee flexion piece which is telescopically adjustable.

**Pearson Component (Knee Flexion Attachment)**

Knee flexion prevents rotation and also prevents stretching of postcapsule that might causes hyperextension instability.

- Note: Have you seen bent Thomas splint which act as Bohler’s splint without pulley?

**BOHLER’S STIRRUP (FIG. 4.4)**

- Components of Bohler’s stirrup:
  - Loop for traction cord.

**BUCK’S PULLEY (FIGS 4.5A AND B)**

- Components:
  - Three pulleys as upper, middle and lower.
  - Bed holding frame.
- Preferred pulley wheels:
  - Wheel diameter: 5–6.25 cm.
  - Axle-diameter: 6 mm.
- Uses: Different pulleys are used for alignment of distal fragment in relation to proximal fragment by adjusting traction cord on at different heights.
Chapter 4 Orthopedic Tractions and their Equipment

**TENSIONIZER/TENSIONER/K-WIRE STRAINER (FIG. 4.6)**

- **Which wire should use:**
  - Ilizarov plain wire.
  - K-wire (2–2.5 mm).
- **Uses:** For pediatric skeletal traction.
- **Why:** Wire can bend without tensioning it.

---

**TRACTION (FIG. 4.7)**

- A mechanical force applied against a resistance to overcome deforming forces on a fractured fragment or pathologic joint.
- **Benefits of traction:**
  - Relieves spasm and pain.
  - Fracture reduction and maintenance.
  - Deformity prevention and correction.
  - Controls movement at fracture site which promotes healing.
- **Traction weight:** On an average, traction weight is equivalent to 10% of body weight but it depends upon following factors:
  - Site of fracture.
  - Skin condition of limb.
  - Bulk and power of muscle.
  - Age and body weight of patient.
  - Friction and mechanical advantage of system.
- **Counter traction (CT):** A force applied opposite to traction force is called counter traction. On the basis of counter traction, traction can be divided into two broad groups:
  - Fixed traction—here leg of the couch need not to be elevated
  - Sliding traction—here leg of couch is elevated with the help of wooden blocks.
Wooden blocks:
- Standard height—9” (6” blocks are also available)
- 1 inch elevation of couch corresponds to 0.46 kg CT force.

**FIXED TRACTION (FIG. 4.8)**

- When counter traction obtained by an appliance which takes the purchase on a part of body, arrangement is called fixed traction.
  - Given through skin traction (mainly).
  - **Traction weight**: 2.3 kg.
  - Cord is fixed to splint.
  - Part of the couch is not elevated.
- **Uses**:
  - Maintain undisplaced fractures.
  - Used for transportation.

**SLIDING TRACTION (FIG. 4.9)**

- When counter traction obtained by weight of all or part of body under influence of gravity, it is called sliding traction.
  - It can be given by both skin and skeletal traction.
  - A traction cord runs over the pulley system.
  - The traction weight is fastened with traction cord.
  - Here counter traction is achieved by elevating the side of couch from where traction weight is passing, e.g.
- **Uses**:
  - Lower limb traction—foot end of couch is elevated.
  - Cervical traction—head end of couch is elevated.
  - Dunlop traction—arm side of the couch is elevated.

**Buck’s Traction**

Skin traction kept over pillow, e.g. fracture neck of femur, fracture acetabulum.

**Perkin’s Traction**

Skeletal traction kept over pillow, e.g. fracture neck of femur, fracture acetabulum.

- **Note**: No splint is used in Buck’s and Perkin’s traction.

**SKIN TRACTION (FIGS. 4.10A AND B)**

- Traction force applied over large area of skin called skin traction.
- **Features**:
  - Apply distal to fracture site; do not extend it too proximal to fracture site otherwise traction will be inefficient.
  - Two types of skin traction are commonly used:
Chapter 4 Orthopedic Traction and their Equipment

- Lateral position of strap—lower to this axis. Why so?—to promote medial rotation.
- Complications:
  - Skin allergy due to adhesive material.
  - Pressure sore due to inadequate padding over bony prominences.
  - Common peroneal nerve palsy:
    - Due to lateral rotation of limb.
    - Direct compression by splint.
    - Sliding skin traction compressing over fibular head.
- Contraindications:
  - Injured skin (abrasion, severe bruise or laceration).
  - Skin disease like dermatitis.
  - Gangrene or varicose ulcer following impaired circulation.
  - Overriding of fracture fragment where skeletal traction is needed.

Note: Pediatric fracture shaft of femur and skin traction: (Few recommendations)
- There is tendency of slippage of straps of skin traction due to continuous and prolonged traction acting over limb and the traction force will be ineffective when straps would slip more distal to fracture site. Hence, the free ends of straps of skin traction exceed 1–2 inches proximally to the fracture site so that even after slight slippage of straps, the resultant traction force will minimally affected.

* • Adhesive (maximum weight—6.7 kg)
  - Allergic—zinc oxide as adhesive material.
  - Nonallergic—acrylic adhesive material.
* • Nonadhesive (maximum weight—4.5 kg) and used for:
  - Allergic skin.
  - Thin and atrophic skin.
- Skin traction kit contain:
  - Skin strap: Recommended length of strap is approx 15–20 cm and add 5 cm to it that loops beyond the distal most part of the limb; loop ensures free movement of toes or fingers.
  - Crepe bandage.
  - Spreader (wooden or metallic)—7.5 cm.
  - Cotton roll.
  - Tincture benzoin.
- How to apply skin traction:
  - Do shaving of skin hairs.
  - Apply tincture benzoin in nonadhesive type.
  - Do padding over bony prominences if any.
  - Apply strapping by the side of limb.
  - Apply crepe bandage around the limb.
- Position of strap in lower limb skin traction:
  - Axis—tip of greater trochanter to lateral malleolus.
  - Medial position of strap—anterior to the this axis.
BRYANT’S/GALLOW’S TRACTION

(Fig. 4.11)

- How to apply:
  - Apply adhesive skin traction on both lower limbs.
  - Tie traction cord to overlying frame (Balkan frame).
  - Raise buttock to just clear the mattress.
  - If knee flexion needed—posterior gutter splint should be used.
- Check for circulation status: Most important in first 24 hours and look for color, temperature, passive stretch pain, pulse, capillary refill, edema and sensation of foot.
- Age and its relation to blood supply in distal part of leg in Gallow’s traction when knee is hyperextended:
  - Age <2 years: Insignificant.
  - Age 2–4 years: Precarious circulations (if needed use posterior gutter splint).
  - Age >4 years: Definite compromise, so absolutely contraindicated.
- Indication and best candidate
  - Given for fracture shaft femur.
  - Age: Less than 2 years or weight less than 16–18 kg.
- Modified Bryant’s:
  - Indication: For child having dysplasia of the hip developmental (DDH) of less than 1 year age.

DUNLOP’S TRACTION (Fig. 4.12)

- Position:
  - Shoulder: 45° abduction.
  - Elbow: 45° flexion.
- How to apply:
  - Padded sling over distal humerus.
  - Weight × size of child; start with 0.5–1 kg—followed by gradual increase under image intensifier up till reduction.
  - Elevate same side of bed for countertraction.
  - Look for circulation hourly.
- Indication:
  - For supracondylar fracture and intercondylar fracture humerus.

SKELETON TRACTION

- Traction forces acting directly through a part of a bone is called skeletal traction.
- Features:
  - It is also applied distal to the fracture site.
  - Applied through a pin or K-wire.
More traction weight can be given.

**Equipment for skeletal traction:**
- Steinmann pin.
- T-handle with Jacob's chuck.
- Surgical blade.
- Xylocaine injection.
- Syringe with needle.
- Surgical gloves.

**Steps of traction application:**
- Stab incision.
- Secure underlying structures.
- Keep the limb in position of 15° external rotation (lower limb).
- Penetrate horizontally.
- Apply tincture benzoin soaked 2 separate gauze over pinskin interface.

**Direction of entry of pin:** Always keep the entry point of pin towards the where there are neurovascular bundle because there is control over pin at entry point but not at exit point.

**Complications:**
- Pin track infection (ring sequestrum).
- Physseal injury in children.
- Ligamentous injury if heavy traction for prolonged periods.
- Distraction of fracture site.
- Neurovascular injury.
- Splintering of cortex (due to hammering).
- Incorrect placement of pin leading to:
  - Altered direction of traction.
  - Rotation of limb.
  - Make splint application difficult.

**Care of pin tract:**
- Daily dressing is preferred.
  Two step dressing:
  - First wipe the pin-skin interface with Spirit (Some prefer normal saline).
  - Then apply cotton gauze soaked with betadine or chlorhexidine solution.
- Do not apply pressure bandage around the limb adjacent to Steinmann pin due to risk of local edema or pressure sore.
- Do local examination for any pin-tract infection. Tenderness, warmth, pus, loosening of pin, etc. if so remove skeletal traction and apply some other modality of traction.
- Prophylactic antibiotic is also preferred in systemically ill patient.

### LATERAL UPPER FEMORAL TRACTION (FIGS 4.13A TO C)

**Equipment:** Screw eye.

**Entry point:** 2.5 cm below the most prominent part of GT, midway between anterior and posterior border of shaft of femur.

**Technique:**
- Neutralize anteverision of hip by internal rotation of hip.
- Directed towards opposite ASIS (anterior superior iliac spine).
- Advance screw up to 3.75–5 cm in neck of femur.

**Traction weight:** 4.5–9 kg and counter traction by elevation of cranial and caudal leg of affected side.

**Lateral upper femoral traction** is commonly combined with upper tibial traction. Here counter traction is obtained by differential elevation of leg of couch, e.g. if traction is applied over right sided proximal femur the blocks in the leg will be applied as follows:
- Cephalic end right arm side—low block
- Cephalic end left arm side—no block
- Caudal end right leg side—high block
- Caudal end left leg side—low block

**Duration of traction:** 4–6 weeks.

**Indications:**
- Central fracture dislocation of hip.
- Acetabular fracture.

**Note:** Lateral upper femoral traction is commonly combined with upper tibial traction.

### DISTAL FEMORAL TRACTION (FIG. 4.14)

**Entry point of pin:**
- Direction—medial to lateral.
- Positioning of entry point:
  - One line along anterior border of head of fibula.
  - Another line along upper border of patella (before backward).
**Section 1  Ward Round**

**Complications:**
- Quadriceps fibrosis.
- Knee stiffness.

**Indication:** For fracture shaft of femur, acetabular fracture dislocation.

**Site for differential elevation of leg of couch application**

*Enter from corresponding junctional point of two above lines on medial side.*

**Site for lateral upper femoral traction application**

- Ways of traction application:
  - *On Thomas splint with Buck’s pulley:* Fracture shaft femur in child-ren.
  - *On pillow (perkins):* Fracture neck femur.

**Entry point of pin:**
- *Direction:* Lateral to medial.
- *2 cm below and behind the tibial tubercle.*

**Danger:** Common peroneal nerve palsy.

**Role of flexed knee in reduction of fracture shaft femur when traction is applied via upper tibial traction:**
- In flexed knee attitude, the periarticular ligaments of knee are relaxed and traction forces directly act over two antagonistic group of muscles (quadriceps and hamstrings) hence deforming forces are balanced and reduction is achieved.
- In extended knee attitude (locked knee position) the traction forces are spent in stretching the periarticular ligaments not for fracture reduction. Side by side

**Fig. 4.14** Site for distal femoral traction application

*Note:* Change the distal femoral traction to upper tibial traction after 3 week due to risk of pin loosening.

**UPPER TIBIAL TRACTION (FIGS 4.15A TO C)**

- Entry point of pin:
  - *Direction:* Lateral to medial.
  - *2 cm below and behind the tibial tubercle.*

**Danger:** Common peroneal nerve palsy.

**Note:** Role of flexed knee in reduction of fracture shaft femur when traction is applied via upper tibial traction:
- In flexed knee attitude, the periarticular ligaments of knee are relaxed and traction forces directly act over two antagonistic group of muscles (quadriceps and hamstrings) hence deforming forces are balanced and reduction is achieved.
- In extended knee attitude (locked knee position) the traction forces are spent in stretching the periarticular ligaments not for fracture reduction. Side by side
in the extended knee position the distal fragment of femur and the tibia acts as a single unit which does not prevent rotation at fracture site.

**DISTAL Tibial Traction (Fig. 4.16)**

- **Entry point of pin:**
  - **Direction:** Medial to lateral.
  - **Positioning of entry point:**
    - One point—5 cm above ankle joint.
    - Other point—midway between anterior and posterior border of tibia.
• **Indication:** Proximal tibial fractures and knee fracture dislocation.

### CALCANEAL TRACTION (FIG. 4.17)

- **Entry point of pin:**
  - Direction—medial to lateral.
  - Positioning of entry point:
    - **Medial side:** 3 cm below and behind the medial malleolus.
    - **Lateral side:** 2 cm below and behind the lateral malleolus.
  - **Indications:**
    - Distal tibial fractures.
    - Ankle fracture dislocation.

### OLECRANON TRACTION (FIG. 4.18)

- **Entry point of pin:**
  - Direction: Medial to lateral.
  - Positioning of entry point:
    - 3 cm distal to tip of olecranon process.
    - Just deep of subcutaneous border of ulna.
  - **Risk:** Injury to ulnar nerve.
  - **Indication:** Supracondylar and intercondylar fracture of distal humerus.

☑ **Note:** A screw eye can also be used for olecranon traction.

### METACARPAL TRACTION (FIG. 4.19)

- **Entry point of pin:**
  - Direction: Lateral to medial.
  - Positioning of entry point:
    - From 2nd to 3rd metacarpal.
    - Transversely perpendicular to long axis of radius.
    - 2–2.5 cm proximal to distal end 2nd metacarpal.
  - **Indication:** Distal radius fracture and wrist injuries.

### AXIAL TRACTION (CERVICAL AND PELVIC)

### HEAD HALTER TRACTION (FIGS 4.20A AND B)

- **Two types:**
  - Canvas head halter—with chin and occiput rest.
  - Crili head halter—with forehead and occiput rest.
• **Parts of Canvas head halter**: Most common variety.
  - Chin and occiput rest.
  - Metal spreader with hook.
  - Side piece.
• **Total effective traction weight**: 10–15% of body weight.
• **Use**:
  - Cervical spondylosis.
  - Cervical trauma.
• **Complications**:
  - Pressure sore.
  - Difficulty in eating.

### PELVIC TRACTION (FIGS 4.21A AND B)

- **Components**:
  - Canvas harness.
  - Side straps.
  - Metal spreader with hook.

- **Total effective traction weight**: 20–30% of body weight (most effective range).
- **Uses**: In prolapsed intervertebral disc.

### CERVICAL SKELETAL TRACTION (FIGS 4.22A AND B)

- **Ways of traction application**:
  - By Crutchfield tong.
  - By barton tong.
  - By garden well.
  - By cervical halo.
- **Traction weight**: Max (9.1–18.2 kg) and for counter traction head end of couch is elevated.
- **Indications**:
  - For reduction of fracture dislocation of cervical spine.
  - Maintenance of reduction.
  - After operative fusion.
Cervical spondylosis with severe nerve compression.

**Crutchfield tong application:**
- **Instrumentation:**
  - Crutchfield tong.
  - Guarded drill bit.
- **How much penetration in scalp bone:**
  - 3 mm (children)
  - 4 mm (adult)
- **Which bone:** Parietal bone (outer-table).
- **Point of entry:** Three finger breath above pinna and in line of mastoid (sagittal line and intermastoid line).
- **Tightening of tong:** Every day for first 3–4 days and then as required.
- **Direction of traction:** As per position of fracture/dislocation shown by image-intensifier or radiographs.
- **Traction weight:** For head 2.5 kg add ½ kg for each cervical vertebrae.

<table>
<thead>
<tr>
<th>Cervical level and weight (pound) correlation</th>
<th>Minimum weight (pound)</th>
<th>Maximum weight (pound)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cervical level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$c_1$</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>$c_2$</td>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td>$c_3$</td>
<td>8</td>
<td>16</td>
</tr>
<tr>
<td>$c_4$</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>$c_5$</td>
<td>12</td>
<td>24</td>
</tr>
<tr>
<td>$c_6$</td>
<td>15</td>
<td>30</td>
</tr>
<tr>
<td>$c_7$</td>
<td>18</td>
<td>35</td>
</tr>
</tbody>
</table>

- Maintenance weight—2.3–3.2 kg (5–7 pound) for 6–10 weeks to prevent traction over cervical vessel.
- **Heavy traction method of reduction:**
  - Start with 2.5–5 kg weight.
  - Increase 5 kg at 15 minutes interval till reduction is achieved (maximum: 30 kg).
  - Maintenance with—5–7.5 kg weight.
- **Contraindication of cervical skeletal traction:**
  - C2 (Hangmann fracture) type IIA.
  - Cervical flexion-distraction (facetal dislocation)—leading to disc herniation.

**Garden-well tonge:** These are U-shaped tongs for cervical traction having pressure controlled pins that are inserted into skulls at opposite ends.

**SPECIAL TYPE OF TRACTION IN LOWER LIMB**

**BOOT AND BAR (FIG. 4.23)**

- **Components:**
  - Well padded boot cast.
  - Wooden scale as derotation bar (6” length).
  - POP bandage loop for traction.
- **Indication:** For conservative treatment of intertrochanteric fracture or impacted
fracture neck of femur specially in medically
moribund patients.

- **Follow-up:**
  - **Patient positioning:** Maintain 45° abduction of limb by keeping pillow between the two thighs.
  - Traction weight maintenance.
  - Serial fracture site examination.
- **Complications:**
  - Pressure sore/bed sore.
  - Deep vein thrombosis.
  - Respiratory and cardiac complications.
  - Malunion.

### CHARNLEY’S TRACTION UNIT (FIG. 4.24)

- **Components:**
  - Upper tibial traction pin with Bohler’s stirrup.
  - Below knee plaster cast.
  - Derotation bar (6 inch length) and midway between heel and toes.

### NINETY-NINETY TRACTION (OBLETZ 1946) (FIGS 4.25A AND B)

- Combination of two tractions that maintain the both hip and knee in 90° of flexion.
Section 1 Ward Round

- **Traction-1**: It is the main traction unit which acts on the pathology. It is given as distal femoral or upper tibial skeletal traction.
- **Traction-2**: It is supportive traction unit which holds the leg in air. This can be given either lower tibial skeletal traction or below knee plaster cast.
- **Indications**:
  - **Proximal 1/3rd femur fracture (why?)**: Here proximal fragment is flexed and abducted. It is impossible to maintain the alignment of distal fragment to proximal fragment for a patient moving on bed.
  - Posteriorly compound fracture shaft of femur due to difficult wound care.

**RUSSELL TRACTION (HAMILTON RUSSELL, 1924) (FIGS 4.26A AND B)**

- **Component of traction**:
  - Skin traction in leg.
  - Knee sling.
  - System of pulley:
    - Pulley-1: Just anterior to knee.
    - Pulley-2 and 4: At the level of foot.
    - Pulley-3: Attached with spreader of skin traction.
- **Effective traction**: It is the resultant force which act in the direction of long-axis of femur.
- **Indications**:
  - Fracture shaft of femur especially in pediatric cases.

**AGNES-HUNT TRACTION [FOR FIXED FLEXION DEFORMITY (FFD) OF HIP] (FIG. 4.27)**

- Triple deformity of knee (tuberculous and rheumatoid) as in flexion deformity or posterior subluxation.
- **Modification in Russell traction**:
  - Distal femoral skeletal traction in place of knee sling.
  - Below knee cast is applied in place of skin traction and 3rd pulley is fixed with cast of sole region.

**Fig. 4.27** Agnes-Hunt traction [for fixed flexion deformity (FFD) of hip]
– Skin traction over Thomas splint (affected limb).

**Why spica in 90° position:**
– It obliterates the lordosis and reveals fixed-flexion deformity of hip.
– Spica covering the lumbar region act as a counter point for deformity correcting forces.

**How to apply traction:**
– Flex the both hip up to 90° to obliterate lordosis.
– Apply single hip spica in unaffected limb in above position.
– Apply a leg sling to hold leg in spica.
– Apply a skin traction in unaffected limb and kept over Thomas splint.
– Decrease the height of Thomas splint as the deformity corrected.

**Indication:** Fixed flexion deformity of hip.

## CHECKLIST FOR EFFECTIVE AND SAFE TRACTION

- **Appropriate splint:** Care for dimension of splint.
- **Padding of splint:** With cotton and roller bandage.
- **Strappings of skin traction:** Wrinkle free and creaseless.
- **Spreader:** Wooden or metallic as a part of skin traction kit.
- **Bandages:** Elastic bandages for wrapping around limb in skin traction.
- **Limb position:** As per demand of fracture pattern or pathology.
- **Direction of traction cord:** By adjusting the height of pulley. Traction cord should not touch any part of bed or ground.
- **Traction weight:** According to type of traction (skin or skeleton) and age of patient.
- **Counter traction:** By elevating the couch legs as per requirement.
- **Padding of limb:** To steadies the limb over splint and reduce angulation at fracture site.
- **Bony prominences:** Proper padding is mandatory.

## CARE OF PATIENT ON TRACTION

- **Check for skin complication like pressure sore:** Proper padding over pressure point, e.g. malleoli, Achilles tendon, heel, etc. (Keep water filled gloves or slit padding of splint near heel and tendoachilles.
- **Check for pin tract infection, if there is any pus or systemic feature:** Do regular dressing and investigate for infection.
- **Check for distal vascular status as shown by feeble pulse, pale, cool, swollen finger or digits— release pressure point if any.**
- **Check for any neurological complication, e.g. common peroneal nerve palsy:** Release pressure point.
- **Continued physiotherapy.**
- **Check for improvement in ailment for which traction is applied.