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Research and Reporting for the current state of art in the field of protocols for orthopedic surgical procedures and correspondant rehabilitation procedures

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ABSTRACT

This report aims to develop common references for VET in orthopedy and rehabilitation.

The Document introduces a brief picture of learning needs in Orthopedics Profession, by research of specific recent literature in connection with main orthopedic surgical procedures for lower limb.

1.1. Purpose of the report

Orthopaedic surgery remains at the center of the healthcare reform debate, with rising procedure volumes, high utilization of expensive (and in some cases unproven) technologies, substantial regional variation in practice patterns , concerns about inappropriate over-utilization of certain orthopaedic interventions, and widespread scrutiny regarding the relationships between orthopaedic surgeons and the medical device industry (1).

Increasing the quality of vocational skills requires the development of world-class VET systems. Increasing transversal and basic skills alone will not be sufficient to generate growth and competitiveness, and there is still too much distance between the educational environment and the workplace. VET must be able to react to the demand for advanced vocational skills, tailored to the regional economic context. It also needs to be an open door for those who want to access higher education,as well as individuals who need to update skills

The field of orthopedics is an extremely competitive field. New technologies are constantly being introduced with the promise of improved patient outcomes, but often with limited information. More, in orthopedics in particular, after surgery, a long and difficult rehabilitation process follows in order to regain normal gait and requires interdisciplinary team approaches.

- ”After completing my resident training I would like to work in England. Professor, do you know what are the standards for total knee replacement? I looked in the internet but the information is limited.” (**resident in orthopedics, 3 rd year).
- Something is wrong in my approach. I have 2 patients with the same type of surgery and none of them has no other complications, but still the evolution in gait rehabilitation is quite different. I would like to evaluate the gait with some other technique, as RX and MRI doesn t show anything peculiar, but we didn t learn that during medschool” (medical specialist in rehabilitation).
- ”Doctor, I am doing all the exercises that you prescribed together with the other patients, but my walking is still difficult and my foot keeps rotating in an uncomfortable position. I understand that this is a standard protocol, but maybe I need something different from the others?” (patient, knee replacement).

These are some of the comments that we face daily and lead us to identify new methods to contribute to the development of a European Area of Skills and Qualifications in the ortopedic field, so that medical vocational education will meet the current and future labour market needs in terms of skills development.

The need for harmonisation development of an unitary system in medical education across Europe with common standard procedures is a well known fact. All EU medical graduates should have equal chances to practice all over EU. Our project focuses on the project partners identification of common needs that EU educational and training systems are facing and that can be met only by a common effort.

The goal of the orthopaedic residency program in all participant countries is to produce orthopaedic surgeons who are technically competent, and knowledgeable of the literature in the field of orthopaedic surgery. In present the training for physicians is quite diverse both in curricula but including mainly classic medicine/therapy knowledge, with a lack of data offered by new technologies, despite the fact that the number and complexity of the investigation methods have increased dramatically in the last years, with integration of many non-invasive biomedical investigation techniques. More, knowledge-based economy require people with higher and more relevant skills. Strategies to optimize walking ability are of maximum importance.

In this context, the rationale of our project is to encourage advanced medical care by developing innovations in orthopedic and rehabilitation training that will enhance the results of surgical and rehabilitation procedures.

Our project addresses to medical professionals in the orthopedic and rehabilitation field (residents, medical specialists), proposing the enhancement of theoretical and practical skils of specialists that will apply systematic the gained knowledge in finding solutions to improve health condition.

The first step in our project consist in identifying and development of an innovative guideline on standardized fundamental surgical and rehabilitation protocols for the lower limb patologies available throught Europe.

To accomplish this goal we proposed to elaborate reports and research studies, aiming to develop common references for VET in orthopedy and rehabilitation.

- This will include elaboration of a report for the current state of art in the field of protocols for orthopedic surgical procedures (present report). The purpose of the present report is to identify the milestones and overall approaches regarding standard surgical procedures in lower limb pathologies. The report will identify Training Requirements for the development of basic and new skills in orthopedy and rehabilitation in direct connection with the needs of the users from literature research and includes an analysis of the specialised recent literature. It will conclude by proposing 12 examples of orthopedic surgical procedures in lower limb pathologies and 12 examples of rehabilitation procedures after surgery in lower limb pathologies to be negociated in the partnership as eligible procedures for the Guide of operational standards. By our report we assume that our assessment can provide busy orthopaedic surgeons and rehabilittion professionals (who do not have the time to keep up with and critically evaluate current literature) with succinct information that enables them to rapidly determine what is and what is not known about any given medical protocol.

- In choosing the procedures we will take into account a national research, study and analyses on labour market demands for all participant countries (Romania, Bulgaria, Turkey and Denmark). The reports must reflect needs' identification for target groups in each participant country on the use of the proposed procedures at work place, based on surveys and questionnaires addressed to the target group and potential users. Analysis of learners' actual knowledge and of knowledge needs for identifying the current performances and gaps will be carried on, as well as analysis of the VET in orthopedics and rehabilitation in participant countries, correlated with the use of orthopedic and rehabilitation procedures in practice. Identifying ways for introducing state of art orthopedic surgical procedures and rehabilitation protocols after surgery into the work environment. Also it will help in adaptation of procedures according to national needs.
- Based on the national reports a transnational summative report will be drawn, aiming in establishment of common standards and identification of the differences in usage of the protocols from one country to another. The report will collect informations not only on needs, but also on specific sectorial impact, country, differences. It will offer a reflection on their envisaged impact and identify the ways to introduce new and consesually agreed basic protocols into the academic medical field (university) and the medical world of work (hospitals). Also it will identify effective innovative solutions to meet the needs of the target group that will use the selected procedures.

- Based on this report the partnership will elaborate the second output of the project, recte ”Guideliness of operational standards in lower limb orthopedic surgery and rehabilitation”.

1.2. Objectives of the present research

- To conduct a medical literature research regarding standard surgical and rehabilitation protocols in lower limb pathologies.
- To select the most common surgical protocols in all participant countries and the correspondent rehabilitation procedures
- To make first steps in standardization of protocols
- To develop interdisciplinary approach (orthopedics-rehabilitation)

1.3. Methodology

- The partnership will review all abstracts, recalled pertinent full articles for review and evaluate the studies meeting the inclusion criteria.
- They also will abstract analyze, interpret and/or summarize the relevant evidence for each standard procedure.
- Upon completion of the systematic reviews, each medical partner will register 30 examples of orthopedic surgical procedures in lower limb pathologies and 30 examples of rehabilitation procedures after surgery in lower limb pathologies of which it will be proposed 12 orthopedic surgical procedures in lower limb pathologies and 12 rehabilitation procedures after surgery in lower limb pathologies to be negociated in the partnership as eligible procedures for the Guide of operational standards.
- Research of specific recent literature in connection with these procedures will lead elaboration of an to up to date bibliographic resource.

The review criteria

Original, English, full-text papers and reviews were identified using the following terms: “protocols for orthopedic surgical procedures”, ”lower limb orthopedic surgery”, ”hip replacement”, ”knee surgery”, ”ankle surgery”, ”knee surgery rehabilitation protocols”, ”hip surgery rehabilitation protocols”, ”ankle surgery rehabilitation protocols”.

1.4. Results

1.4.1. Orthopaedic Surgery and Rehabilitation: Current State of the Art

Our assessment is a literature-based research that seeks to determine what procedures are effective by summarizing the literature on a given technology. When there was little available information, such as with new technologies, unbiased examinations showed that enthusiasm for that technology is not backed by much data. When it was more information, our assessment determined whether a technology is effective, but also how effective it is.

Our literature research on training requirements for the development of basic and new skills in orthopedy and rehabilitation identified several key concepts, as follows:

- Meta-analyses are important evaluations in orthopaedic surgery, not only to create clinical guidelines, but also because their findings are included in public health and health policy decision making. However, with increasing numbers of meta-analyses, discordant and frankly conflicting conclusions have been reported. We searched for conflicting meta-analyses, ie, those arriving at different conclusions despite following the same research question, identified potential reasons for these differences, and assessed the statistical significance and clinical importance of differences. Thus conclusions and interpretations from meta-analyses should be scrutinized as critically as those from any other type of study and subjected to reassessment if deemed necessary (2).
- Musculoskeletal procedures often show wide variation in rates across geographic areas, which begs the question, “Which rate is right?” Clearly, there is no simple answer to this question. We summarize a conceptual framework for thinking about how to approach this question for different types of interventions. One guiding principle is the “right rate” is usually the one that results from the choices of a fully informed and empowered patient population. For truly effective care without substantial tradeoffs, the right rate may approach 100%. The rate of operative treatment of hip fracture, for example, approaches the underlying incidence of disease; however, the rate of some forms of effective care, like osteoporosis evaluation and treatment

after a fragility fracture, is often quite low and undoubtedly reflects underuse (3).

- The healthcare system is currently facing daunting demographic and economic challenges. Because musculoskeletal disorders and disease represent a substantial and growing portion of this healthcare burden, novel approaches will be needed to continue to provide high-quality, affordable, and accessible orthopaedic care to our population. The introduction of mobile fluoroscopic imaging systems, the development of the Surgical Implant Generation Network intramedullary nail for treatment of long bone fractures in the developing world, the expanding role and contributions of physician assistants and nurse practitioners to the orthopaedic team, and the rise of ambulatory surgery centers are all examples of disruptive innovations in the field of orthopaedics. Although numerous cultural and regulatory barriers have limited the widespread adoption of these “disruptive innovations,” we believe they represent an opportunity for clinicians to regain leadership in health care while at the same time improving quality and access to care for patients with musculoskeletal disease (4).
- Improving quality of care in orthopedic protocols and techniques is of increasing importance to payors, hospitals, surgeons, and patients. Efforts to compel improvement have traditionally focused measurement and reporting of data describing structural factors, care processes (or ‘quality measures’), and clinical outcomes. Reporting structural measures (eg, surgical case volume) has been used with varying degrees of success. Care process measures, exemplified by initiatives such as the Surgical Care Improvement Project measures, are chosen based on the strength of randomized trial evidence linking the process to improved outcomes. However, evidence linking improved performance on Surgical Care Improvement Project measures with improved outcomes is limited. Outcome measures in surgery are of increasing importance as an approach to compel care improvement with prominent examples represented by the National Surgical Quality Improvement Project. Although outcomes-focused approaches are often costly, when linked to active benchmarking and collaborative activities, they may improve care broadly. Moreover, implementation of computerized data systems collecting information formerly collected on paper only will facilitate

benchmarking. In the end, care will only be improved if these data are used to define methods for innovating care systems that deliver better outcomes at lower or equivalent costs (5).

- While all of medicine is under pressure to increase transparency and accountability, joint replacement subspecialists will face special scrutiny. Disclosures of questionable consulting fees, a demographic shift to younger patients, and uncertainty about the marginal benefits of product innovation in a time of great cost pressure invite a serious and progressive response from the profession. Current efforts to standardize measures by the National Quality Forum and PQRI will not address the concerns of purchasers, payors, or policy makers. Instead, they will ask the profession to document its commitment to appropriateness, stewardship of resources, coordination of care, and patient-centeredness. One mechanism for addressing these expectations is voluntary development of a uniform national registry for joint replacements that includes capture of preoperative appropriateness indicators, device monitoring information, revision rates, and structured postoperative patient followup. A national registry should support performance feedback and quality improvement activity, but it must also be designed to satisfy payor, purchaser, policymaker, and patient needs for information. Professional societies in orthopaedics should lead a collaborative process to develop metrics, infrastructure, and reporting formats that support continuous improvement and public accountability (6).
- As healthcare expenditures continue to rise, reform has shifted from spending controls to value-based purchasing. This paradigm shift is a drastic change on how health care is delivered and reimbursed. For the shift to work, policymakers and physicians must restructure the present system by using initiatives such as process reengineering, insurance and payment reforms, physician reeducation, data and quality measurements, and technology assessments. Value, as defined in economic terms, will be a critical concept in modern healthcare reform. (7).

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5. David Lansky PhD, Arnold Milstein MD, MPH ,Healthcare Quality Measurement in Orthopaedic Surgery: Current State of the Art Quality Measurement in Orthopaedics: The Purchasers' View

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10. Antonia C. Novello, M.D., M.P.H., Dr.P.H. Commissioner of Health, Surgical and Invasive Procedure Protocol for Hospitals ~ Diagnostic and Treatment Centers Ambulatory Surgery Centers ~ Individual Practitioners
https://www.health.ny.gov/professionals/protocols_and_guidelines/surgical_and_invasive_procedure/docs/protocol.pdf

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www.wsava.org/sites/default/files/jsap_0.pdf

13. Postoperative rehabilitation following trapeziectomy and ...
healthcare.utah.edu/clinicaltrials/trial.php?id=FP00001924
Specialty: Orthopaedic Surgery ... Postoperative rehabilitation and splinting protocols have varied widely between institutions. ... There is one Cochrane Review on surgical treatment of trapeziometacarpal joint arthritis that ... The Hand Clinics, a comprehensive, state-of-the-art review by experts in the field, provide current, ...

14. [PDF]WHO guidelines for safe surgery 2009 : safe surgery saves ...
whqlibdoc.who.int/publications/2009/9789241598552_eng.pdf

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21. http://www.orthopaedicprotocols.com/

22. http://www.sportssurgerynewyork.com/postop-rehab-protocols.html

1.4.2. Main surgical protocols in lower limb pathologies

Protocol:

a written plan specifying the procedures to be followed in giving a particular examination, conducting research, or providing care for a particular condition.

Mosby's Medical Dictionary, 8th edition. © 2009, Elsevier.

1. Developmental dysplasia of the hip

Developmental dysplasia of the hip (DDH) is the most common orthopedic disorder in the new born. Incidence varies due to cultural variety. It is more common in Northern Europe, Middle East, and among Native Americans.[1] Treatment aims to keep the femoral head inside the acetabulum so that the bone structure remodels in the first year of life. After the 18th month, surgical correction is required for containment. Although there are many surgical and nonsurgical procedures described in the treatment algorithm of this disorder, general principles are somewhat consistent.[2]

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Developmental Dysplasia of the Hip: Background, Anatomy ...

emedicine.medscape.com/article/1248135-overview

Hip Dislocation in Emergency Medicine: Background ...

emedicine.medscape.com/article/823471-overview

Developmental Dysplasia of Hip (DDH) - OrthopaedicsOne ...

www.orthopaedicsone.com › ... › OrthopaedicsOne Review › Pediatrics

2. Osteonecrosis of the femoral head

Standard basic procedure for early stage osteonecrosis of the femoral head is the core decompression. Addition of various vascularized or non-vascularized grafts to the procedure increases resistance to collapse. Recently bone marrow transfers gained popularity.[1-2] There is also rotational osteotomy alternative and hip arthroplasty for further stages of the disease.[3]

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Other:

Femoral Head Avascular Necrosis: Background, Epidemiology

emedicine.medscape.com/article/86568-overview

Avascular Necrosis: Background, Pathophysiology ...

emedicine.medscape.com/article/333364-overview

Hip Osteonecrosis: Background, Problem, Epidemiology

emedicine.medscape.com/article/1247804-overview

3. Total hip arthroplasty

Total hip arthroplasty is the most common procedure that is applied in non-traumatic hip disorders. There are many prosthesis alternatives but the procedure and the postoperative period are somewhat standard. Anterior, direct lateral, and posterolateral approaches are the most common surgical approaches.[1,2] Complications and rehabilitation protocols may vary due to the prosthesis and approach choices.

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http://nzoa.org.nz/system/files/total_hip_replacement_good_practice_guidelines.pdf

Other:

Hip Replacement Imaging: Overview, Radiography, Computed
emedicine.medscape.com/article/398669-overview

Minimally Invasive Total Hip Arthroplasty: Background ...
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Acetabular Wear in Total Hip Arthroplasty: Background ...
emedicine.medscape.com/article/1247594-overview

Hip Resurfacing: Overview, Advantages and Limitations ...
emedicine.medscape.com/article/1358168-overview

4. Revision total hip arthroplasty

Hip arthroplasty may require revision due to periprosthetic infections, instability, aseptic loosening and osteolysis, polyethylene wear, and periprosthetic fractures. Although gathered under the same procedure topic, procedure might vary to great extent according to the reason of revision. Rehabilitation protocols, likewise, should be structured based on the patients specific requirements.

References:

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5. Posterior cruciate ligament reconstruction

Posterior cruciate ligament is the major restraint of the knee in posterior stability. Patient with a complete rupture generally requires surgical reconstruction.[1] Both the procedure and the rehabilitation period are fairly standard. Yet, accompanying injuries are common and may change the protocols.

References:

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Posterior Cruciate Ligament Injury Treatment & Management

emedicine.medscape.com/article/90514-treatment

6. Chondral/osteochondral injury of the knee (including osteochondritis dissecans)

Patients selection is very important in the treatment results of cartilage injury. There are symptom relieving, repairing, and restructuring surgical alternatives. Healing time and thus rehabilitation period is generally long, taking at least 3 to 6 months.[1,2]

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Knee Osteochondritis Dissecans: Background, Epidemiology

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Soft Tissue Knee Injury: Practice Essentials, Background ...

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Meniscus Injuries: Practice Essentials, Background ...

emedicine.medscape.com/article/90661-overview

7. Unicompartmental knee arthroplasty

Unicompartmental knee arthroplasty is the replacement of the medial compartment of the joint in cases of isolated single compartment osteoarthritis. It is a relatively new procedure and has concerns about the longevity of the implant and short term revision possiblity.[1,2]

References:

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Total Knee Arthroplasty: Practice Essentials, Overview ...

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Surgical Treatment of Lateral Compartment Arthritis: Lateral ...

emedicine.medscape.com/article/1251668-overview

8. Total knee arthroplasty

Treatment of last stage degenerative joint disease, when conservative measures fail, is the total knee replacement surgery. The procedure is very frequently performed and results are satisfactory. 10 year excellent result rate is over 90%, 20 year excellent result rate is over 75%.[1]

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Complications of Total Knee Arthroplasty: Background ...

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Minimally Invasive Total Knee Arthroplasty Technique ...

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Complications of Total Knee Arthroplasty: Background ...

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9. Revision total knee arthroplasty

Complications like infection, periprosthetic fracture, dislocation, component malposition, wear, and component failure may lead to a need for revision of the total knee arthroplasty. During removal of the implant bone and stability loss is inevitable. Therefore revision arthroplasty procedures are more prone to complication and require dealing with various intraoperative difficulties.[1]

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http://orthoinfo.aaos.org/topic.cfm?topic=A00712

10. Periprosthetic fractures

Prosthetic materials are made of metals which tend to decrease elasticity of the applied location and lead to stress riser areas at proximal and distal bones. Low energy traumas after arthroplasty surgeries may result in fractures neighboring prosthetic implants.[1] Besides general fracture treatment principles the surgeon must also deal with the future of the prosthesis.

References:

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Periprosthetic Fractures: Background, History of the ...

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11. Talar osteochondral lesion

Although the incidance of chondral or osteochondral lesion of the talus is as high as 69% after fractures around the ankle few require surgical treatment.[1] The major difficulty in treatment is the constrained structure of the anle joint which hinders approach to the injured zone.

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Other:

Osteochondral Lesions of the Talus Treatment & Management

emedicine.medscape.com/article/1237723-treatment

12. Ankle arthrodesis

Arthrodesis is the golden standard in the treatment of advanced ankle arthrosis, but it has a high complication rate and patient satisfaction is a concern.[1]

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http://www.arthrosurface.com/wp-content/uploads/2013/06/McGahan_OCD-lesions-of-the-talus_FAI_2010.pdf

13. Posterior tibial tendon dysfunction (acquired flatfoot)

Four stages of the dysfunction is described. Surgical procedures vary due to the stage of the disease. In the first stage debridement, in the 2nd stage tendon transfers, and in the later stages osteotomies or arthrodesis are recommended.[1]

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Tibialis posterior dysfunction: a common and treatable ...

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14. Achilloplasty

Various neurological disorders and congenital deformities cause development of plantar flexion contracture of the ankle. When the heel does not touch the ground during walking and when the constervative measures fail, achilloplasty is performed to lengthen the Achilles tendon. Sometimes posterior capsulotomy is also required.[1]

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15. Hallux valgus

Hallux valgus is the lateral deviation of the first proximal phalanx which frequently is accompanied by varus deviation of the 1st metatarsal. Pain is the major surgical indication. Surgery aims to remove bunion, correct metatarsal varus deformity if required, release abductor power, reduce sesamoids, and correct phalangeal valgus deformity.[1]

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Other:
Hallux Valgus: History of the Procedure, Epidemiology ...
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Hallux Valgus Osteotomy: Pre-Procedure, Technique, Post ...
emedicine.medscape.com/article/2000519-overview

16. Surgical stabilization of the fractures of the posterior acetabular fractures

a. Posterior wall acetabular fractures are the most common type of acetabular fracture accounting for 25% of all acetabular fractures. Most posterior wall fractures are comminuted or tend to have areas of impacted bone into the underlying cancellous bone. The posterior wall fractures can be visualized on the AP and obturator oblique radiographs. The AP will reveal a disruption only in the posterior rim shadow, with the obturator oblique view showing the size and the multifragmentary nature of the fracture. CT scans are always useful providing help in recognizing comminution and marginal impaction,. Marginal impaction is a rotated and impacted osteochondral fragment that is displaced as the femoral head dislocates and the wall fractures. This situation has been documented in about 46% of posterior wall fractures.

b. Posterior column acetabular fractures involve detachment of the entire ischioacetabular segment from the innominate bone and represent about 3 to 5% of acetabular fractures. The fracture begins at the posterior border of the innominate bone near the apex of the greater sciatic notch, it descends across the articular surface, quadrilateral surface, ischiopubic notch and across the inferior ramus. On the AP radiograph the ilioischial line, the posterior rim and the inferior ramus are disrupted. In widely displaced fractures it is common to find the neurovascular bundle in the posterior column fracture site and it must de carefully extracted before reduction to prevent iatrogenic injury.

It must be underlined that CT scan with 3D reconstruction is mandatory for establishing the diagnosis and treatment of all acetabular fractures, thus including the posterior ones

Surgical indications:

- hip joint instability and/or incongruity;
- fragments of bone or soft tissue incarcerated within the hip joint;
- fracture displacement in the weight-bearing dome ;
- irreducible hip dislocation;
- recurrent hip dislocation following reduction despite traction;
- associated vascular injury;
- open fractures;
- ipsilateral femoral neck fracture;

The standard surgical approach for the posterior acetabular fractures is the Kocher-Langenbeck approach. Still, for special circumstances, a modified Gibson approach or a trochanteric flip osteotomy may be needed.

Kocher-Langenbeck approach:

The skin incision is centered over the greater trochanter, with the proximal branch is directed toward the posterior superior iliac spine, ending 4-6 cm short to this bony landmark. Distally the incision extends 15 cm along the midlateral aspect of the tigh. The fascia lata is incised and the gluteus maximus in disected toward the posterior superior iliac spine with care to the inferior gluteal nerve. The insertion of the gluteus maximus into the femur is released, and the sciatic nerve is found along the posterior surface of the quadratus femoris muscle. Then the short external rotators and piriformis tendon are divided and tagged with sutures. Retraction of this muscles allows visualization of the posterior column and retroacetabular space while protecting the sciatic nerve. If additional superior and anterior extension of the exposure is required, to secure buttress plate fixation of a superior posterior wall fracture, anterior extension of the exposure can be achieved by using a standard or a flip osteotomy of the greater trochanter. In this approach, for avoiding sciatic nerve damage, it must be visualized and protected. Typically the nerv runs deep to the piriformis muscle, appearing in the buttock at the inferior border of this muscle, but potential anatomic variations may exist. The most common variation is for one part of the nerve (the peroneal division) to pass through the muscle and the other part (the tibial division) to pass below the muscle.

Surgical Technique

The posterior wall fracture fragments must be delineated and cleared of debris. The femoral head is distracted and free osteochondral fragments are removed from the joint. Distraction can be achieved by inserting a temporary Schanz screw placed through the greater trochanter into the femoral neck. After the fracture fragments have been reduced, any underlying bony defect is filled with structural graft. The small articular fragments can be held in place using temporary Kirschner wires. The use of lag screws must be supplemented with a buttress plate that spans the posterior wall fragments from the ischium to the intact ilium. The plate should be slightly undercontoured so as to provide compression to the posterior wall when tightened. The plate is best placed parallel and close to the rim of the acetabulum, where it can provide the best buttress for the wall fragments. Ideally, three screws are placed cephalad to the fracture fragments and two placed distal, with one of them being a long screw into the ischium. Due to the importance of this issue upon the outcome of the loint, intra-operative fluoroscopic control of screw position (so as to avoid joint penetration) is strongly recommended. Suture include muscular restoration as musch as possible, especially that of the external rotators, so as to prevent any further negative impact upon weight-bearing and gait

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17. Treatment of a Garden II femoral neck fracture using cannulated screws

Femoral neck fractures occur most frequently in elderly female patients, being considered fragility fractures. They are uncommon in patients younger than 60 years, and when they appear, they are usually an expressions of a high energy traumatic agent.

Classification of Femoral Neck Fractures

Garden classification divides femoral neck fractures into four groups. The divisions are based on the degree of displacement, which is judged on the AP radiograph by determining the relationship of the trabecular lines in the femoral head to those in the acetabulum.

Garden I fracture is a valgus-impacted subcapital fracture. The fracture might be considered incomplete with a lateral fracture line that does not breach the medial cortex. The trabecular lines in the femoral head therefore form an angle (valgus) with those in the acetabulum.

Garden II fracture is complete, but undisplaced and the trabecular lines in the head are in continuity with those in the acetabulum and the femoral neck distal to the fracture.

Garden III fractures are complete and partially displaced; the femoral head has not lost contact with the femoral neck, but the head is in varus and extended, resulting in angulation of the trabecular lines. The angulation is in the opposite direction to that described for Garden I fractures (varus) .

Garden IV fractures are complete and totally displaced and the trabecular lines line up as the femoral head returns to a neutral position within the acetabulum. The femoral neck loses contact with the head and externally rotates, so the trabecular lines in the neck are parallel with those in the head.

Patient positioning

The patient is placed supine on the orthopedic operating table, with a fluoroscope positioned to screen an AP and lateral radiograph of the hip. This is facilitated by flexion and abduction of the contralateral hip.Since the fracture is not displaced, careful manipulation should be performed, so as not to displace the fracture

Technique

The surgical exposure is minimal and the procedure can be carried out percutaneously, but it always requires fluoroscopic control. Guide wires are inserted in the femoral neck using the image intensifier to guide the position. Most surgeon prefer to use three cannulated screws, although some studies reveal that two screws have the same efficacy.

Inferior Screw:

Is generally inserted first, and is placed midway between anterior and posterior cortices (as seen on lateral view). The guide-pin should lie inferiorly in the femoral head on AP view and in the center of the head on the lateral radiograph and it should be placed as inferiorly as possible along the calcar. The inferior screw must exit lateral femoral cortex above lesser trochanter, in order to lessen the chance of iatrogenic fracture. When the patient is upright, the inferior screw resists compression.

Two Superior Screws:

After the inferior guide-pin has been placed, two more guide-pins are inserted with the use of image intensification. When the patient is upright, the superior screws resists tension. When sitting the more anterior screw resists tension, whereas the more posterior screw resists compression. The posterior screw is inserted as far peripherally as possible in the lateral plane and centrally in the AP plane. The remaining screw is inserted anteriorly (in the lateral plane) and centrally in the AP plane.

In Garden II fractures, no compression is required; should it be necessary, washers can augment the thightening of the screws.

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18. Hemiarthroplasty of the hip using a bipolar cementless prosthesis for Garden IV femoral neck fractures

Femoral neck fractures occur most frequently in elderly female patients, being considered fragility fractures. They are uncommon in patients younger than 60 years, and when they appear, they are expressions of a high energy traumatic agent.

Classification of Femoral Neck Fractures

Garden classification divides femoral neck fractures into four groups. The divisions are based on the degree of displacement, which is judged on the AP radiograph by determining the relationship of the trabecular lines in the femoral head to those in the acetabulum.

Garden I fracture is a valgus-impacted subcapital fracture. The fracture might be considered incomplete with a lateral fracture line that does not breach the medial cortex. The trabecular lines in the femoral head therefore form an angle (valgus) with those in the acetabulum.

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Garden III fractures are complete and partially displaced; the femoral head has not lost contact with the femoral neck, but the head is in varus and extended, resulting in angulation of the trabecular lines. The angulation is in the opposite direction to that described for Garden I fractures (varus).

Garden IV fractures are complete and totally displaced and the trabecular lines line up as the femoral head returns to a neutral position within the acetabulum. The femoral neck loses contact with the head and externally rotates, so the trabecular lines in the neck are parallel with those in the head.

Bipolar hemiarthropasty with cementless prosthesis

Is indicated in patients with high life expectations, with good bone stock, able to fulfill the non-weight bearing requirements, with healthy acetabular cartilage, with a Garden IV femoral neck fracture, which is an unstable fracture, without chances to heal by osteosynthesis

The use of bipolar hemiarthroplasty has been a very popular alternative to the unipolar hemiarthroplasty. Bipolar heads have a number of proposed advantages. It has two mobile interfaces: one between the inner head and the shell, and the other between the shell and the acetabulum. This dual articulation was proposed to reduce the risk of wear and acetabular protrusion. There is some evidence that the function of the articulation varies with the diameter of the inner head. There are available bipolar designs with head of 22 mm and with 32mm. The prosthesis with the smaller head diameter exhibited predominantly intraprosthetic motion compared with the larger diameter head where motion was mainly extraprosthetic, thus concluding larger femoral heads decrease the risk of late mechanical complications and loosening.

Technique

The procedure is carried out with the patient in the supine position. Most surgeons choose a posterior or a direct lateral exposure. Lateral exposures may result in some abductor weakness, but there is a low risk of dislocation. After incising the fascia, the capsula is cut in a T-shape, with the vertical line situated externally, thus allowing the capsular reconstruction at the end of the procedure, inorder to increase the post-arthroplastic joint stability. After capsulotomy, the fracture is visualized and allows the extraction of the femoral head (prior to the femoral neck osteotomy, if the fragments are not fixed one to the other, but after the femoral neck osteotomy whenever extraction is too difficult.

The femoral neck is measured and the corresponding probe is used in order to evaluate the congruence and stability of the joint with the chosen supposed implant.The femoral canal is then reamed and, after the fluoroscopic control detects the good length and position, the stem is inserted, assuring by X-ray control that the rotation of the prosthesis and the length are correct.

Modern bipolar prosthesis have a modular design with a variety of inner head neck lengths. Trial heads and neck additions are available with some implants. This makes precision in judging tissue tension and leg length easier at the time of surgery. After the modulation is complete, the prosthesis is then reduced. Forceful maneuvers, especially rotation, should be avoided to minimize the risk of a periprosthetic femoral shaft fracture. Once the implant is reduced, the position should be checked by fluoroscopy in AP and lateral view.

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19. Treatment of stable trochanteric fractures with DHS

Definition

Pertrochanteric fractures involve those occurring in the region between the extra capsular basilar neck region to the region along the lesser trochanter proximal to the development of the medullary canal. They can be subdivided into intertrochanteric and peritrochanteric fractures. Their incidence is roughly the same as femoral neck fractures, with a higher incidence in the female population.

In elderly people, they can occur due to low energy falls in osteoporotic patients, while at younger people they are the result of high energy trauma.

Signs and Symptoms

Patients most commonly present with a history of pain and inability to walk after a fall or other injury. The pain is localized to the proximal thigh and is exacerbated by passive or active attempts of hip flexion or rotation. Physical findings include shortening and external rotation of the extremity. The clinical findings will then be correlated with imaging, which generally include only plain radiographs in AP and lateral films, but can be completed with CT and MRI scans for a better diagnosis in undisplaced fractures and atypical fractures in high energy trauma patients.

Classification

Several classifications are used for these fractures:

- Kyle classification describes
  - I Stable 2-part, no comminution
  - II Stable, 3-part, minimal comminution
  - III Unstable 4-part, large posteromedial comminuted area
  - IV Unstable, subtrochanteric extension, highly unstable
- Evans classification includes
  - Type I- oblique fracture line from superior-external to inferior-internal
    - Group 1- internal cortices intact, undisplaced fracture- STABLE
    - Group 2- simple overlapping of the internal cortices, reducible using external manoeuvres- STABLE
    - Group 3- the overlapping of the internal cortices does not reduce, the fracture is UNSTABLE
  - Group 4- comminuted UNSTABLE fracture
  - Type 2- reverse oblique fracture line, UNSTABLE fractures

DHS Technique

Dynamic Hip Screw is indicated in stable trochanteric fractures.

The patient is positioned in a supine position on the fracture table; fracture reduction under fluoroscopy is mandatory before osteosynthesis starts.

A straight incision starting from the tip of the greater trochanter going 10-15 cm downwards (depending on the fracture morphology) is performed. The muscle is split form the external septum and reclined anteriorly, thus discovering the bone.

Using a Hofmann retractor, the guide for the chosen angle of the DHS is fixed on the external cortices.

Under fluoroscopic control, a Kirschner wire is introduced in order to maintain reduction, if necessary; the guide-wire (single use, threaded) is then introduced in the distal part of the femoral neck (on AP view) and in the middle of the femoral neck (on the lateral view) until the subcondral bone. After measuring the guide-wire, the special drill (three-parts), and then the thread are used so as to create the space for the cervico-cephalic screw. After the screw is inserted using fluoroscopy, the plate is placed on the external aspect of the femur and secured with at least 3 cortical 4.5 mm screws ; insufficient fixation of the plate increases the risk of secondary implant failure and trochanteric collapse.

After the compression screw is inserted, a 6.5 partially threaded screw is introduced , as close to the inferior cortices of the femoral neck as possible, so as to prevent rotation.

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20. Treatment of unstable trochanteric fractures with Gamma nails

Definition

Pertrochanteric fractures involve those occurring in the region between the extra capsular basilar neck region to the region along the lesser trochanter proximal to the development of the medullary canal. They can be subdivided into intertrochanteric and peritrochanteric fractures. Their incidence is roughly the same as femoral neck fractures, with a higher incidence in the female population. In elderly people, they can occur due to low energy falls in osteoporotic patients, while at younger people they are the result of high energy trauma.

Classification

Trochanteric fractures can be classified according to Evans, Kyle and the AO-OTA.

Several classifications are used for these fractures:

- Evans classification includes
  - Type I- oblic fracture line from superior-external to inferior-internal
    - Group 1- internal cortices intact, undisplaced fracture- STABLE
    - Group 2- simple overlapping of the internal cortices, reductable using external maneouvres- STABLE
    - Group 3- the overlapping of the internal cortices does not reduce, the fracture is UNSTABLE
  - Group 4- comminuted UNSTABLE fracture
  - Type 2- reverse oblique fracture line, UNSTABLE fractures
- Kyle classification describes
  - I Stable 2-part, no comminution
  - II Stable, 3-part, minimal comminution
  - III Unstable 4-part, large posteromedial comminuted area
  - IV Unstable, subtrochanteric extension, highly unstable

Thus, the unstable fractures are defined based in the comminution of the posteromedial cortex; this means that the fracture will collapse into varus and retroversion when loaded without proper fixation. Fractures with a large posteromedial fragment, with subtrochanteric extension or with reversed obliquity (oblique fracture line extending from medial cortex both laterally and distally) are included in this category.

Gamma nail technique

Unlike the DHS, Gamma nails are indicated both for stable and unstable fractures, due to their superior force distribution resulting from the intramedullary position. After thorough preoperative planning, the appropriate length for the implant is chosen. Fracture reduction as anatomically as possible should be obtained by placing the patient on the fracture table and using fluoroscopy.

Through an incision just above the greater trochanter, the entry point is located and the medullary canal is opened using an awl. Then, the medullary canal is prepared, using flexible reamers or just a one-step conical reamer, depending on the operator's preferences. The targeting device with the Gamma nail is assembled and introduced in proper position under image intensification. The next step is the lax screw insertion, after appropriate measuring and preparation of the bone. The last step is distal screw locking using free hand technique under AP and lateral repeated imaging.

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Links to pre defined protocols for treatment

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21. Treatment of femoral fractures using an unreamed nail

Definition

The femoral shaft consists of strong cortical bone, therefore considerable energy is required to produce the fracture, in normal bone, and especially that it is also protected by a strong surrounding muscular layer. The typical aspect is that of a young patient sustaining a high energy trauma, which produces a femoral shaft fracture, usually associated with other injuries, sometimes as polytrauma.

Due to the considerable vascular supply, as well as due to surrounding tissue associated injuries, femoral fractures have considerable impact upon the general balance, with hemorrhagic and traumatic shock associated. Other complications, such as open fractures and neuro-vascular injuries, frequently worsen the prognosis of these patients.

Signs and Symptoms

In the conscious patient, the diagnosis of the femoral shaft fracture is usually obvious. A complete history is the most important part of the patient evaluation; this includes the injury mechanism, the time elapse from injury to presentation, the location of the accident and any known associated injuries.

Following clinical examination, radiographic evaluation should be performed for the entire femur, followed by CT scans if considered necessary.

Classification

Hansen Classification

Type 0 – no comminution

Type I – small butterfly segment (<25%) or minimally comminuted segment with at least 75% cortical contact remaining between the diaphyseal segments

Type II – butterfly fragment with at least 50% cortical contact between the diaphyseal segments

Type III – large butterfly fragment or comminuted segment (50-75%) with minimal cortical contact between the diaphyseal segments

Type IV – complete cortical comminution such that there is no predicted cortical contact between the diaphyseal segments.

Unreamed Nail Technique

With the patient placed in supine position on the fracture table, the fracture is reduced under image intensifier and AP and lateral radiographs, by traction and rotation, so as to restore the normal anatomy. Careful assessment of symmetrical aspect of the thigh should be repeatedly performed, so as not to produce limb length discrepancy. The nail length can be measured using bone landmarks and fluoroscopy. After incision of the skin at about 10 cm above the tip of the greater trochanter, the entry point of the nail will be set in line with the medullary canal in the AP and lateral views. This point is posterior in the proximal femur, in the piriformis fossa, but varies with patient anatomy. The guide is inserted after closed reduction, the length of the nail is measured again, and then nail insertion is performed. The nail must be carefully inserted so as to limit the distraction on the fractured side. In order to assure stability and to oppose the strong muscular tensions, the femoral nails must be locked both proximally and distally, dynamically or statically, depending on the type of fracture.

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22. Treatment of distal femoral fractures using Dynamic Condylar Screw

Supracondylar femur fractures usually occur as a result of low-energy trauma in osteoporotic bone in elderly persons or of high-energy trauma in young patients. Distal femur fractures can be classified anatomically in supracondylar, intercondylar and combined supra-intercondylar fractures.

The supracondylar part of the femur is the zone between the femoral condyles and the junction of the distal metaphysis with the femoral diaphysis.The distal femur is funnel-shaped, and the area where the stronger diaphyseal bone meets the thinner and weaker metaphyseal bone is prone to fracture .

. The goals of the surgical treatment of distal femur fractures are anatomic reduction of the articular suface, restoration of limb alignment and lenght, stable internal fixation for rapid mobilization and early functional rehabilitation of the knee.

Depending of the type of distal femural fracture and of the biological status of the patient the treatment can be nonoperative (rarely) or surgical.

Surgical treatment further divides in:

-temporary fixation with an external fixator in open fractures, as part of damage control surgery or in patients temporarily medically unfit for surgery;

-closed reduction internal fixation, used in relatively undisplaced fractures, fractures that can be reduced in an closed manner or when large cominution of the metaphysis forbids opening of the fracture site

-open reduction internal fixation for the cases when thereduction and stabilization cannot be proformed in a closed manner.

Open reduction and internal fixation further splits accordingly to the implant used: lag screws, 95 degree angled blade plate, dynamic condylar screw, condylar locking compression plate, less invasive stabilization system.

Preoperative correct classification of the fracture, quite often requiring CT with 3D reconstruction is mandatory as it helps the surgeon to chose the right implant and the most suited approach for the patient.

As an example the dynamic condylar screw plate can be succesfully used in extraarticular type A fractures when interfragmentary compression is necessary

All C-type fractures, complete articular fractures require open operative reduction and internal fixation but the differentation between the C1/C2 injury and the C3 injury is important, the dynamic condilar screw and the blade plate are indicated in C1, C2 injurys and contraindicated in C3 as it may disrupt the complex articular injury.

SURGICAL APROACH

The patient is positioned supine so that complete fluoroscopic evaluation is possible- either on the surgery table with the knee flexed, either on the orthopedic table with a knee special pad. A lateral approach to the distal femur is used. The skin incision starts in line with the diaphysis of the femur and curves distally over the lateral femoral condyle, towards the tibial tubercle. If an arthrotomy needs to be carried out the incision goes to the level of the tibial tubercle, if not the skin incision can stop proximal to the joint line. The iliotibial band is divided, the fascia of the vastus lateralis is incised and the vastus lateralis is elevated off the septum with an elevator, care should be taken to ligate the perforating vessels. If the fracture is articular it should be done a joint capsule arthrotomy.

DYNAMIC CONDYLAR SCREW TECHNIQUE

Reduction of the articular surface is done by direct measures, afterwards provisional fixation with Kirschner wires is carried out. Definitive articular fixation is done by inserting lag screws (4.5 or 6.5 mm) in the periphery of the articular surface. All these procedures are done with X-ray control of each step. Distal femur epiphysis has a trapezoidal shape, it tapers from the posterior to the anterior, when a K-wire or screw is seen penetrating the far cortex on an AP-view that means that the implant is to long. It should be taken an oblique 30 medial inclination X-ray to assess the corect lenght of the implant.

The ideal entry point for the DCS is at 2cm proximal of the articular surface, at the junction of the anterior and medial third of the femur seen from profile, paralel to the tibio-femural articular surface and to the femuro-patelar articular surface.

First is inserted a guide wire, respecting the radiological markers from above, its insertion depth is measured, afterwards with the DCS triple reamer fixed at the correct depth you ream over the guide wire. Then if the patient has a good quality of the bone it should be tapped, if it is an osteoporotic bone, this step could be omitted. The DCS is inserted over the guide wire, at the end of the insertion the T-handle must be parallel to the long axis of the femur in order for the plate barrel to slide over the screw. The plate is connected to the DCS screw, with the impactor the plate is brougt to the bone, sliding over the screw. If further compression is needed, the compression screw could be used. Another screw is inserted threw the first distal hole of the plate, to asure rotational stability of the distal fragment. Afterwards the metaphyseal part of the fracture is reduced and screws are inserted in the proximal fragment.

The wound is closed, drainage is applied.

Post-operative treatment includes thrombo-prophylactic agents, elastic bandage, early rehabilitation procedures, starting when appropriate with passive continous movements using special devices.

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23. Treatment of a Schatzker II fracture of the tibial plateau

Schatzker type II tibial plateau fractures are fractures of the lateral plateau with a wedge-shaped cleavage fracture of the lateral tibial plateau and a depressed component.

They can be treated nonoperative or by surgical means depending on the level of displacement, the stability of the knee, the biological status of the patient and the soft tissue lesions.

The best surgical treatment is by open reduction, internal plate fixation and void filling with spongious bone or calcium phosphate cements.

Patient positioning

Tha patient should lay supine on a radiotransparent table, so as fluoroscopic intra-op is available. The hip is bumped to neutral extremity rotation, and the knee is flexed on a radiolucent platform. The C-arm can be placed on the medial side, leaving the lateral side free for the surgeons to work while the knee is assessed fluoroscopically or as the surgeon prefers. A tourniquet is placed on the limb.

Antero-lateral approach

The skin incision starts 3-5 cm proximal to the joint line, lateral to the border of the patella tendon. It curves anteriorly over Gerdy's tubercle ant then extends distally lateral to the anterior border of the tibia.

Below the joint line, deepen the incision through subcutaneous tissue and incise the fascia overlying the tibialis anterior muscle, detach some of the origin of tibialis anterior from the proximal tibia to expose the bone.

The subcutaneous tissue is divided to expose the lateral aspect of the knee joint capsule.The capsule is incised longitudinally down to the superior border of the lateral meniscus. Divide the synovium, afterwards detach the lateral meniscus from its attachments inferiorly and elevate the meniscus from the lateral plateau thus exposing the split depression. Stain sutures can be inserted on the meniscus to facilitate reattachment during closure. Arthrotomy of the knee is not performed if the arthroscopic control instead of fluoroscopy is chosen

Technique

Reduction of the fracture is composed of the reduction of the lateral split fragment and the elevation of the depressed fragment.To gain exposure and to reconstruct a depressed articular fragment, it is best to exploit the primary fracture line. The lateral condylar fracture fragment can be hinged back on its softtissue attachment,. One can then see the joint depression, which usually consists of a centrally impacted area. Reduction of the articular surface is always accomplished by elevating the fragments from below.

After the fracture is reduced, temporarily fixation with K wires and C clamps is done. The metaphyseal defect, which results when the articular fragments are reduced, must be filled with cancellous autograft or a corticocancellous block to support the elevated fragments. Alternatively bone substitutes may be used.

Bone grafting can be performed by creating a window in the metaphysis and tapping the area of subsidence in the articular surface with an elevator . Elevation of the depressed fragment frequently requires the same maneouvre with the Zanoli device

Plate osteosynthesis is afterwards performed, the plate cand be with angular stability, but are rarely necessary in monocondylar fractures except in osteoporotic bone, usually are used precontoured 3.5mm plates for the lateral tibial plateau.The plate acts as a buttress plate .

In the proximal fragment are inserted screws accordingly to the fracture pattern and the degree of comminution.Compression of the articular fragments and of large metaphyseal fragments is achieved by means of lag screws .In the distal fragment it should be at least three screws.

Wound closure. Drainage is applied. Do not close the fascia to avoid a compartment syndrome. Close the soft tissues in a routine manner.

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24. Treatment of a epi-metaphyseal proximal Schatzker VI fracture of the tibial plateau

Schatzker type VI fractures are high-energy fractures often accompanied by other injuries and complications, such as postoperative inflammation, wound problems and infections. They tend to have a poor prognosis. Various surgical approaches and fixation techniques have been developed to treat Schatzker and VI fractures. The preferred surgical approaches have been the anterolateral single incision and anteromedial/posterolateral bilateral incisions for easier reduction of fractures and better wound healing.

Several fixation methods could be used for tibial plateau fractures including unilateral fixation with a single plate, dual-plate, a hybrid external fixator or a less invasive stabilizing system (LISS). All of these techniques have strengths and weaknesses and there is no clear consensus on which leads to the best outcomes.

Patient Positioning

Patients are positioned supine on the operating table before receiving general or spinal anesthesia. A tourniquet is placed around the proximal thigh. The hip is bumped to neutral extremity rotation, and the knee is flexed on a radiolucent platform. The C-arm can be placed on the medial side, leaving the lateral side free for the surgeons to work while the knee is assessed fluoroscopically or as the surgeon prefers.

Surgical approach

When double plating a Schatzker VI proximal tibia fracture there are performed a antero-lateral approach and a postero-medial approach. The incisions must not be to close, because of the risk of necrosis. The length of the skin incision should correspond with the length of the plate that would give full support to the region of the fracture.

Antero-lateral approach

The skin incision starts 3-5 cm proximal to the joint line, lateral to the border of the patella tendon. It curves anteriorly over Gerdy's tubercle ant then extends distally lateral to the anterior border of the tibia.

Below the joint line, deepen the incision through subcutaneous tissue and incise the fascia overlying the tibialis anterior muscle, detach some of the origin of tibialis anterior from the proximal tibia to expose the bone.

The subcutaneous tissue is divided to expose the lateral aspect of the knee joint capsule. The capsule is incised longitudinally down to the superior border of the lateral meniscus. Divide the synovium, afterwards detach the lateral meniscus from its attachments inferiorly and elevate the meniscus from the lateral plateau thus exposing the split depression. Stay sutures can be inserted on the meniscus to facilitate reattachment during closure.

Postero-medial approach

With the knee in slight flexion the incision runs from the medial epicondyle towards the postero-medial edge of the tibia. After opening the fascia, one should ifentify and expose pes anserinus. Retract the pes anserinus and gastrocnemius posteriorly and distally. Identify the medial edge of the tibial plateau. Identify the meniscus and incise the capsule between the meniscus and the edge of the tibial plateau thus gaining access to the knee joint.

Technique

Rotation, length and axial alignment should be restored first by axial traction (distractor, external fixator or manual traction) and by direct reduction methods, after the fracture is reduced, temporarily fixation with K wires and C clamps is done.

Most often the medial fragment is less comminuted and should be addressed first in order to restore the anatomical relationship of the medial joint surface, original length and rotation. The medial plate is secured with bicortical screws but care must be taken that these do not interfere with the antero-lateral plate placement.

On the lateral plateau, the metaphyseal defect, which results when the articular fragments are reduced, must be filled with cancellous autograft or a corticocancellous block to support the elevated fragments. Alternatively bone substitutes may be used. Bone grafting can be performed by creating a window in the metaphysis and tapping the area of subsidence in the articular surface with an elevator .

Plate osteosynthesis is afterwards performed, the plate acts as a buttress plate .

In the proximal fragment are inserted screws accordingly to the fracture pattern and the degree of comminution.Compression of the articular fragments and of large metaphyseal fragments is achieved by means of lag screws, in cominuted fractures attention must be paid not to narrow the proximal tibia by overtightening .In the distal fragment it should be at least three screws.

Wound closure. Drainage is applied. Do not close the fascia to avoid a compartment syndrome. Close the soft tissues in a routine manner.

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25. Treatment of a tibial fracture using a reamed nail

Fractures of the tibia and fibula are relatively common and have been recognized as serious and debilitating injuries for centuries. Tibial fractures are associeted with a wide range of inujury mechanisms and severities. Altough most fracures are closed, open fractures of the tibia are more commonly seen than in other bones, because of its subcutaneous location.

The most commonly used classification system for fractures of the tibia is the AO/OTA classification which separetes fractures intro three basic types, these being simple fractures (type A), wedge fractures (type B) and complex fractures (type C). The managment of the tibia diaphyseal fractures is influenced most significantly by the state of the soft tissues. Therefore, in clinical practice, there are two more classifications of the soft tissues: the Tscherne and Gustilo classification.

Intramedullary nailing is indicated for the majority of closed mid-shaft fractures of the tibia, as well as for open fractures with adequate soft-tissue cover (type I and II- Gustillo classification). In metaphyseal fractures it may be difficult to control and hold the correct alignment of the short fragment, so many surgeons prefer plates in such situations. Reamed intramedullary nails are preferred for closed fractures, allowing the use of stronger implants of larger diameter and offering a higher chance of undisturbed healing.

Based on the surgeon's preference and experience, the patient is placed on a fracture table or on a radiolucent table, with the leg draped so as to be freely mobile. A support can be placed under the thigh or the knee can be held fully flexed. Surgical access to the ankle for distal locking must be assured.

As the proximal nail entry point is not in line with the medullary canal in the sagittal plane, its exact position varies depending on the nail design and nail stiffness. The recommendations for the different types of nails must therefore be carefully considered. Generally, in the frontal plane the entry point, which should remain extra-articular, must be centered over the canal, especially if there is a short proximal fragment. Eccentric nail insertion will result in a valgus or varus tilt of the proximal fragment. The incision can be performed directly in line with the patellar ligament (which is split in the middle and gently held apart) or medial, parapatellar, so as to go medially to the patellar ligament in order not to violate it. This may result in an eccentric starting point if not monitored by fluoroscopy.

After opening the medullary canal under fluoroscopic control, a guide (with the proper length for reaming) is inserted through the entry point up to the fracture site.

With external maneuvres, the fracture is reduced under fluoroscopic control; failure to perform closed reduction can result in opening the fracture site. The guide is passed from the proximal to the distal fragment under fluoroscopic control, up to the sign of the growth cartilage, thus confirming the length of the nail. Progressive reaming (with 0.5 mm) is performed, preferably using a RIA (Reaming-Instillation Aspiration System), until cortical contact is satisfactory achieved.

With the guide inserted, the nail is introduced under fluoroscopic control, including knee and ankle AP and lateral views, then locking is performed with two screws proximally and distally, so as to prevent the „ bell-tongue" phenomenon.

The most difficult part is determining the correct rotation. Keys to this are matching of cortical thickness on x-rays, placement of pointed fragments in correct position, and ensuring that the tension lines of the skin are not "twisted".

In severely comminuted fractures it is advisable to prepare the opposite leg to allow intraoperative comparison of length and rotation.

After final fluoroscopic control, aspirative drainage is inserted and a recommended elastic bandace is applied after suture.

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26. Treatment of a distal tibial fracture using a Locked Compression Plate

Distal tibial fractures remain one of the most substantial therapeutic challenges that confront the ortopedic traumatologist. The outcome of pilon fractures depends on the quality of reconstruction of the joint and on how well the soft tissues recover. Knowledge of the mechanism of injury is most important. Low-energy trauma usually leads to simpler fracture patterns with minimal soft-tissue injury, while high-energy trauma with axial compression (fall from height, road traffic accident) produces complex intraarticular fractures with metaphyseal impaction and bone loss.

Two main classification sytems are used for the fractures of the distal tibia: the Ruedi and Allgower system and the OTA/AO fractures classification system. Both are descriptive systems, with the severity of the injury only being inferred. The Ruedi and Allgower system is moderately useful and divides fractures of the tibial plafond into three types based on the displacement and degree of comminution of the articular surface: type I – intraarticular fratures without displacemnet, type II – displaced intraarticular fragments without comminution and type III – displacement and comminution of articular fragments.

The majority of displaced distal tibial fracures are managed operatively. The patient lies supine on a radiolucent table. After preparation of the entire limb including the ipsilateral iliac crest, the leg is placed on a pad. This permits rotation for better access both to the medial and lateral sides. A sterile tourniquet is applied to the thigh, but inflated only if necessary.

For the medial side, the incision is vertical, going downward to the tip of the medial malleolus, and proximally as far necessary depending on the vertical extension of the fracture. The skin and subcutanous tissues are split as a flap, so as to minimise the risk of skin necrosis. Good visualisation of the articular surface is mandatory, followed by reduction of the articular gaps with temporary fixation using Kirschner wires. The LCP is placed over the surface of the tibia and fixed using the dedicated instruments.

If necessary, an external incision over the peroneum or an antero-lateral incision over the distal tibia my be performed, depending on the extension of the fracture.The peroneal fracture is fixed using a 3.5mm LC-DCP or a 3.5 mm LCP, depending on the bone stock and the fracture morphology

Some rules must befollwed, regardless of the type of the fracture:

- If more incisions are used, a distance of at least 6-8 cm between them must be repsected, in order to prevent the necrosis of the intermmediate flap
- Safe coverage of the implants with soft tissue is mandatory
- Anatomical reduction of the articular surface is desired
- Fluoroscopic intra-operative control is mandatory

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27. Treatment of a spiroid fracture of the external malleolus (lag-screw+plate)

Ankle fractures represent 10% of all fractures, making these the second most common lower limb fractures, after hip fractures. They are typically low-energy injuries with the majority occurring due to simple falls of sport.

Classification of ankle fractures may be undertaken on the basis of anatomy, injury mechanics or stability. Whilst multiple classification systems have been developed, only a few remain in frequent use. Such is the Danis-Weber, which describes the injury based on the location of the lateral malleolar fracture. Fractures may be classified as A, B or C with the fractures being below, at the level of or above the syndesmosis. The AO-OTA classification, which expands on the Danis-Weber classification, is based upon the location of fractures lines and degree of comminution and serves to describe the severity and the degree of instability associated with a particular fracture pattern.

The doctrine for early movement achieved by open reduction and the rigid internal fixation led to rapid popularization of the use of a laterally placed neutralization plate. However experience over the years with the plating has revealed a number of limitations, such as wound dehiscence and infection, because of the thin tissues over the distal fibula, and the subcutaneous location of the plate. The incision also puts at risk the superficial peroneal and sural nerves, both having variable anatomy.

To start surgery, the patient is placed supine with a bolster under the ipsilateral hip to allow the foot to lie vertically. A tourniquet may be applied to reduce bleeding. A radiolucent box or platform holding the injured ankle above the level of the other side is helpful, allowing lateral fluoroscopy without the need to move the limb. The lateral malleolus is addressed first through a longitudinal incision placed directly over the fibula and centred on the fracture. Blunt dissection is performed through subcutaneous fat to avoid damage to the superficial peroneal nerve. The fracture is identified and periosteum and ligamentous attachments are debrided back from the fracture clearly. The fracture itself is distracted gently to allow irrigation and curettage of clot and small bone fragments. Reduction is achieved and held by the application of a serrated „lobster claw" clamp. The reduction may be assisted with a number of manoeuvres, such as, a gentle torsion movement with the clamp, or if more force is needed, distraction and inversion of the foot and ankle will assist in regaining fibular length.

The next stage is to place a lag screw across the fracture in an orientation as close to perpendicular on the fracture as possible. The lag screw may be placed in either an AP or PA direction. A 3.5 mm gliding hole is drilled in the first cortices and a 2.5 mm pilot hole is then drilled through a cantering device, followed by a countersinking, measuring and screw placement. A one third tubular plate is selected of sufficient length to allow the placement of three screws above and below the fracture. Often a seven-hole plate is needed to avoid conflict with the lag screw. The plate is precontoured and then applied to the bone with three bicortical screws in the proximal diaphysis and three cancellous screws in the distal metaphysis. These distal screws are unicortical and extend to the second cortex, but not through it. Their pull-out strength can be improved by varying their orientation, typically in a triangular construct. As an alternative, the tip of the plate can be bent sharply to allow a long screw to be placed in a retrograde manner.

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https://www2.aofoundation.org/wps/portal/surgery/?showPage=redfix&bone=Tibia&segment=Malleoli&basicTechnique=Malleoli%20fracture%20management%20with%20minimal%20resources

28. Treatment of a calcaneal fracture using a calcaneal plate

Fractures of the calcaneus remain among the most challenging for the orthopaedic surgeon. Calcaneal fractures account for approximately 2% of all fractures, with displaced intra-articular fractures comprising 60% to 75% of these injuries. Calcaneal fractures are most commonly the result of a high energy motor vehicle crash or a fall from a height.

Classification of calcaneus fractures

Based on plain radiography

Essex-Lopresti popularized the concept of two distinct fracture patterns. A tongue type fracture, where the articular fragment remained attached to a tuberosity fragment, and a joint depresion type fracture, in which the articular fragment was separate from the adjacent tuberosity.

Based on CT

The Sanders classification system is used to asses intraarticular calcaneal fractures, which are those involving the posterior facet of the calcaneus. This classification is based on the number of intraarticular fracture lines and their location on semicoronal CT images. This classification is useful not only in understanding typical fracture patterns of the calcaneus, but also in predicting outcome. As you move from type 1 to type 4 injuries, expected outcomes are progressively worse.

Type 1: includes all intraarticular fractures that have less than 2mm of articular displacement, regardless of the number of fracture lines/fragments present.

Type 2a: involves one primary fracture line that courses through the lateral aspect of the posterior facet; the primary fracture usually assumes a "y" shaped configuration as it exits medially and laterally out of the calcaneal body; this fracture is often accompanied by one or more accessory fracture lines that do not involve the posterior articular facet.

Type 2b: involves one primary fracture line that courses through the central aspect of the posterior facet; the primary fracture usually assumes a "y" shaped configuration as it exits medially and laterally out of the calcaneal body; this fracture is often accompanied by one or more accessory fracture lines that do not involve the posterior articular facet.

Type 2c: involves one primary fracture line that courses through the medial aspect of the posterior facet and is accompanied by a transverse fracture through the body of the calcaneus; this fracture is often accompanied by one or more accessory fracture lines that do not involve the posterior articular facet.

Type 3ab: involves two primary fracture lines, one coursing through the lateral aspect of the posterior facet and the second through the central aspect; this subtype usually presents with depression of the central fragment; the two primary fracture lines may be accompanied by additional accessory fracture lines that do not involve the posterior articular facet.

Type 3ac: involves two primary fracture lines, one coursing through the lateral aspect of the posterior facet and the second through the medial aspect; this subtype usually presents with depression of the central fragment. The two primary fracture lines may be accompanied by additional accessory fracture lines that do not involve the posterior articular facet.

Type 3bc: involves two primary fracture lines, one coursing through the central aspect of the posterior facet and the second through the medial aspect; this subtype usually presents with depression of the central fragment; the two primary fracture lines may be accompanied by additional accessory fracture lines that do not involve the posterior articular facet.

Type 4: involves three or more primary fracture lines with greater than 2mm of articular displacement, and are therefore severely comminuted.

ORIF through an extensile lateral approach for joint-depression fractures

The patient is placed in the lateral decubitus position on a beanbag. A pneumatic thigh tournique is used in all cases, and an Esmarch elastic bandage can be used to empty the blood from the limb and provide a dry operative field. All patients should receive preoperative prophylactic antibiotics prior to surgery, and an additional dose of antibiotics is administrated following deflation of the tournique.

The incision which creates less necrotic complications is a curved one, starting approximately 2 cm above the tip of the lateral malleolus, just lateral to the Achilles tendon, continuing vertically toward the plantar surface of the heel, and curves anteriorly " surrounding " the tip of the external malleolus, aiming anteriorly ideally centering over the middle of the calcaneocuboid joint, or carried straight to the base of the fifth metatarsal. It is recommended to create a flap that contains skin and the subcutaneous layer in order to avoid skin necrosis. Once the flap is raised, the calcaneofibular ligament is ecountered and peeled off the calcaneus. The peroneal tendons are dissected of the peroneal tubercle and then freed from the anterior calcaneus. They are slightly subluxated anterior of the lateral malleolus.

When considered useful, the calcaneal tuberosity is predrilled, and a short Schantz pin is placed from lateral to medial. Using the Schanz pin, the tuberosity is pulled plantward and distracted into varus. The lateral fragment is elevated in one piece, then the articular surface is evaluated. A small elevator is used to get underneath the fragment, and the fragments are disimpacted gradually. Then the posterior tuberosity is disimpacted from the sustentaculum, which restores the height and length of the calcaneus.

The articular fragments should be repositioned such that height, rotation and varus-valgus alignment are correct. After reduction the surgeon should obtain intraoperative lateral, Broden and axial fluoroscopic views.

The lateral wall remnant is placed back and an appropriately sized, low profile lateral plate is selected and positioned. The plate position is verified on a lateral fluoroscopic view and the secured with cancellous 4.0 mm screws. The antero-superior screw hole is filled first, followed by the posterior-superior and posterior-inferior screw holes over the posterior tuberosity. The anterior process, the posterior tuberosity and the posterior facet articular surface are secured to the plate with two screws placed into each component. The final reduction is verified fluoroscopically.

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6. Rockwood and Green’s Fracture in Adults, 8th edition

Links

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3. http://www.orthobullets.com/trauma/1051/calcaneus-fractures
4. http://www.aofas.org/footcaremd/treatments/Pages/Calcaneus-Fracture-Surgery.aspx

29. Treatment of meniscal tears

Injury of the knee joint meniscus is one of the most prevalent injuries in the human body. Meniscal tears often occur in young patients who have suffered a twisting injury to the knee. Tears present as severe pain, swelling, and possibly catching, clicking, difficulty on deep knee bending and locking of the knee in partial flexion.

The menisci of the knee have several important roles:

- shock absorption and distributing load throughout the joint
- increasing stability
- providing nutrition for articular cartilage
- limiting extreme flexion and extension
- controlling the movements of the knee joint

Meniscal tears occur due to a shear force between the femur and tibia. In younger patients, this is typically a twisting force on a weight-loaded flexed knee. These are often 'bucket-handle tears', in which there is a vertical or oblique tear in the posterior horn running toward the anterior horn, forming a loose section which remains attached anteriorly and posterior. In older patients, tears are generally due to degeneration and tend to be horizontal tears.

Meniscal tear incidence may be as high as six per 1000 population with a 2.5 to 4 time's male predominance. Age of injury peaks at 20–29 years. Partial meniscectomy (removal of the torn section) is one of the most commonly performed orthopaedic surgical procedures.

Treatment

Nonoperative treatments are an important part of the management of all patients, regardless of whether surgery is being considered. Immediate conservative measures include the RICE regimen:

- Rest (with weight bearing as tolerated or with crutches)
- Ice
- Compression bandaging
- Elevation of the affected limb to minimise acute swelling and inflammation.

The basic principle of meniscus surgery is to save the meniscus. Tears with a high probability of healing with surgical intervention are repaired. However, most tears are not repairable and resection must be restricted to only the dysfunctional portions, preserving as much normal meniscus as possible.

Surgical options include partial meniscectomy or meniscus repair (and in cases of previous total or subtotal meniscectomy, meniscus transplantation).

Partial meniscectomy is the treatment of choice for tears in the avascular portion of the meniscus or complex tears that are not amenable to repair. Torn tissue is removed, and the remaining healthy meniscal tissue is contoured to a stable, balanced peripheral rim.

Meniscus repair is recommended for tears that occur in the vascular region (red zone or red-white zone), are longer than 1 cm, are root tears, involve greater than 50% of the meniscal thickness, and are unstable to arthroscopic probing. A stable knee is important for successful meniscus repair and healing. Thus, associated ligamentous injuries must be addressed.

The principles of repair include smoothing and abrading the torn edges and bordering synovium to promote bleeding and healing. Likewise, needle trephination of the meniscal body (poking holes to create vascular channels) can be performed.

Meniscus repair fixation techniques are numerous and variable. Fixation can be accomplished with outside-in, inside-out, or all-inside arthroscopic procedures.

The outside-in and inside-out methods are usually performed with sutures and require additional incisions. Suture repair can be accomplished with vertical or horizontal stitches. The all-inside method is very popular, and a numerous of commercially meniscus repair devices are available (eg, biodegradable arrows or darts, sliding knot sutures with extracapsular anchor fixation).

Surgical repair of root tears, however, poses a unique challenge in that the meniscus must be repaired to bone. The root is fixed to bone by either arthroscopically-assisted bone suture anchors (all-inside technique) or an intraosseous suture technique ("pullout technique").

Human allograft meniscal transplantation is a relatively new procedure but is being performed increasingly frequently. Meniscus transplantation requires further investigation to assess its efficacy in restoring normal meniscus function and preventing arthritis.

Instead conclusions:

- Meniscal injury is common, and the medial meniscus is more frequently injured.
- Younger and elderly patients typically sustain different types of tears.
- Optimal diagnosis and management is essential to prevent long term sequelae.
- The Thessaly test is the most sensitive and specific clinical test to diagnose meniscal injury.
- Magnetic resonance imaging is first line for investigating potential meniscal lesions, but should not replace thorough clinical history and examination.
- Conservative management is important in all patients with acute rest, intensive rehabilitation with physiotherapy and modification of activity.

Surgical treatment is usually reserved for younger patients with a vertical longitudinal tear within the vascularised outer third of the meniscus (the ’red-red).

Repair of the ’red-white zone’ (watershed area between vascular and avascular meniscus) is controversial with many different surgical techniques.

Tears in the ’white-white zone’ (avascular zone) are rarely repaired – rather the damaged segment is resected (meniscectomy).

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www.mayoclinic.org/diseases-conditions/torn-meniscus

30. ACL reconstruction

The anterior cruciate ligament (ACL) is one of the most commonly injured ligaments of the knee. The incidence of ACL injuries in USA is currently estimated at approximately 200,000 annually, with 100,000 ACL reconstructions performed each year. The incidence of ACL injury is higher in people who participate in high-risk sports, such as basketball, football, skiing, and soccer.

Approximately 50 percent of ACL injuries occur in combination with damage to the meniscus, articular cartilage, or other ligaments.

It is estimated that 70 percent of ACL injuries occur through non-contact mechanisms while 30 percent result from direct contact with another player or object.

The mechanism of injury is often associated with deceleration coupled with cutting, pivoting or sidestepping maneuvers, awkward landings or "out of control" play.

Immediately after the injury, patients usually experience pain and swelling and the knee feels unstable., a loss of full range of motion, and tenderness along the joint line and discomfort while walking.

The prognosis for a partially torn ACL is often favorable, with the recovery and rehabilitation period usually at least three months. However, some patients with partial ACL tears may still have instability symptoms.

Complete ACL ruptures have a much less favorable outcome. After a complete ACL tear, some patients are unable to participate in cutting or pivoting-type sports, while others have instability during even normal activities, such as walking. There are some rare individuals who can participate in sports without any symptoms of instability. This variability is related to the severity of the original knee injury, as well as the physical demands of the patient.

Surgical treatment is usually advised in dealing with combined injuries (ACL tears in combination with other injuries in the knee).

ACL tears are not usually repaired using suture to sew it back together, because repaired ACLs have generally been shown to fail over time. Therefore, the torn ACL is generally replaced by a substitute graft made of tendon.

The grafts commonly used to replace the ACL include:

-Patellar tendon autograft (autograft comes from the patient)

-Hamstring tendon

-Quadriceps tendon

Allograft (taken from a cadaver) patellar tendon, Achilles tendon, semitendinosus, gracilis, or posterior tibialis tendon.

The goal of the ACL reconstruction surgery is to prevent instability and restore the function of the torn ligament, creating a stable knee.

Patellar tendon autograft, occasionally referred as the "gold standard" for ACL reconstruction, it is recommended for high-demand athletes and patients whose jobs do not require a significant amount of kneeling.

The pitfalls of the patellar tendon autograft are:

-Postoperative pain behind the kneecap

-Pain with kneeling

-Slightly increased risk of postoperative stiffness

-Low risk of patella fracture

Hamstring graft - there are some advantages using this kind of graft compared to the patellar tendon autograft :

-Less postoperative stiffness problems

-Smaller incision

-Faster recovery

Disadvantage using this hamstring graft consists in probability to become lax.

The quadriceps tendon autograft is often used for patients who have already failed ACL reconstruction. . There is a high association with postoperative anterior knee pain and a low risk of patella fracture. Patients may find the incision is not cosmetically appealing.

Allografts. These grafts are also used for patients who have failed ACL reconstruction before and in surgery to repair or reconstruct more than one knee ligament. Advantages of using allograft tissue include elimination of pain caused by obtaining the graft from the patient, decreased surgery time and smaller incisions.

Allografts are associated with a risk of infection, including viral transmission (HIV and Hepatitis C), despite careful screening and processing.

Small (one-centimeter) incisions called portals are made in the front of the knee to insert the arthroscope and instruments and the surgeon examines the condition of the knee. Meniscus and cartilage injuries are trimmed or repaired and the torn ACL stump is then removed.

The goals of treatment for an ACL injury are to:

-Restore normal or almost normal stability in the knee.

-Restore the level of function you had before the knee injury.

-Limit loss of function in the knee.

-Prevent injury or more damage to other knee structures.

-Reduce pain.

-Prevent osteoarthritis

In the most common ACL reconstruction technique, bone tunnels are drilled into the tibia and the femur to place the ACL graft in almost the same position as the torn ACL. Now, anatomical technique is preferred. Variations on this surgical technique include the "two-incision," "over-the-top," and "double-bundle" types of ACL reconstructions, which may be used because of the preference of the surgeon or special circumstances (revision ACL reconstruction, open growth plates).

The graft is held under tension and fixed in place using interference screws, suspensor devices, spiked washers, posts, or staples. The devices used to hold the graft in place are generally not removed.

The patient may return to sports when there is no longer pain or swelling, when full knee range of motion has been achieved, and when muscle strength, endurance and functional use of the leg have been fully restored.

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Links

-http://orthoinfo.aaos.org/topic.cfm?topic=a00297

-http://www.webmd.com/a-to-z-guides/anterior-cruciate-ligament-acl-injuries-treatment-overview

1.4. 3 Main rehabilitation protocols in lower limb pathologies

1. Developmental dysplasia of the hip

Non-surgical treatment methods are most common when a baby is less than 6 months of age. The goal is to influence the natural growth processes of the baby so a more stable hip joint is developed [1]. There are a wide variety of positioning devices available, but the most common type is the Pavlik Harness [2]. Other braces called fixed abduction braces are commonly used [3]. Another treatment method is traction. Children who do not improve, or who are diagnosed after 6 months often need surgery. After surgery, a cast will be placed on the child's leg for a period of time [4].

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Links to predefined protocols for treatment:

http://hipdysplasia.org/developmental-dysplasia-of-the-hip/child-treatment-methods/

http://orthoinfo.aaos.org/topic.cfm?topic=a00347

2. Osteonecrosis of the femoral head

The aim of treatment is to prevent collapse of the femoral head and may vary depending on the underlying etiology and stage of progression. Treatment options include physical measures, medication, hyperbaric oxygen treatment, electrical stimulation, extracorporeal shock-wave treatment [1, 2], as well as joint-preserving and joint-replacing surgeries. Physical therapy methods consist in weight bearing exercises, range of motion exercises, muscle strength exercises, aerobic training. All kind of isometric, isotonic and isokinetic exercises can be used [3]. Medical management has been increasingly used in early stages in attempt to delay the progression of the disease [4].

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Links to predefined protocols for treatment:

http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4748149/

http://www.humpalphysicaltherapy.com/Injuries-Conditions/Hip/Hip-Issues/Avascular-Necrosis-of-the-Hip/a~5525/article.html

3. Total hip arthroplasty

Total hip arthroplasty has revolutionized the care of patients with end-stage joint disease, leading to pain relief, functional recovery, and substantial improvement in quality of life[1]. Feasibility of neuromuscular exercise was confirmed in patients about to have total joint replacement [2]. Early postoperative protocols should include additive interventions whose effectiveness has been shown, like: treadmill training with partial body weight support, unilateral resistance training of the quadriceps muscle, and arm-interval exercise program with an arm ergometer. Late postoperative programs are useful and should comprise weight-bearing exercises with hip-abductor eccentric strengthening [1].

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Links to predefined protocols for treatment:

http://www.mattpricemd.com/pdf/total-hip-arthoplasty-protocol.pdf
http://orthoinfo.aaos.org/topic.cfm?topic=a00303
http://www.orthonc.com/sites/default/files/forms/kirby/THA_Posterior_Approach.pdf
http://www.orthoassociates.com/_pdfs/Total_Hip_Replacement_Protocol.pdf
http://www.massgeneral.org/ortho/patienteducation/pt-ed-hiprehab.pdf
http://www.pthaven.com/page/show/811686-total-hip-arthroplasty-hemiarthroplasty-rehab-protocol
http://www.southshoreorthopedics.com/downloads/Total_Hip_Replacement.pdf
http://www.carefirstortho.com.au/pdf/thr-protocol.pdf

4. Revision total hip arthroplasty

Hip revision surgery improves mobility, strength and coordination of the torso and leg, in addition to improving the appearance of the hip and leg. A successful hip revision surgery is also contingent on the patient’s diligence the rehabilitation program following surgery. Physiotherapy rehabilitation after total hip revision is accepted as a standard and essential treatment. The physiotherapy rehabilitation routine has 4 components: therapeutic exercise, transfer training, gait training, and instruction in activities of daily living [1].

References:
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Links to predefined protocols for treatment:
http://www.wbamc.amedd.army.mil/Documents/PatientCare/PostOpRehabProtocols/THA%20Rev%20Post%20WB08.pdf
https://my.clevelandclinic.org/services/orthopaedics-rheumatology/treatments-procedures/hip-revision

5. Talar osteochondral lesion

It is often associated with a traumatic injury, such as a severe ankle sprain. However, it can also occur from chronic overload due to malalignment or instability of the ankle joint. Patients with this condition often complain of localized ankle pain, as well as discomfort on either the inside or outside of the ankle [1]. Physical therapy consists of: working on strengthening the muscles around the ankle, range of motion of the ankle, and balancing (proprioception) [2].

References:

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Links to predefined protocols for treatment:
http://www.physioadvisor.com.au/8071050/osteochondral-lesion-of-the-talar-dome-physioadv.htm
http://www.footeducation.com/foot-and-ankle-conditions/osteochondral-lesions-of-talus-olt-talar-ocds-talar-ocls/

6. Ankle arthrodesis

Ankle arthrodesis is a surgical procedure which fuses the bones that form the ankle joint, essentially eliminating the joint [1]. Patients with longstanding symptomatic ankle arthrosis who have joints so severely damaged that usual pain management techniques fail are candidates for arthrodesis [2]. Once conservative measures have failed, surgery should be considered. Ankle fusion recover best practices often focus on giving the injured foot as much exercise as possible [3].

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https://www.rnoh.nhs.uk/sites/default/files/downloads/physiotherapy_rehabilitation_guidelines_-_subtalar_and_hindfoot_fusion.pdf
http://www.footeducation.com/surgical-procedures/ankle-fusion-arthrodesis/
https://www.tcomn.com/wp-content/uploads/2014/08/Ankle_Fusion_and_Subtalar_Fusion.pdf

7. Posterior tibial tendon dysfunction (acquired flatfoot)

Conservative care often can prevent or delay surgical intervention. Decreasing inflammation and stabilizing the affected joints associated with the posterior tibial tendon can decrease pain and increase functional levels [1]. With many different modalities available, aggressive non-operative methods should be considered in the treatment, including early immobilization, the use of long-term bracing, physical therapy, and anti-inflammatory medications [2-4]. If these methods fail, proper evaluation and work-up for surgical intervention should be employed [5].

References:
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Links to predefined protocols for treatment:

http://www.physio-pedia.com/Posterior_Tibial_Tendon_Dysfunction

http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4094099/

8. Achilloplasty

Achilloplasty is a procedure that lengthens the Achilles tendon [1]. This may be indicated in children with an equinus contracture such as may occur due to cerebral palsy or in clubfoot deformity [2]. It also may be indicated in adults who have a flatfoot deformity, a contracture due to stroke, or have diabetic foot issues which have caused an equinus contracture [3]. The cut Achilles tendon does need to heal, this typically requires six weeks of relative immobilization in a cast, boot, or splint. Partial weight bearing is often possible early on. This is often followed by another six weeks of gradual increasing of activity. The actual recovery may be dictated more by the other procedures that are often done in addition to the Achilles lengthening.

References:

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Links to predefined protocols for treatment:

http://www.livestrong.com/article/423496-physical-therapy-protocol-for-achilles-lengthening/

9. Hallux valgus

The treatment measures go from conservative measures to relieve the pain to surgical care with which the deformity may be permanently removed [1]. Physiotherapy may be used alone or in combination with other conservative treatments as a basic treatment for mild hallux valgus [2]. It also represents an important component of recovery following the correction of hallux valgus deviation, where it helps to restore physiological gait and foot function [3-5].

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Links to predefined protocols for treatment:

https://www.rnoh.nhs.uk/sites/default/files/downloads/rehabilitation_guidelines_for_patients_undergoing_hallux_valgus_deformity-_scarf_osteotomy.pdf

http://www.davidgordonortho.co.uk/wp-content/themes/drgordon/resources/bunion%20surgery%20rehabilitation%20guide%20david%20gordon.pdf

http://www.physio-pedia.com/Hallux_Valgus

10. Pelvis fractures

Athletic teens, the elderly and people with osteoporosis are all at increased risk for pelvic fractures. The severity of the pelvic fracture determines the treatment plan [1]. Typically, stable and uncomplicated fractures do not require surgery but do still require a period of bed rest, pain medications and limited weight-bearing. Pelvic fractures can be treated surgically or non-surgically, but typically in both cases, activity is limited for several months post-injury [2]. Once the bones have healed, strengthening, flexibility and range-of-motion exercises can be prescribed.

References:

1. McCormack R, Strauss EJ, Alwattar BJ, Tejwani NC. Diagnosis and management of pelvic fractures. Bull NYU Hosp Jt Dis, 68:281–291, 2010.

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Links to predefined protocols for treatment:

http://www.moveforwardpt.com/symptomsconditionsdetail.aspx?cid=1388924b-8118-4182-b8e9-247463af00bf

http://www.mdguidelines.com/fracture-pelvis

https://www.kch.nhs.uk/Doc/pl%20-%20702.1%20-%20pelvic%20fracture%20-%20physiotherapy%20after%20surgery.pdf

http://nyulangone.org/conditions/hip-pelvic-fractures/treatments/nonsurgical-treatment-for-hip-pelvic-fractures

https://www.baylorhealth.com/PhysiciansLocations/Dallas/SpecialtiesServices/Orthopaedics/Documents/Hip%20Fractures%20Guide_Web.pdf

11. Acetabulum fractures

The non-operative treatment is recommended for patients with no displacements or minimal displacement, so the superior part of the acetabulum must be intact [1, 2]. Early mobilization is necessary because prolonged recumbency can be life-threatening. Physical therapy includes gait training, stabilization exercises and mobility training. Patients who underwent an operation have to start with passive ROM exercises followed by active non weight bearing such as a series of flexion/extension. Partial weight-bearing with stepwise progression usually starts

6 weeks postoperatively and full weight bearing is eventually allowed at 10 week [3, 4].

References:

1. Magu NK, Rohilla R, Arora S. Conservatively treated acetabular fractures: A retrospective analysis. Indian J Orthop, 46(1): 36–45, 2012.

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Links to predefined protocols for treatment:

http://www.livestrong.com/article/483657-the-rehabilitation-protocol-for-a-hip-acetabulum-fracture/

https://www.stgeorges.nhs.uk/wp-content/uploads/2013/10/88_Physiotherapy_Your+fractured+acetabulum.pdf

http://www.hipandpelvis.com/for-patients/patient-education/patient-education-acetabular-fractures/

12. Medial and lateral malleolar fractures

Ankle fractures are a common injury across all age groups. Management may be operative or nonoperative, depending on the severity of the injury and the patient's overall health and functional status [1, 2]. Rehabilitation after either operative or nonoperative treatment aims at restoring range of motion, strength, proprioception, and function. Rehabilitation is very important regardless of how an ankle fracture is treated.

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1. Lin CC, Moseley AM, Herbert RD, Refshauge KM. Pain and dorsiflexion range of motion predict short-and medium-term activity limitation in people receiving physiotherapy intervention after ankle fracture: an observational study. Australian Journal of Physiotherapy, 55;31-37, 2009.

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Links to predefined protocols for treatment:

https://www.rimed.org/rimedicaljournal/2013/05/2013-05-23-ortho-ankle.pdf

http://orthoinfo.aaos.org/topic.cfm?topic=a00391

13. Calcaneus fractures

Whether the treatment is surgical or nonsurgical, the rehabilitation is very similar. Non-operative management is preferable when there is no impingement of the peroneal tendons and the fracture segments are not displaced (or are displaced less than 2 mm) [1]. Non-operative care is also recommended when, despite the presence of a fracture, proper weight-bearing alignment has been adequately maintained and articulating surfaces are not disturbed [2]. Surgical repair is recommended in calcaneal fractures which present with displaced fracture segments, impinged peroneal tendons, or entrapped medial compartments [3].

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Links to predefined protocols for treatment:

http://www.physio-pedia.com/Calcaneal_Fractures

http://orthoinfo.aaos.org/topic.cfm?topic=A00524

https://xnet.kp.org/socal_rehabspecialists/ptr_library/09FootRegion/31Foot-CalcanealFracture.pdf

14. Talus fractures

The goals of rehabilitation following a fracture of the talus are to decrease pain and to return the individual to full function with a painless mobile ankle. The duration of treatment is related to associated soft tissue involvement and type of fracture. The main focus of rehabilitation should emphasize restoring full range of motion, strength, proprioception, and endurance while maintaining independence in all activities of daily living [1, 2].

References:

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Links to predefined protocols for treatment:

https://xnet.kp.org/socal_rehabspecialists/ptr_library/09FootRegion/28Foot-TalarFracture.pdf

http://www.mdguidelines.com/fracture-talus

http://orthoinfo.aaos.org/topic.cfm?topic=A00170

15. Achilles rupture

The goals of the rehabilitation program in Achilles tendon rupture are reduction of pain and swelling and the recovery of ankle motion and power. The rehabilitation protocol must be directed by the injury and the quality of the repair, along with the patient's age, medical and social history, and athletic inclination. The protocol must be dynamic and responsive to changing clinical findings [1,2]. Some studies support accelerated functional rehabilitation and non-operative treatment for acute Achilles tendon ruptures [3]. Most of the studies recommend early functional postoperative treatment [4].

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Links to predefined protocols for treatment:

http://www.massgeneral.org/ortho-sports-medicine/conditions-treatments/pdfs/Achilles%20repair%20rehabilitation%20protocol.pdf

http://www.stoneclinic.com/achilles-tendon-repair-rehab-protocol

http://www.orthonc.com/sites/default/files/forms/kirby/Achillles_Tendon_Repair.pdf

16. Lisfranc fracture / dislocation

The diagnosis of a Lisfranc injury is challenging due to the presentation similarities it shares with less severe injuries. The available rehabilitation literature has focused on the mechanism of injury and the conservative management of this injury. Lisfranc injuries can be treated conservatively in some cases. There are a variety of recommendations in the literature [1, 2] for conservative treatment ranging from immediate weight-bearing in an orthotic with arch support to non–weight bearing in a cast for 6 weeks.

References:

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Links to predefined protocols for treatment:

https://www.rcmclinic.com/patient-info/foot-and-ankle/119-orif-lisfranc-fracture-post-op

http://www.sw.org/HealthLibrary?page=Lisfranc%27s%20Fracture-Dislocation%20and%20Mid-Foot%20Sprain%20with%20Rehab-SportsMed
http://www.lisfranc.org/2013/09/georgetown-accelerated-post-op-lifranc.html

17. Rehabilitation management of fractures

The management of post-traumatic rehabilitation is based on the RICE rule (Rest, Ice, Compress, Exercises).

The algorithm is divided into immobilization and post-immobilization periods of the PRM programme of care (PRM = physical and rehabilitation medicine). Some authors prefer the next classification of the rehab periods: Pre-operative (if planning of the operation); Early post-operative period; Middle post-operative period; Tardive rehabilitation (stabilization).

The goal of rehabilitation of individuals with fractures is to restore functional abilities of the individual (Salter). The duration and type of rehabilitation treatment required following a fracture are related to the associated soft tissue involvement, as well as the location and type of fracture and the method of stabilization (Chapman). Protocols for rehabilitation must be based upon stability of the fracture and fracture management (operative, nonoperative).

Rehabilitation emphasizes restoring full range of motion, strength, proprioception, and endurance, while maintaining independence in all activities of daily living (Bucholz). Cold and other modalities may be used in controlling pain and edema (Salter). The individual should be encouraged to continue functional activities to prevent complications of inactivity and bed rest. Depending on the stability of the fracture, range of motion exercises of the adjacent joints may be started immediately and progressed to strengthening exercises as indicated (Chapman).

Bone healing may occur within 6 to 20 weeks; however the bone strength and the ability of the bone to sustain a heavy load may take up to several years (Chapman). Once healing has occurred, the individual may resume full activities of daily living. Resumption of pre-injury status is the goal, with consideration of any residual deficit. The treating physician should guide the resumption of heavy work and sports; it is important to instruct the individual not to overload the fracture site until the bone has regained its full strength.

After either surgery, a period of non weight bearing for 6 to 8 weeks is recommended in a cast or cast boot. Weight bearing is started while the patient is in the boot if the X-rays look appropriate after 6 to 8 weeks. The amount of weight a patient can put on their foot, as well as the distance the patient is allowed to walk, is at the surgeon's discretion. Impact activities, such as running and jumping, should be avoided until the hardware has been removed. A lot of ankle supports are applied: splints, braces, insoles, and ankle-foot orthosis orthoses.

Rehabilitation includes predominantly physiotherapy (hands on) procedures - active or passive kinesitherapy in combination with cryotherapy (cold application): range-of-motion exercises, strength exercises, analytic exercises with a gradual increase of the resistance, soft tissue techniques (post isometric relaxation, calf stretch, soleus stretch, plantar fascia stretch, massages), cryotherapy (ice or cold packs), hydro or balneo-kinesitherapy (underwater exercises). The ergonomic approach and ergotherapy (occupational therapy) are obligatory for the quality of gate rehabilitation. In some countries a lot of preformed physical modalities with trophic and analgesic effects are applied: low frequency electric currents, low frequency low intensity magnetic field, laser therapy or laser puncture

In every case a detailed and individually adapted patient education is included in the fracture management process.

BIBLIOGRAPHY (recently used sources):

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18.Rehabilitation after femur fractures

The goal of rehabilitation after a femur fracture is to restore function. The rehabilitation protocol depends on the type, location, and severity of the fracture, as well as the physician's protocol for treatment. Consideration must be given to the method for stabilizing the fracture (operative, nonoperative) and on the stability of the fractured bone. The individual's general condition prior to the fracture and the individual's weight-bearing status may influence the rehabilitation process.

Of primary importance during the early phase of recovery is ambulation, with weight bearing as advised, and assistive devices as needed. Depending on the procedure, partial weight bearing may be delayed until there is evidence of bony union, and full weight bearing may be restricted for an additional month (Whittle). The physical therapist should teach ankle exercises to promote circulation through the lower extremities and should advise individuals to perform these intermittently throughout the day.

As the individual increases his or her mobility, an occupational therapy evaluation may be beneficial to maximize independence with activities of daily living and to supply adaptive equipment, such as a raised commode or tub seat, to promote independence.

Once the fracture is stable, gentle range of motion and strengthening exercises can be started and progressed as indicated. The therapist should make sure that adjacent joints are exercised to prevent loss of motion and strength (Whittle). Both to complement supervised physical therapy and to be continued independently after the completion of rehabilitation, a home exercise program should be taught during this period.

Bone healing may occur within 6 to 12 weeks; however, the bone strength and the ability of the bone to sustain a heavy load may take up to several years (Chapman). Once healing has occurred, the individual may resume full activities of daily living. It is important to instruct the individual not to overload the fracture site until the bone has regained its full strength. The resumption of heavy work and sports should be guided by the treating physician.

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2. Rang M. Story of Orthopaedics. Philadelphia, Pa: WB Saunders;. 2000:373-395.
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4. http://www.mdguidelines.com/fracture-femur/rehabilitation

19. Intertrochanteric femur fractures

Intertrochanteric fractures are considered one of the three types of hip fractures. The anatomic site of this type of hip fracture is the proximal or upper part of the femur or thigh bone.

An intertrochanteric fracture was described by Cooper in his treatise of 1851 as follows: ‘’...fracture of the femur through the trochanter major, passes obliquely upwards and outwards from the lower portion of the neck but instead of traversing the neck completely, it penetrates the base of the trochanter major; the line of fracture being such as to separate the femur into two fragments, one of which is composed of the head, neck and trochanter major, and the other of the shaft with the remaining portions of the femur.—Cooper’s recommended treatment was "moderate extension and steady support of the limb in its natural position."

Current treatment of intertrochanteric fractures involves surgical intervention. Open reduction and internal fixation (ORIF) is indicated for all intertrochanteric fractures, unless the patient’s medical condition is such that any anesthesia, general or spinal, is contraindicated. Total hip arthroplasty has a limited role in treatment and is usually reserved for patients with coexisting severe symptomatic arthritis of the hip. External fixation is also rarely indicated but is useful as a quick procedure in patients who may not tolerate general or spinal anesthesia and can only tolerate local techniques. Medial displacement osteotomy and valgus reduction are no longer practiced, because of the severe deformities they produced and because of substantial advances in the understanding of fracture fixation.

The future of intertrochanteric fracture repair focuses, in part, on preventing such fractures by means of antiosteoporosis treatments, including medications and health programs. Another focus includes fixation devices that require smaller incisions and are more forgiving, with retention of the fixation, regardless of whether the fracture is ideally reduced or has an element of instability. A final goal is to eliminate or substantially decrease the mortality and morbidity of postoperative deep vein thrombosis (DVT) and pulmonary embolism (PE) by developing a better understanding of the clotting mechanism and the genetic, metabolic, serologic, and hormonal factors that affect the likelihood of developing PE.

Rehabilitation begins in the first post-operatory day. The early physiotherapy is oriented towards impairments in range of motion, knee extensor and hip abductor strength, and gait.

The PRM programme includes: respiratory exercises, active exercises for hip and knee muscles, gait training. Interventions are focused on immediate weight bearing and early progression of strengthening.

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20. Femur shaft fractures

Fractures of the femoral shaft often result from high energy forces such as motor vehicle collisions. Complications and injuries associated with midshaft femur fractures in the adult can be life-threatening and may include hemorrhage, internal organ injury, wound infection, fat embolism, and adult respiratory distress syndrome. Femoral shaft fractures can also result in major physical impairment due to potential fracture shortening, malalignment, or prolonged immobilization of the extremity with casting or traction [2]. The art of femoral fracture care involves a balancing act between anatomic alignment and early functional rehabilitation of the limb.

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21. Distal femur fractures

Defined as fxs from articular surface to 5 cm above metaphyseal flare. Two types of mechanisms are described:

i. In young patients - high energy with significant displacement,

ii. older patients - low energy in osteoporotic bone with less displacement.

Descriptive classification – supracondylar or intercondylar;

OTA classification 33 :

A: extraarticular,

B: partial articular - portion of articular surface remains in continuity with shaft, or: 33B3 is in coronal plane (Hoffa fragment),

C: complete articular - articular fragment separated from shaft.

Non-operative Treatment: hinged knee brace with immediate ROM, NWB for 6 weeks

Operative treatments includes: open reduction internal fixation, retrograde IM nail, distal femoral replacement

Surgical techniques:

- ✓ ORIF Approaches (anterolateral, lateral parapatellar, medial parapatellar, medial/lateral posterior);
- ✓ Blade Plate Fixation ;
- ✓ Dynamic Condylar Screw Placement;
- ✓ Locked Plate Fixation;
- ✓ Non-fixed angle plates;
- ✓ Retrograde interlocked IM nail.

BIBLIOGRAPHY:

http://www.orthobullets.com/trauma/1041/distal-femur-fractures

22. Patella fracture

Patellar (KneeCap) fractures account for 1% of all skeletal injuries; occur either by direct impact injury or indirect eccentric contraction; male to female 2:1; most fractures occur in 20-50 year olds.

Patella sleeve fracture is seen in pediatric population (8-10 year olds). The Bipartite patella may be mistaken for patella fracture.

Classification is based on fracture pattern: nondisplaced, transverse, pole or sleeve (upper or lower), vertical, marginal, osteochondral, comminuted (stellate).

The nonoperative treatment consists in knee immobilization in extension (brace or cylinder cast) and full weight bearing.

Different types of Operative treatment are applied: ORIF with tension band construct, partial or total patellectomy.

Rehabilitation is needed in all cases and depends from the type of principal treatment.

PRM programme plays a vital role in getting the patient back to daily activities. Keeping the fractured leg immobilized in a cast can result in knee stiffness and weak thigh muscles. Specific exercises will help strengthen the leg muscles and restore range of motion in the fractured knee.

A Knee conditioning programme is realized.

The orthopedic surgeon will tell when the patient can begin to put weight on the leg. Initial weight-bearing exercise is usually limited to gently touching the toe to the floor. As the injury heals and the muscles strengthen, the patient will gradually be able to put more weight on the leg.

The most often Long-Term Outcomes are: Arthritis, Muscle weakness, and chronic pain.

In order to protect the development of complications, some lifestyle changes are suggested: avoiding exercise activities that involve repetitive deep knee bending or squatting; Climbing stairs or ladders should be avoided, as well.

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23.Proximal tibia fractures

Synonyms: proximal tibial fracture, tibial plateau fracture

Tibial Plateau Fracture ICD-10

- S82.101A - Unspecified fracture of upper end of right tibia, initial encounter for closed fracture
- S82.102A - Unspecified fracture of upper end of left tibia, initial encounter for closed fracture
- S82.109A - Unspecified fracture of upper end of unspecified tibia, initial encounter for closed fracture

The tibial plateau is one of the most critical loadbearing areas in the human body; fractures of the plateau affect knee alignment, stability, and motion. Early detection and appropriate treatment of these fractures are critical for minimizing patient disability and reducing the risk of documented complications, particularly posttraumatic arthritis.

Sir Astley Cooper first described fractures of the proximal tibia in 1825. Anger treated most minimally displaced fractures with early knee traction mobilization. Rausmusen introduced open reduction and internal fixation (ORIF) of tibial condylar fractures, and Sarmiento popularized functional cast bracing of most tibial condylar fractures.

More than 50% of patients who sustain a tibial plateau fracture are aged 50 years or older. The increased frequency of tibial plateau fractures in older females is due to the increased prevalence of osteoporosis in these individuals. Tibial plateau fractures in younger patients are commonly the result of high-energy injuries.

Approximately 50% of the knees with closed tibial plateau fractures have injuries of the menisci and cruciate ligaments that usually require surgical repair. Because of the valgus stress at the moment of impact, the medial collateral ligament is at greater risk than the lateral collateral ligament; however, disruption of the lateral collateral ligament is of grave concern because of possible injuries to the peroneal nerve and the popliteal vessels. Dislocation-relocation injuries are more common with medial plateau injuries and carry an increased risk of peroneal nerve damage.

From the group of Tibial Plateau Fractures, the fracture displacement ranging from 4-10 mm can be treated nonoperatively; however, a depressed fragment greater than 5 mm should be elevated and grafted.

The following are absolute indications for surgery: Open plateau fractures, Fractures with an associated compartment syndrome, Fractures associated with a vascular injury.

Rehabilitation is needed in all cases.

Early complications include the following: Compartment syndrome, Vascular injuries, Swelling and wound-healing problems, Infections, Deep vein thrombosis, Nerve injuries.

Late complications include : Knee stiffness, Knee instability, Angular deformities, Late collapse, Malunion, Osteoarthrosis.

Nonweight bearing precautions generally continue for 12 weeks. Active flexion and passive extension are encouraged for 6 weeks, after which period active knee extension is started. Active knee extension is delayed if ORIF of a tibial tubercle avulsion was required.

The pure Physical therapy includes physiotherapy and cold-therapy.

The rehabilitation protocols includes predominantly knee range of motion (ROM) and stretching exercises, but too balance and proprioception exercises.

Cold treatment (icing) relieves pain and reduces inflammation. Cold treatment should be applied for 10 to 15 minutes every 2 to 3 hours, and immediately after activity that aggravates your symptoms. Use ice packs or an ice massage.

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24. Distal tibial fractures

Fractures of the tibia can involve the tibial plateau, tibial tubercle, tibial eminence, proximal tibia, tibial shaft, and tibial plafond.

The tibial plafond fracture or Plafond fractures are infrequent injuries, accounting for 7-10% of all tibial fractures. Most fractures are secondary to high-energy trauma that result in significant bone and soft tissue damage. Plafond fractures are also known as "pilon" fracture, or "explosion fracture."

Goals of treatment are: Reestablishment of articular congruity, Stable fixation of the metaphysis to the diaphysis in acceptable alignment, Prevention of complications, Rapid return to function. Acute ankle-spanning external fixation followed by delayed reconstruction of the tibial plafond with plating or limited internal fixation combined with external fixation is the primary treatment option in cases of extensive soft tissue injury. Long-leg cast may be an acceptable treatment in patients with isolated, nondisplaced fractures. Acute open reduction with internal fixation (ORIF) should be limited to low-energy fracture patterns with minimal soft tissue injury or swelling. IM nailing with internal fixation is indicated in the event of tibial diaphyseal fractures with nondisplaced split through the plafond. Supplemental fixation of the split should be considered For pain and soft tissue considerations, early motion should be delayed 7-10 days following treatment. In all intra-articular fractures, weight-bearing is prohibited in the first 8 weeks.

The most common complication is post-traumatic osteoarthritis.

The type of external fixation device and the need for concomitant fixation of the fibula are the major sources of debate. Hybrid external fixation systems or articulated frames are the main devices used for fixation.

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25. Rehabilitation programmes of care after knee surgery in traumatic knee conditions

In all traumatic knee conditions with a knee surgery the PRM Algorithm includes: Functional evaluation of the knee mobility and stability (see table of the Knee Society) and a Complex PRM programme of care, including natural and pre-formed physical modalities. The pre-defined PRM protocol includes only physiotherapy (analytic exercises) combined with cryotherapy. We consider that the traditions of some rehabilitation schools (including Bulgarian, Romanian, etc.) can be used too: we apply preformed physical modalities - electrostimulations of the quadriceps femoris muscle (accentuating on m.vastus lateralis and musculus vastus medialis); interferential currents; low intensity low frequency magnetic field; ultraphonoforesis with NSAIDs.

Knee Society

Knee Society Rating	Points	Patient Score
Pain (50 points)		
None	50	= 50
Mild or occasional	45	
Stairs only	40	
Walking and stairs	30	
Moderate occasional	20	
Moderate continual	10	
Severe		
Range of Motion 5 degrees = 1 point	25	= 25
	0	
Anteroposterior Stability (maximum movement in any postion)		= 10
<5mm	10	
5-10mm	5	
10mm	0	
Medial lateral Stability		= 15
<5 degrees	15	
6-9 degrees	10	
10-14 degrees	5	
15 degrees	0	
Deductions		= 0
Flexion contracture		
5-10 degrees	2	
10-15 degrees	5	
16-20 degrees	10	
>20 degrees	15	
Extension lag		
<10 degrees	5	
10-20 degrees	10	
>20 degrees	15	
Alignment		
5-10 degrees	0	
0-4 degrees	3 points each	
11-15 degrees	3 points each	
Other		

Function Rating		
Walking		= 50
Unlimited	50	
>10 blocks	40	
5-10 blocks	30	
<5 blocks	20	
Housebound	10	
Unable	0	
Stairs		= 50
Normal up and down	50	
Normal up; down with rail	40	
Up and down with rail	30	
Up with rail; unable down	15	
Unable	0	
Deductions		= 0
Cane	5	
Two canes	10	
Crutches or walker	20	

Score

Knee Rating= 100
Function= 100
(Adapted from: Insall JN, CORR 1989; 248: 12)

Knee arthroplasty / knee endoprosthesis

REHABILITATION AFTER JOINT REPLACEMENT (ENDOPROSTHESIS)

Endoprosthesis is the reconstruction of joints with mobile artificial joint models, consisting of metal alloys and synthetic materials. These reconstructions are performed on the shoulder, elbow, hip and knee joints. The achievement obtained on the knee and hip reconstructions could not be obtained in upper extremity reconstructions.

Endoprosthesis is a good option for: knee calcifications that do not respond to intra-articular injection or physiotherapy; for patients who are considered not to benefit from knee arthroscopy and directing operations; in those who had such operations but have persistent complaints; for calcifications which do not respond to drug injection or physiotherapy applications in the hip joint.

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25. UNICOMPARTMENTAL KNEE ARTHROPLASTY

Unicompartmental knee arthroplasty is a surgical procedure used to relieve arthritis in one of the knee compartments in which the damaged parts of the knee are replaced. UKA surgery may reduce post-operative pain and have a shorter recovery period than a total knee replacements. Also, UKA may have a smaller incision because the implants may be smaller.

In the United States, this procedure constitutes approximately 8% of knee arthroplasty.

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Partial knee replacement (PKR) is a surgical procedure that helps relieve arthritis in one or two of the three compartments of the knee. With PKR, only the damaged area of the knee joint is replaced, which may help to minimize trauma to healthy bone and tissue. Stryker has worked with surgeons to develop innovative products to be utilized in Partial Knee Replacement surgery. Stryker's

Robotic-Arm Assisted partial knee replacement procedure is designed to relieve the pain caused by joint degeneration due to osteoarthritis (OA).
There are three types of Partial Knee Replacement.

1. Unicondylar Knee Replacement is a procedure that replaces only the single affected compartment of the knee, either the medial or lateral compartment.
2. Patellofemoral Knee Replacement is a procedure that replaces the worn patella (the kneecap) and the trochlea (the groove at the end of the thighbone).
3. Bicompartmental Knee Replacement is a procedure that replaces two compartments of the knee, the medial and patellofemoral compartments.

26. Total knee arthroplasty/ revision total knee arthroplasty

REHAB: Patients with knee endoprosthesis are transferred from acute to subacute or outpatient rehab at an ever earlier stage. In rehab, major goals are the improvement of range of motion of the knee or hip. In addition to individual physiotherapy, it is inevitable that the patient participates in accompanying measures.
In the early stage of rehab, a motor splint is usually utilized. Further on in the rehab process, it is important that the patient starts to become active and to apply his/her own strength. Often, the transition from continuous passive motion with the motor splint to active training on an ergometer turns out to be problematic. Due to a small range of motion, pain or hematoma, the application of a cycle ergometer is not yet possible in many cases.
Training goals:

- Improvement of motor skills, cardiovascular conditions and strength
- Prevention of contractures (mobilization of joints, muscles and tendons)
- Prevention of thrombosis (improvement of the venous backflow from the legs)
- Rapid muscle build-up: Particularly in patients with a non-cemented endoprosthesis, who usually tend to have larger deficits in the area of quadriceps and gluteal muscles, enforced muscle gain can regularly be observed after additional training with a mechanotherapy device, v.g. the MOTOmed leg trainer.

- Early start of active training (less muscle loss, less stiffening). Particularly for weaker and older patients, the combination of passive-assistive and active training has proven to be of great value: In order to initiate movement, the legs are being moved and loosened up by the motor without any strain on the patient. After that, the patient can start cycling him/herself against a minimal resistance, even if putting in very little impulses. The motor supports the movement (assistive training). A further progression of the training is the active cycling against finely adjustable resistances.
- Improvement of circulation and therefore increased sensation of warmth
- Improvement of the general patient condition: Psychologically, a transition to an active form of training is of great importance for many patients. Thus, it can be quite valuable for post surgery patients to be able to perform movements without pain or tension after a long time of great pain and relieving postures.
- Support of the process to restore a correct gait pattern: Usually, physiotherapy training is only provided during the first two months after surgery. However, studies show that the largest increase of muscle strength only happens after those two months. Therefore, it is important that the patients continue with muscle strength training after the period of physiotherapy.

PRM programmes

- Rehab programmes after total KNEE REPLACEMENT
  - In patients with gonarthrosis
  - In patients with knee fracture

- Rehab procedures after partial KNEE REPLACEMENT
  - In patients with gonarthrosis
  - In patients with trauma of the knee

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28. ACL reconstruction

Rehab programme in case of ACL Reconstruction

Anterior cruciate Ligament – ACL tear

The Injury: The anterior cruciate ligament (ACL) is an important stabilizing ligament of the knee. It is located deep inside the knee joint and provides almost 90% of the stability to forward force on the joint. Injuries to this ligament are very common in aggressive sports such as skiing and basketball. Injury to the ACL usually occurs with a sudden hyperextension or rotational force to the joint. The exact mechanism differs for different sports. Typically the injured athlete will hear or feel a "pop", and will have sudden onset of pain, instability and swelling. If this scenario occurs, the athlete should not attempt to continue playing, and should seek medical attention. Because the ACL is such an important stabilizer of the knee, injury to the ligament makes it difficult to participate in aggressive twisting sports.

It should be emphasized that certain sports can continue to be performed quite well without an ACL. These are "straight ahead" sports such as bicycling, rollerblading, light jogging and swimming. Twisting, cutting and jumping sports are not recommended however due to the risk of the knee giving way. The knee is designed to work as a hinge, moving in one plane. With a torn ACL, there is increased play in the joint allowing shearing forces across the cartilage surface, and leading to progressive tearing of the cartilage discs (menisci) and breakdown of the joint surface. Over time, this breakdown leads to degenerative arthritis.

Treatment Options: Treatment of ACL injuries has come a long way in the past ten years. Today athletes have greater than a 90% chance of returning to their pre-injury level of sports participation.

Non-Surgical : Conservative care is recommended for minor and partial tears of the ACL, or tears in which the knee is still within the accepted limits of stability (less than 3mm of laxity). Non surgical treatment is also recommended for the patient who is willing to modify their activity to non twisting less aggressive sports. In these athletes, we begin an immediate specialized rehabilitation program, and provide a custom fitted knee brace for use during sports activity.

Surgical Options: Surgery for ACL injuries is extremely specialized and should only be performed by a surgeon who specializes in this type of injury. The techniques continue to change and only someone on the cutting edge can hope to stay up with all of the latest changes.

Surgical Technique

- Suture Repair of the ACL.
- Reconstruction: creating a new ligament out of a tendon from another location in the patient’s knee or using cadaver tissue. There are three popular choices for the choice of tissue:

Patella Tendon (Autograft)

- This means taking a strip of the tendon from the front of the athlete’s own knee (autograft), and is the most popular choice for this surgery. This technique has been utilized for the longest period of time in the largest number of patients, and is considered the gold standard for ACL reconstruction.
- Advantages: Strong graft, with bone attachments at each end, which allows the graft to be fixed very solidly at the time of surgery and which allows

healing to the body in the shortest period of time (bone to bone healing) of 4-6 weeks.

- Disadvantages: Requires taking tissue from the body. This may cause donor site soreness in a small percentage of patients. To avoid this we utilize a unique method for harvesting the patella tendon graft. This method utilizes a round oscillating tool, which takes a circular graft and leaves the patella with a smooth defect. This makes the patella much less prone to any post surgical problems, and we have not found this to be a problem in many hundreds of patients.

Hamstrings

Allograft

New Frontiers - ACL Tightening (Shrinkage): Currently a study utilizing a new technique which tightens the partially torn or stretched ACL is performed. This is not applicable to the completely torn ligament. Surgery is done arthroscopically with no incisions. Recovery time is dramatically faster than with a reconstruction.

- AFTER-CARE REHABILITATION: Patients are sent home with a knee brace for the first day. Range of motion is started as soon as the wound is checked. Early goals are to obtain range of motion and to reeducate the muscles. Weight bearing is begun immediately with crutches. The brace is utilized for three weeks or until the quadriceps are strong enough to support the limb. Crutches are discontinued after 1-2 weeks. Stationary bicycling is begun as soon as the patient can achieve 100 degrees of flexion and can get around on the pedal (usually 2 weeks). Outdoor bicycling and jogging are allowed at 3 months. Return to twisting cutting and jumping sports is delayed for 6 months since this is how long it takes for the graft to biologically heal. Prior to returning to sports, the patient is expected to have regained 90-95% of their muscular strength.

- The pre-defined PRM protocol includes only physiotherapy (analytic exercises) combined with cryotherapy. We consider that the traditions of some rehabilitation schools (including Bulgarian, Romanian, etc.) can be used too: we apply preformed physical modalities - electrostimulations of the quadriceps femoris muscle (accentuating on m.vastus lateralis and musculus vastus medialis); interferential currents; low intensity low frequency magnetic field; ultraphonoforesis with NSAIDs.

Prognosis: ACL reconstruction is a highly successful operation. 90-95% of patients can be expected to return to full sports participation with 6 months and with aggressive rehabilitation.

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29. Posterior cruciate ligament reconstruction

Rehab procedure in case of PCL Reconstruction

The posterior cruciate ligament, or PCL, is one of four ligaments important to the stability of the knee joint. The PCL is the ligament that prevents the tibia from sliding too far backwards. Along with the ACL which keeps the tibia from sliding too far forward, the PCL helps to maintain the tibia in position below the femur.

PCL Tears: The most common mechanism of injury of the PCL is the so-called "dashboard injury." PCL tears can be associated with other knee ligament injuries, including ACL tears, MCL tears, and LCL tears. They can also be found with complex ligament injury patterns such as posterolateral rotatory instability. In addition, PCL injuries may be associated with meniscus tears and cartilage damage.

The major factor in making the diagnosis of a PCL tear is by knowing how the injury happened. Knowing the story of the injury (for example, the position of the leg and the action taking place) will help in making the diagnosis. Specific maneuvers can test the function of the PCL. The most reliable is the posterior drawer test. X-rays and MRIs are also helpful in clarifying the diagnosis and detecting any other structures of the knee that may be injured. It is common to find other ligament injuries or cartilage damage when a PCL tear is found.

PCL tears are graded by the severity of injury, grade I through grade III. The grade is determined by the extent of laxity measured during your examination. In general, grading of the injury corresponds to the following: Grade I: Partial tears of the PCL; Grade II: Isolated, complete tear to the PCL; Grade III: Tear of the PCL with other associated ligament injury.

Treatment of PCL tears is controversial, and, unlike treatment of an ACL tear, there is little agreement about the optimal treatment for all patients. Initial treatment of the pain and swelling consists of the use of crutches, ice, and elevation. Once these symptoms have settled, physical therapy is beneficial to improve knee motion and strength. Nonoperative treatment is recommended for most grade I and grade II PCL tears.

Surgical reconstruction of the PCL is controversial, and usually only recommended for grade III PCL tears. Because of the technical difficulty of the surgery, some orthopedic surgeons do not see the benefit of PCL reconstruction.

Others, however, believe PCL reconstruction can lead to improved knee stability and lower the likelihood of problems down the road.

Surgical PCL reconstruction is difficult in part because of the position of the PCL in the knee. Trying to place a new PCL graft in this position is difficult, and over time these grafts are notorious for stretching out and becoming less functional. Generally, surgical PCL reconstruction is reserved for patients who have injured several major knee ligaments, or for those who cannot do their usual activities because of persistent knee instability.

Knee Exercises are obligatory. The goal of knee rehab is twofold: to prevent weakening of the muscles that surround the knee, and to diminish the burden on the knee joint. Stretches are important, strengthening exercises for all muscles that surround the knee : quadriceps, hamstring, and calf muscles. Increasing endurance is best accomplished with low-impact cardiovascular activities, among the best of which is riding a stationary bicycle. Also excellent are swimming or other pool workouts. Walking is an OK exercise, but higher impact on the knees.

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30.Meniscus tears

MENISCUS TEAR

The Injury: The meniscus is a circular shaped disc of cartilage tissue that function as a shock absorber between the bones of the knee. The meniscus is frequently damaged in twisting injuries or with repetitive impact over time. When the meniscus tears, a piece of cartilage can move in an abnormal way inside the joint causing pain catching and swelling. Because cartilage has no blood supply, normal healing does not occur.

Treatment Options: New techniques currently allow the meniscus to be repaired arthroscopically, using sutures or small dissolving tacks, eliminating the need for an incision in many cases.

In cases where the torn meniscus cannot be repaired, the smallest possible amount of tissue is removed, in order to preserve as much cushion for the joint as possible.

In rare cases, where a large portion of the meniscus has to be removed, current techniques allow transplantation of a new meniscus from a cadaver.

AFTER CARE REHAB: Surgery is done as an outpatient, using arthroscopic techniques. Immediate weight bearing is allowed using crutches for 48 hours. Range of motion and physical therapy are started immediately. Bandages are removed after 24 hours and band aids are applied. Stationary bicycling is allowed within a few days.

Prognosis: Results are 90-95% successful, with full return to sports at 4-6 weeks for most surgeries. Complex repairs and transplantations may take 6 months for full recovery.

- PRM programmes after MENISCECTOMY
- After PARTIAL meniscectomy
- After TOTAL meniscectomy

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Chondral injury of the knee

PATELLA (KNEE CAP) PATHOLOGY

The patella is a relatively small bone in the front of the knee that is embedded in the quadriceps (thigh muscle) tendon and acts to increase the biomechanical leverage of the quadriceps. The patella slides in a groove on the femur as the knee flexes and extends. Because the patella 'floats' within the substance of the quadriceps, proper tracking of this bone in the femoral groove is dependent on proper muscle balance to maintain a central position. Congenital anatomic factors such as the shape of the patella also influence this tracking. Also, because of the location of the patella, it is subject to higher stresses than other joint surfaces. So, despite having a thicker cartilage lining than any other bone, it often begins to wear out before other parts of the knee.

CHONDROMALACIA PATELLAE (Erosion of the knee cap)

Definition: This is a Latin term meaning softening or break down of cartilage. Chondromalacia of the patella is one of the most common problems to affect the knee, and is particularly common in running and jumping athletes. Chondromalacia usually begins as softening of the otherwise very resilient cartilage and proceeds to cracking and eventually complete loss of the cartilage lining beneath the patella. Symptoms include: Pain in the front of the knee, crunching under the knee cap, swelling in the knee, symptoms increase with stair climbing, or prolonged sitting.

Early on, symptoms may simply be mild aching in the area of the patella due to the loss of integrity of the cartilage and a diminished ability for it to protect the underlying bone. Nerve fibers in the bone sense the increased stresses and pain occurs. In later stages of chondromalacia, the cartilage surface of the patella becomes roughened as pieces of cartilage begin to break off. This roughened surface causes a crunching sound under the patella and can lead to swelling of the knee. Symptoms will aggravate as small fragments of cartilage continue to break off and irritate the joint.

Treatment Options: Initial treatment focuses on physical therapy techniques for strengthening the muscles around the patella to balance the patella tracking and more evenly distribute forces on the patella. In severe cases, ice and anti-inflammatory drugs will be necessary to calm down inflammation before exercises can be initiated. Occasionally, a patella tracking brace or special taping techniques will be utilized. Most patients will improve with non surgical management. In resistant cases arthroscopic surgery can be very helpful in smoothing out the roughened surface of the patella, removing any loose fragments of cartilage, and realigning the patella. Many cases of chondromalacia can be helped by a mini arthroscopy performed under local anesthesia in the office.

PATELLA MALALIGNMENT

The normal patella should track straight down the middle of the femoral groove. There are varying degrees of abnormal tracking, or patella malalignment. In mild cases of malalignment the patella is simply tilted in the groove, leading to increased pressure on the downward tilted side of the patella. Think of this as being like a tire out of alignment, where a subtle imbalance can quickly lead to uneven wear of the tire treads. In more severe cases, the patella will actually sublux, or slide partially out of the groove. In the most severe cases of malalignment, the patella will actually completely dislocate.

Proper tracking of the patella is influenced by many factors. Proper muscle balance is important and is one of the few factors that we can control. Usually the patella wants to sublux toward the outside of the knee (lateral). Strengthening the inside muscle (the VMO) can act to counter this tendency.

Tracking is also influenced by the anatomical shape of your patella, femoral groove, the angle your knee makes with your hip (knock knees) and even the position of your foot (pronation). The hip knee angle is important because the patella is embedded in the quadriceps tendon which originates at the hip and attaches at the knee. The more knock kneed someone is, the more of an angular pull occurs on the patella every time the quadriceps contracts. This angle is called the "Q" angle in medical terminology. In severe cases of angulation (a high "Q" angle) surgery can be performed to correct the "Q" angle. The shape of the patella and femoral groove cannot be easily modified. Increased pronation of the foot (flat feet) can influence the tracking of the patella. This occurs because the rotation of the rest of the leg is affected by the way the foot contacts the ground. In patients with increased pronation, use of shoe orthotics (arch supports) may help patella tracking by modifying the rotation of the knee.

Patella malalignment - Surgical Treatment: For severe cases of patella malalignment surgery may be necessary. This is a new all arthroscopic method for realigning the patella (knee cap). Traditionally, patients with an unstable patella are subjected to an extensive operative procedure that involves making an incision to tighten the inner ligaments controlling the tracking of the patella.

An even newer technique for treatment of some types of patella instability is the use of a heated probe to shrink the stretched patella ligament or retinacullum. This method eliminates the need for any incisions or sutures in the knee. This method is currently being utilized for patients with less severe instability of the patella (called subluxation). With this method, rather than using sutures to tighten the ligaments and realign the patella, the stretched ligaments are heated which shrinks and tightens them.

PATELLA DISLOCATION

The patella is held in place by thin ligaments that act as check reins, keeping it from coming out of the femoral groove, while the muscles provide the fine tuning. With severe twisting maneuvers or direct trauma, the patella can dislocate, tearing these ligaments and coming completely out of place. Sometimes the patella will spontaneously reduce, sometimes a trip to the emergency room is necessary. Because the ligaments have torn, the patella usually will continue to be off balance even after the dislocation is reduced. This will lead to abnormal tracking and increased risk of redislocation in the future. In addition, small fragments of cartilage are often chipped off as the patella dislocates, and can cause damage to the joint as they float around.

Numerous studies have shown that patients who have dislocated their patella do not do well in the long term, and suffer either repeated dislocations or develop degeneration under the knee cap due to the now abnormal tracking. Recommended treatment is for immediate arthroscopic evaluation to remove the loose chips and to repair the torn ligaments and rebalance the patella tracking.

PATELLA FRACTURES

Fractures of the patella most commonly occur from direct trauma, usually a fall on the knee or a direct blow to the patella. Less frequently, the patella can be fractured by a sudden, violent contraction of the quadriceps.

Patella fractures are classified as either transverse, stellate or vertical. These three categories can be further classified as displaced or nondisplaced. The arterial blood supply to the patella is derived from two systems of vessels from branches of the geniculate arteries. These two systems supply the middle third and apex of the patella. In cases of displaced transverse fractures, the proximal blood supply may be compromised leading to avascular necrosis of the proximal segment.

Overall, the management of patella fractures is based on classification and morphology of the injury. Treatment options range from nonoperative to operative with open reduction and internal fixation to partial or total patellectomy.

Nondisplaced Fractures

Nonoperative care involves the use of extension splinting from four to six weeks. Weight-bearing status is as tolerated. Generally, quad sets and straight leg raises are permitted as soon as pain allows. Usually at around four weeks, active knee flexion can proceed once radiographic confirmation is made of fracture consolidation.

The contralateral limb is exercised freely, and a general conditioning program is initiated for upper and lower extremity strengthening. Aerobic fitness is maintained via a single leg stationary cycle ergometer or upper body ergometer (UBE). Care is taken during the maximum protection phase of recovery to guard against passive knee flexion beyond the healing constraints of the fracture.

If quadriceps strengthening and knee flexion are progressed too soon, the forces acting across the healing fracture may delay union. Therefore, the PTA must be acutely aware of osseous healing mechanisms and time constraints when overseeing range of motion and strengthening exercises during each phase of recovery from nondisplaced patella fractures. Usually, active range of motion is initiated. Gradual progression to passive range of motion will correlate with solid bone union. Close consultation with the PT is important, since some degree of evaluative skills is necessary for patient progression.

Displaced Fractures

Treatment of patella fractures is based on ranges of acceptable fracture fragment separation exceeding 3 to 4 millimeters. Although patella fracture patterns may vary, stabilization of displaced patella fragments is best accomplished with an open reduction internal fixation procedure. Various techniques are used including tension band wiring, cerclage wiring, lag screws or combinations of the above.

Commonly, tension band and cerclage wiring is used to stabilize displaced transverse patella fractures. The tension band is a dynamic compression device that approximates and compresses the fracture fragments. The additional use of cerclage wiring adds to the stability of the repair and allows early joint motion without redisplacing the fracture fragment. Postoperatively, the involved limb is immobilized in 20 degrees of flexion to support dynamic compression of the tension band wiring procedure.

Postoperative rehabilitation begins approximately one week after surgery. Active knee flexion should be limited to about 100 degrees for at least six weeks following surgery to allow for proper fracture consolidation.

Straight leg raises, submaximal quad isometrics and gentle active short arc knee extension exercises characterize the initial maximum protection phase of recovery. Weight bearing as tolerated with assistive devices is encouraged during the first few weeks following surgery, progressing to full weight bearing by the third or fourth week.

As clearly stated during treatment of nondisplaced patella fractures, care must be taken not to overstress the healing fracture by aggressive flexion, range of motion or resisted knee extension exercises. Radiographic confirmation of fracture consolidation with stable implant fixation and postoperative time greater than six weeks will dictate to the physician and the PT the gradual implementation of the moderate protection phase of recovery.

Active-assisted knee flexion and light resistance quad exercises are begun once the patient is able to demonstrate good quad control, improved knee flexion to 100 degrees, reduced pain and swelling and normalized gait mechanics. Functional closed chain resistance exercises are deferred until the patient is able to demonstrate increased range of motion without signs or symptoms of articular cartilage degeneration. Strength-training exercises of remedial isometrics and progressive concentric and eccentric resistance must approximate and correlate with solid bone union.

Severe comminuted patella fractures are treated surgically with a partial or total patellectomy if significant bone mass cannot be salvaged. However, as little as 25 percent of the patella can be retained with a good outcome when compared to the overall poor results of total patellectomy.

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Periprosthetic fractures

Fractures around implants pose unique fixation challenges. The original placement of the implant may predispose to later fracture, the long-term presence of the device may change the structure of the bone and increase susceptibility to fracture, and the implant itself may interfere with healing or the placement of other fixation devices.

Fractures around joint replacement prostheses are commonly called periprosthetic fractures, while fractures around plates, rods, or prostheses can be more generally termed peri-implant fractures. As more peri-implant fractures occur, the orthopedic surgeon needs to learn methods to manage the specific problems involved.

As the number of implants placed increases, it is inevitable that associated fractures also become more common. Once a fracture occurs, treatment is complicated by osteoporosis, defects in the bone, and the presence of the implant. Common problems include malalignment, stiffness, and nonunion. If malalignment occurs after a periprosthetic fracture, the abnormal joint biomechanics may cause a high rate of revision secondary to loosening.[

The incidence of supracondylar fracture after total knee replacement is 0.3-2.5%. Fracture can occur more than 10 years after joint replacement; thus, as the number of patients with replacements accumulates, more fractures occur. In data from the Mayo Clinic Joint Registry, the incidence of periprosthetic fracture after primary total hip replacement was 1.1%, and it was 4% after revision total hip replacement. Periprosthetic fracture after total hip replacement may be the second leading cause of revision, after aseptic loosening.

The exact incidence and frequency of other peri-implant fractures has not been established.

Treatment of periprosthetic fractures requires strict adherence to the basic principles of treating any fracture. The surgeon must restore the biomechanical integrity of the bone. This requires restoration of a biologic environment in which the bone can heal and a mechanically stable construct to give the bone a chance to heal.

Biology is maintained by strict soft tissue and indirect reduction techniques, when possible, to preserve periosteal and/or endosteal blood supply. The surgeon should minimize periosteal stripping, avoid dead space, and consider bone grafting if the biological environment is compromised. The patient's medical condition should be optimized. The patient should be encouraged to stop smoking when applicable.

Mechanical stability is obtained by restoring the anatomic integrity of the bone and following Association for the Study of Internal Fixation (AO/ASIF) principles with adequate fixation distal and proximal to the fracture.

Essentially all periprosthetic fractures require some treatment. Stable nondisplaced fractures may only require protected weightbearing or cast/brace immobilization (and pain medication), but most unstable peri-implant fractures require surgical stabilization and/or implant replacement to restore function. Surgical intervention for peri-implant fractures follows the same guidelines as for other fractures. The goals of treatment include early ambulation, which helps avoid pulmonary complications, decubiti, disuse osteoporosis, and other complications of prolonged bedrest; restoration of axial alignment, which helps prevent eccentric stress on the prosthesis that leads to early loosening; and stabilization of the limb, which allows joint motion and helps prevent stiffness and muscle atrophy.

Current efforts to treat periprosthetic fractures focus on ways to avoid the fracture and new implants for improved fixation. New designs of replacement prostheses include changes in the shape of stems to better share load with the bone and avoid the osteoporosis of stress shielding, which weakens the bone and predisposes for fracture. New plate designs, such as the low contact dynamic compression plate, decrease the contact area of plates and decrease the osteoporosis of stress shielding. Changes in materials decrease bone destruction from osteolysis. Less rigid metals (eg, such as titanium vs stainless steel) share the load better. Fixed-angle plate systems (eg, LISS), allow more stable fixation with minimally invasive techniques (see image below).

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1.4.4. Selected Main surgical protocols in lower limb pathologies

1. Developmental dysplasia of the hip

Developmental dysplasia of the hip is a clinical condition which varies from a mild acetabular dysplasia to a frank dislocated hip. Incidence is reported between 1 to 35 per 1000 live births. It does show a geographical distribution where swaddling habbits increase incidence. Ultrasonography of the hip is the golden standard technique for diagnosis in infants less than 6 months of age. In the first 3 months of age the dislocated hip can usually be reduced. After 6 months soft tissue contractures hinder reduction. The treatment aims to keep the femoral head inside the acetabulum, without disturbing its circultion, until acetabulum remodels over. During the first 6 months this can be achieved with device that would keep the hip in flexion and abduction. The most commonly used device is the Pavlik harness. Between 6 to 12 months closed reduction under general anesthesia, adductor tenotomy, and keeping the reduction in plaster of paris pelvipedal cast for 3 to 4 months is required. Between 12 to 18 months, several tissues which prevent concentric reduction need to be removed, so open reduction, adductor tenotomy and cast immobilization are done. After 18 months acetabular insufficiency requires osteotomy for correction. Pelvic osteotomies are sometimes supported with femoral osteotomies for reduction.

2. Total hip arthroplasty

Many disorders of the hip like developmental dysplasia, osteoarthritis, osteonecrosis, fractures and dislocations, femoroacetabular impingement, and immunologic, septic or metabolic diseases, result in disruption of the hip joint. When conservative measures fail, and pain affects normal daily living of the patient total hip replacement is indicated. The major contraindication to this procedure is the presence of an septic focus in the body. Rapid return of function and subsidence of pain can be expected after the surgery. The replaced components are the acetabulum and the femoral side of the joint. Femoral head is osteotomized at the neck level and excised. Acetabulum is reamed until all cartilage is debrided and sound bleeding subchondral bone is reached. An acetabular component is placed. Acetabular component can be fixed temporarily with the help of screws or is press-fit. There are also non-metal all-polyethylene cemented cups which are kept in place with the help of bone cement (poly methyl methacrylate – PMMA). most cementless cups are porous coated to let bone ingrowth. Femoral stem is placed into the femoral medulla after reaming and rasping. These can also be cemented or cementless. Motion and thus wear is between the artificial joint surfaces which may be metal, polyethylene, ceramic or different combinations. Most common complications are infection, which may require removal of the implants, dislocation, deep venous thrombosis, perirosthetic fractures, wear and osteolysis.

3. Osteonecrosis of the femoral head

Femoral head gets its main blood supply from an arc formed around the base of the femoral neck by the medial and lateral circumflex femoral arteries. The vessels course over the femoral neck to enter the femoral head. Some part of these vessels are inside the hip joint and this makes them prone to injuries. Some conditions like corticosteroid use, alcohol intake, sickle cell disease, leukemia, myeloproliferative diseases, Caissons disease, thrombophilia, hypofibrinolysis, may disrupt the femoral head blood circulation. This causes osteocytes and the bone marrow elements to die and persistance of the bone matrix is disturbed leading to collapse and shape change in the femoral head. When congruity of the hip joint deteriorates degeneration of the overlying cartilage begins. The treatment aims to protect femoral head sphericity and thus joint congruity. For the early stages there are various procedures defined to debride necrotic bone and replace with a bone graft. If the necrotic volume is small and the disease is in early stages, core decompression is the procedure of choice, where only tunnel of 10mm’s in diameter is drilled from the trochanteric region into the necrotic volume. This decreases intraosseous compartment pressure, allows removal of necrotic bone and provides space for a new granulation tissue to form. A bone graft can also be inserted into this tunnel for structural support. This bone graft can also be augmented with bone marrow elements or its own vasculature. In the later stages, when sphericity is disrupted, total hip replacement is the procedure of choice.

4. Chondral injury of the knee

Cartilage is a difficult tissue to heal. Articular cartilage is formed of type II collagen within cartilage matrix organized radially at the deeper zones and parallel to the surface at the superficial zone. Restoring this organization and structure makes complete healing nearly impossible. The healing tissue is usually fibrous cartilage which consists of varying ratios of type I and II collagens and which is biomechanically inferior to the hyaline cartilage. Partial thickness cartilage injuries tend not to heal and stay as is. When the tidemark and calcified cartilage layer is injured a healing response may be stimulated and a fibrous cartilage can fill the defect. The filling amount depends also on the size of the defect. Larger defects are unable to be filled without treatment. A cartilage defect the doesn't bear load leads to degeneration of the neighboring tissue and eventually to progressing stages of degenerative joint disease. The defects less than $2cm^2$ in area may be treated with bone marrow stimulation techniques like, drilling, abrasion or more popularly microfracture. These techniques provide access to bone marrow and migration of stem cells into the defect. Larger defects require higher quality cartilage formation. Osteochondral Autologous Transfer System – OATS, Autologous Chondrocyte Implantation – ACI are some of the techniques which are known to be able to provide better quality cartilage for weight bearing.

5. Total knee arthroplasty

When conservative measures fail in treatment of the last stage degenerative joint disease of the knee, total knee arthroplasty (TKA) is indicated. TKA provides rapid return of functionand relief of pain. The femoro-tibial joint is replaced by a bicondylar metallic prothesis. A patellofemoral component is optional and use depends on requirement of the specific case. Menisci, cartilage surfaces and anterior cruciate ligament are removed and a femoral component and a tibial component are fixed with the help of bone cement (Poly methyl methacrylate – PMMA). Posterior cruciate may (cruciate replacing) or may not (cruciate retaining) be sacrified. The prosthesis aims to restore the ligament balance and the natural mecahnical axis. Between the two metallic implants, there is a polyethylene insert which locks on to the tibial component. This insert may be static or rotating depending on the surgeons choice. The polyethylene insert is prone to wear and expected life of the insert is 15 to 20 years. Patient can walk full weight bearing immediately after the surgery and return to normal daily living functions is expected between 3 to 6 weeks. Possible complications are infection, venous thromboemboli, instability, arthrofibrosis and loss of motion, neurovascular injury, periprosthetic fractures, implant failure, and wear.

6. Hallux valgus

Hallux valgus is the lateral deviation of the 1st toe. It is seen 10 times more frequent in women. Possible causes are familial tendency, inappropriate shoe wear, congenital deformities, metatarsus varus, flexible pes planus, neuromuscular diseases, trauma and inflammatory arthropaties. The deformity includes adductor tightness. Adductor muscles pull the 1st toe laterally uncovering the head of the 1st metatarsal. Sesamoids are also pulled laterally until the are dislocated in the later stages of the deformity. Medial capsule of the joint is thinned and elongated. Friction over the metatarsal head causes bone overgrowth and a bursitis over it which is called the bunion. Lateral and pronation displacement of the hallux also disrupts the biomechanic of the second toe causing secondary disorders. Patients seek treatment starting from the early stages. Surgical treatment is only indicated when there is unmanagable pain. Surgery aims to correct 1st tarso-metatarsal angle, removal of the bunion, and correction of the metatarso-phalangeal angle. Proximal metatarsal osteotomy, bunion removal, adductor release, sesamoid rerduction, soft tissue or bony correction of the distal metatarsal angle are the surgical alternatives. Most patients are allowed to mobilize bearing weight on heel, after the surgery, but full weight bearing usually takes 6 to 8 weeks.

1.4.5. Selected Main rehabilatation protocols in lower limb pathologies

1. Developmental dysplasia of the hip (REHABILITATION ASPECTS)

Non-surgical treatment methods are most common when a baby is less than 6 months of age. They typically consist of bracing a baby in such a way so that the hips are kept in a better position for hip joint development. The goal is to influence the natural growth processes of the baby so a more stable hip joint is developed. Hip abduction braces are commonly used immediately following treatments involving a spica cast. This time in a brace helps to reintroduce more range of motion to the hips while the hip is growing and becoming more stable. There are a wide variety of positioning devices available, but the most common type is the Pavlik Harness. The Pavlik harness is specially designed to gently position the baby's hips so they are aligned in the joint, and to keep the hip joint secure. It is typically used to treat babies from birth to six months of age. In addition to this, other braces called fixed abduction braces are commonly used.

Six to 18 months: Open reduction or closed manipulation is required. Prior to the manipulative procedure, the child is placed in a traction device, preferably at home.

Children who do not improve, or who are diagnosed after 6 months often need surgery. After surgery, the child is placed in a spica cast after the treatment.

Eighteen to 36 months: After an osteotomy, the child is placed in a spica cast for eight to 12 weeks or until union of the osteotomy occurs.

Three to 8 years: The latest and most effective form of treatment combines open reduction and femoral shortening. After treatment, a spica cast is applied and may be removed within eight to 12 weeks.

Older than 8 years: Only palliative operative procedures are possible. Arthritic change will develop in the hip joint that leads to a reconstructive surgery.

Rehabilitation program includes: exercise programs, orthoses, casts, traction, medication, bed rest and adaptive devices. A physical therapist may develop a program that includes: strengthening the lower extremity and trunk, range of motion, pain control and functional activities, instructing the parents or caregivers on positioning techniques and handling skills before and after surgery, teaching the parents how to care for the child with a cast, traction or braces, focusing on evaluating the areas of muscle weakness and decreased range of motion, and working with the patient to gain functional strength and mobility.

2. Total hip arthroplasty (REHABILITATION ASPECTS)

Recovering from Total Hip Arthroplasty surgery is complex. It is very important for the patients to realize that the recovery process is difficult and time consuming.

Postsurgical rehabilitation goals are: allow healing/maintain safety, reduce pain, inflammation, and swelling, increase range of motion (ROM) while adhering to precautions, increase strength and functional independence, gait training – appropriate use of assistive device to emphasize normal gait pattern and limit post-operative inflammation.

The final goals of the rehabilitation program are: return to appropriate sports/recreational activities, enhance strength, endurance, and proprioception of the patients.

Rehabilitation program includes: medication, adaptive devices (walker or crutches, canes), orthoses, exercise programs, bed rest, cold pack or ice pack for 10-15 minutes 3x/day to manage pain and swelling.

The exercises (performed 3x/day after instruction by therapist) are important to the overall recovery – preventing blood clots, improving circulation, improving flexibility and hip movement and strengthening muscles. Patients must be active participants during this process, performing daily exercises to ensure a proper return of range of motion and strength. The exercises used, mainly consist of quad sets, glue sets, ankle pumps, hip and knee flexion, hip abduction, knee extension, short arc quad, squats, strengthening exercises (quadriceps sets in full knee extension, gluteal sets, short arc quadriceps, hooklying ball/towel squeeze, standing hip flexion, stationary bike, closed chain weight shifting activities including side-stepping, balance exercises, sit to stand activities), endurance training (walking, swimming, progress biking) and training of all normal phases of gait pattern using appropriate device.

3. Osteonecrosis of the femoral head (REHABILITATION ASPECTS)

The goal in treating avascular necrosis is to improve the affected joint, reduce the risk of further damage to the bone, diminish pain and limitation of movement, and ensure bone and joint survival. The treatment may vary depending on the underlying aetiology and stage of progression.

Medical management has been increasingly used in early stages in attempt to delay the progression of the disease.

Physical Therapy can be very effective in treating osteonecrosis of the femoral head if it is detected early. Treatment options include physical measures, medication, hyperbaric oxygen treatment, electrical stimulation, extracorporeal shock-wave treatment, as well as joint-preserving and joint-replacing surgeries.

Non-surgical therapeutic means consists of behavioral changes involving avoiding overload weights on the affected joint, limited weight bearing on the affected limb by using canes, crutches and physiotherapy. The aim of mechanical load reduction is to support the body's own regeneration processes and to halt progression of the disease.

Electrical modalities such as ultrasound or interferential current can be used to decrease the pain and inflammation. In some cases, an electrical stimulator may be employed to help the bone heal. These non-surgical measures may help delay the need for surgery, but they rarely reverse the problem.

Massage, particularly for the buttocks, back, or anterior and lateral hip muscles, may also be helpful. The kinetic program includes: weight bearing exercises, stretching exercises, range of motion exercises, muscle strength exercises, aerobic training. All kind of isometric, isotonic and isokinetic exercises can be used.

Post-Operative Care. The goals of physical therapy during the acute care period are to increase mobility, teach the patient the exercises to regain hip range of motion and strength and precautions and prepare the patient for discharge. Before returning home, the patient practices getting in and out of bed and walking with a walker or crutches. The patient is also taught how to use his new hip safely. One month after surgery, an evaluation with a standardized physical therapy assessment is typically conducted. The patient's body position and weight-bearing safety measures are discussed. The physical therapist instructs the patient on exercises to strengthen muscles and improve range of motion. The patient specifically learns how to move, while maintaining hip precautions. The rehabilitation protocol combined with a home exercise program twice daily led to a quicker restoration of a normal gait after surgery.

4. Chondral injury of the knee (REHABILITATION ASPECTS)

Following microfracture surgery, the rehabilitation program proceeds in accordance with the anatomic location and size of the chondral defect.

Rehabilitation for defects on the condyles of the femur or tibial plateau

The initial goals include protecting the site of repair, restoring normal quadriceps function and patellar mobility, and decreasing swelling of the joint. In most cases touchdown weight bearing with assistance of crutches is allowed during the first 6–8 weeks though this could change depending upon the size and location of the lesion. Bracing of the knee is not typically performed with femoral condyle or tibial plateau lesions. Cryotherapy is used for pain and inflammation and is continued until signs and symptoms are under control.

Immediately after surgery the patient is placed in a CPM machine for 6–8 h per day. The use of CPM after microfracture has demonstrated improvements in cartilage lesion grades in patients with full thickness chondral defects. Therapeutic exercises in phase one include quad sets, straight leg raises (SLRs) in all four directions, wall slides, ankle pumps, and core stabilization training. The patient is also taught self-mobilizations to be performed at home three to four times per day. After 1–2 weeks, stationary biking with no resistance and aquatic exercises in deep water are initiated.

Between 8 and 12 weeks after surgery, weight bearing status is progressed as the patient weans off the crutches and is allowed to bear weight as tolerated. Instructions for correct gait mechanics are given to the patient and reiterated as the normal gait pattern is restored. More aggressive activities such as incline treadmill walking, interval pool workouts, elliptical, and bike with resistance are acceptable once gait is normalized and pain free. Exercises in this phase, shift from early protection of the surgical site to concentrating on muscle endurance of the quadriceps, hamstrings, gastrocnemius-soleus complex, and gluteal muscles while continuing to focus on core stability. As the muscle endurance base is established, strength gains can be made in later phases. The goals of this phase include protecting the surgical site, increasing muscle endurance and proximal stability, re-establishing proprioception and kinesthesia of the knee and lower extremity.

After 12 weeks, the cardiovascular portion of the rehabilitation is intensified. Agility exercises are initiated on soft surfaces while focusing on controlling the forces going through the knee by using correct form and using the muscles for shock absorption. Rehabilitation of the knee should include a component of hip and core strengthening throughout each phase. Finally, exercises are structured such that functional sport loads are applied to the joint in preparation for return to sport.

5. Total knee arthroplasty (REHABILITATION ASPECTS)

Total knee arthroplasty (TKA) surgery is a common orthopedic surgery performed to reduce pain and improve function in degenerative knee joints of geriatric populations.

Because patients who receive joint arthroplasties are now being discharged from the hospital at an earlier stage in their recovery, a focus of rehabilitation is mobilizing the patient and regaining range of motion (ROM) in the knee.

Because restricted knee ROM affects functional activities, knee ROM is still considered to be one of the primary indicators of a successful TKA.

Continuous passive motion (CPM) machines are frequently used to increase knee ROM after a TKA and to promote a rapid postoperative recovery.

The kinetic program includes the following exercises: quadriceps sets, straight leg raises, ankle pumps, knee straightening exercises, bed-supported knee bends, sitting supported knee bends, sitting unsupported knee bends, begin to walk short distances in your hospital room and perform everyday activities, walking (at first, with a walker or crutches, cane in the hand opposite the knee with arthroplasty), stair climbing and descending, advanced exercises and activities (knee exercises with resistance, exercycling,

Regular exercise to restore knee mobility and strength and a gradual return to everyday activities are important for full recovery. The physical therapist may recommend exercise approximately 20 to 30 minutes two or three times a day and walk 30 minutes, two or three times a day during the early recovery.

In the Week 1: icing, elevation, and aggressive edema control, straight leg raise exercises (standing and seated), passive and active range of motion (ROM) exercises, initiate quadricep/adduction/gluteal sets, gait training, balance/proprioception exercises, well-leg cycling and upper body conditioning, soft tissue treatments and gentle mobilization to the posterior musculature, patella, and incisions to avoid flexion or patella contracture.

Weeks 2 – 4: continue with home program, progress flexion range of motion, gait training, soft tissue treatments, and balance / proprioception exercises, incorporate functional exercises as able, aerobic exercise as tolerated.

Weeks 4 – 6: increase the intensity of functional exercises, continue balance / proprioception exercises, slow-to-normal walking without a limp.

Weeks 6 – 8: Add lateral training exercises (i.e. lateral steps, lateral step-ups, step overs) as able, incorporate single-leg exercises as able (eccentric focus early on), patients should be walking without a limp and range of motion should be <10° extension and >110° flexion.

6. Hallux valgus (REHABILITATION ASPECTS)

The treatment measures go from conservative measures to relieve the pain to surgical care with which the deformity may be permanently removed.

An improvement of the symptoms can be achieved by conservative treatment. This can include: choosing a sufficiently large and soft shoe, fitting orthotics to provide arch support and to support the bones of the midfoot, hallux valgus splint with and without joint, physiotherapy to strengthen the foot muscles, fitting orthotics taking sensorimotor factors into account to strengthen the foot muscles.

Physiotherapy may be used alone or in combination with other conservative treatments as a basic treatment for mild hallux valgus or as a supplement to surgical treatment in the post-operative period.

Modern Hallux valgus surgery is focussed on the deformity of the bone. The goal is to sustainably resolve this deformity. Postoperative rehabilitation timeframe may vary depending on the surgical technique and can be performed in an outpatient setting. The use of Aircast cryo-cuff and appropriate footwear that allows safe walking and does not compromise the surgical result is important immediately after surgery. Postoperatively, participants were placed in the Rathgeber postoperative shoe for 4 weeks. Elevation of the leg, lymphatic drainage, activation of the muscle pump, and cryotherapy (cool packs) were used to reduce the swelling.

Rehabilitation program is mainly oriented to encourage both plantar pressure on the first ray and joint mobility. It also represents an important component of recovery following the correction of hallux valgus deviation, where it helps to restore physiological gait and foot function.

During gait training, physiologic gait patterns were achieved. The stance phase was trained by performing a heel-strike in its physiological position at the lateral aspect of the heel, followed by weight bearing of the first metatarsal during mid-stance and terminal stance, with training of active push-off by the great toe flexors, the flexor digitorum longus and brevis muscles, and the lumbrical muscles. Selective strengthening of the peroneus longus muscle also was performed.

Manual therapeutic interventions were performed for all MTP joints. These manipulations focused on an improvement of flexion and included caudal sliding of the proximal phalanx to improve flexion and dorsal sliding of the proximal phalanx to improve extension. In addition, oscillating traction was performed to activate the mechanoreceptors that inhibit the afferent pain sensors.

1.5. Conclusions

Good health care involves a continuum of education and prevention to rehabilitation, to optimal outcomes all with the aim of ensuring patients return to and maintain a good quality of life. These challenges present opportunities to examine innovative ways of delivering an excellent trauma/orthopaedic and rehabilitation services.

The treatment of trauma and orthopaedic patients is dependent on a wide range of staff who work closely with surgeons to provide integrated, safe care.

Elaboration of an evidence-based clinical practice guidelines based on a systematic literature review of published studies can serve as an educational tool based on an assessment of the current published scientific and clinical information and accepted approaches to treatment.

Standardising pathways of care will lead to improvements in access, quality and value manwhile sharing knowledge and expertise and benefit from good practice from countries with great experience in the field would help in harmonisation and common standards for on line education in orthopedy and rehabilitation.

We believe that the best practice principles set out in this document will provide guidance and support to all who are essential to the delivery of an improved service.