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Sisältö 1/2017

Welcome to the XIX Finnish-Austrian Orthopaedic Trauma Course!

This course is part of the professional education of the Finnish Orthopaedic Association (FOA), arranged together with the Finnish Trauma Association. Education has been continuously very active during FOA's 68 years history. The annual congress with FOA's general meeting in Helsinki is the biggest event with scientific presentations and professional discussions. Since 1974, the Lapland Course has been organized biennially. In addition, a spring meeting takes place every second year in different cities in Finland. The Finnish-Austrian Orthopaedic Trauma Course has been arranged 18 times every second January in various locations in Austria. The first course took place in Schruns 1981, together with the Austrian Trauma Society. The 2017 course will take place in Oberlech, hotel Montana's Congress Center. The aim of the Finnish-Austrian courses is to provide the participants high-level, evidence-based education through lectures, group discussions, and hands-on practical exercises.

After the 2015 Finnish-Austrian Course we conducted a survey among the participants. The most important results of this questionnaire are listed below.

Quality of the lectures was evaluated to be	4,7 /5
Quality of the course place (2015 Oberlech)	4,9/5
New professional contacts	4,6/5
New international contacts	3,7/5
New ideas for clinical work	4,3/5
New ideas for scientific work	17/28 answers

This type of a small international orthopaedic trauma course with long history is quite a unique convention. Lecturers from Austria, Germany, Hungary, Switzerland, Sweden and Finland elucidate different aspects of orthopaedics and trauma treatment. For those of us with subspeciality, for example, in the field of elective orthopaedics, it is useful to get an update on most recent developments in trauma treatment and vice versa. The course gives a cross section of many different topics and leaves the participants with useful take-home practices and diagnostic tools.

Social program is naturally one important part of this legendary event. The downhill triathlon, nick-named "bone-head competition" consists of slalom, maximum skiing speed, and bob sled competition. Last time, 2015, winner of this honoured challenge cup was Tomi Simons from Helsinki University Hospital. Who is the next?

I hope that all participants will enjoy this educational event and its recreational opportunities. On behalf of the organizing committee, I would like to thank the whole faculty for their excellent work. My warmest thanks to Jan Lindahl who has, once again, created an exciting scientific program, to Wolfgang Grechenig for his unselfish work for this cooperation, and Juha Kalske for taking care of the finances and social program of the course. We all want to thank our sponsors. And at last but not least our greatest thanks to family Ortlieb in hotel Montana for this opportunity to again arrange this course in this high-quality and beautiful hotel and congress center.

We aim to continue arranging these combined Finnish-Austrian courses for years to come.

Helsinki, January 5, 2017

Mikko Manninen
Chair of the Organizing Committee
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XIX Finnish-Austrian Orthopaedic Trauma Course

January 22 – 26, 2017

Congress Center, Hotel Montana, Oberlech, Austria

Finnish Orthopaedic Association

Finnish Trauma Association

XIX Finnish-Austrian Orthopaedic Trauma Course
January 22 – 26, 2017
Congress Center, Hotel Montana, Oberlech, Austria

Program chairs:

Jan Lindahl, MD, PhD and Wolfgang Grechenig, MD, Prof.

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Oliver Michelsson, MD, Diacor Hospital, Helsinki, Finland

Markus Parkkinen, MD, Helsinki University Hospital, Helsinki, Finland

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Thomas Schlenzka, MD, Helsinki University Hospital, Helsinki, Finland

Kristian Seppänen, MD, Helsinki University Hospital, Helsinki, Finland

Matti Seppänen, MD, Turku University Hospital, Turku, Finland

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Endre Varga, MD, Prof., University of Szeged, Department of Traumatology, Szeged, Hungary

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Organizing committee:

Mikko Manninen, MD, PhD, Chairman
Jan Lindahl, MD, PhD, Co-Chairman
Wolfgang Grechenig, MD, Prof.
Juha Kalske, MD

Finnish Orthopaedic Association
Finnish Trauma Association

Sunday, January 22, 2017

12:00 Registration

18:00 OPENING SEREMONY

Monday, January 23, 2017

08:00 SESSION I – Shoulder

Chairmen: Endre Varga, MD, Prof. and Axel Gänsslen, MD

08:00 Surgical anatomy of the shoulder
Axel Gänsslen, MD
Klinikum Wolfsburg, Wolfsburg, Germany

08:25 Longterm results after Bakart repair and Latarjet
Karl Wieser, MD
Zürich University Hospital, Zürich, Switzerland

08:50 Rotator cuff tear
Thomas Ibounig, MD
Helsinki University Hospital, Helsinki, Finland

09:15 Reverse total shoulder arthroplasty after humeral head fractures
Karl Wieser, MD
Zürich University Hospital, Zürich, Switzerland

09:40 Coffee and technical exhibition

10:00 SESSION II – Foot and ankle

Chairmen: Wolfgang Grechenig, MD, Prof., and Oliver Michelsson, MD

10:00 Treatment of pilon tibiale fractures – 2 years of follow up
Markus Parkkinen, MD, Ville Bister, MD, Jan Lindahl, MD
Helsinki University Hospital, Helsinki, Finland

10:25 Injuries of posterior tibial tendon and peroneal tendons
Oliver Michelsson, MD
Diacor Hospital, Helsinki, Finland

10:50 Mangled foot - Decision making amputation vs. reconstruction
Thomas Schlenzka, MD, Mikko Miettinen, MD
Helsinki University Hospital, Helsinki, Finland

11:15 Management of soft tissue defects of foot and ankle
Vesa Juutilainen, MD
Helsinki Hospital, Helsinki, Finland

11:40 Discussion

12:30 Lunch and technical exhibition

16:00 Discussion in groups (case presentations) 1:
Group I: Shoulder
Axel Gänsslen, MD, Karl Wieser, MD, Thomas Ibounig, MD, Stephan Grechenig, MD, Roope Sarvilinna, MD
Group II: Foot and Ankle
Wolfgang Grechenig, MD, Oliver Michelsson, MD, Markus Parkkinen, MD, Vesa Juutilainen, MD, Thomas Schlenzka, MD

Tuesday, January 24, 2017

08:00 AOTrauma symposium 1

Chairmen: Wolfgang Grechenig, MD, Prof., and Jan Lindahl, MD

08:00 Timing of fracture surgery in multiply injured patients
Axel Gänsslen, MD
Klinikum Wolfsburg, Wolfsburg, Germany

08:25 Knee dislocations –Acute treatment
Jan Lindahl, MD
Helsinki University Hospital, Helsinki, Finland

08:50 Management of medial side injuries in knee dislocations - Clinical and radiological outcomes
Mikko Jokela, MD, Tatu Mäkinen, MD, Mika Koivikko, MD, Jyrki Halinen, MD, Jan Lindahl, MD
Helsinki University Hospital, Helsinki, Finland

09:15 Results of operative acetabular fracture management
Kristian Seppänen, MD, Tomi Simons, MD, Veikko Kiljunen, MD, Jan Lindahl, MD
Helsinki University Hospital, Helsinki, Finland

09:40 Coffee and technical exhibition

10:00 AOTrauma symposium 2
Chairmen: Axel Gänsslen, MD and *Endre Varga, MD, Prof.*

10:00 K-wires and cerclage in traumasurgery – Risks and complications
Wolfgang Grechenig, MD, Prof.
Graz University Clinic, Graz, Austria

10:25 Avoidable complications in intramedullary nailing
Stephan Grechenig, MD
University Hospital Regensburg, Regensburg, Germany

10:50 Tips and tricks how to avoid nerve injuries in osteosynthesis
Wolfgang Grechenig, MD, Prof.
Graz University Clinic, Graz, Austria

11:15 MIPO in tibia fractures
Endre Varga, MD, Prof.
University of Szeged, Szeged, Hungary

11:40 Discussion

12:30 Group picture, lunch and technical exhibition

16:00 Discussion in groups (Case presentations) 2:
Group I: Knee injuries
Juha Kalske, MD, Markus Parkkinen, MD, Mikko Jokela, MD
Group II: Hip, Acetabulum
Endre Varga, MD, Jan Lindahl, MD, Kristian Seppänen, MD, Eero Hirvensalo, MD

Wednesday, January 25, 2017

08:00 SESSION V – Special issues in orthopaedics and traumatology
Chairmen: Petri Virolainen, MD and Mikko Manninen, MD

08:00 Neurophysiology and neuromythology - a short introduction
Björn Falck, MD
University Hospital, Uppsala, Sweden

08:20 MAGNEZIX® - the material that breaks the rules
Martin H. Kirschner, MD, PhD
Syntellix AG, Hannover, Germany

08:35 Magnesium implants - clinical insights
Martin H. Kirschner, MD, PhD
Syntellix AG, Hannover, Germany

08:50 The Importance of radiologic results in distal radius fracture operations: Functional outcome after long-term follow up
Leena Raudasoja, MD, Heidi Vastamäki, MD, Timo Raatikainen, MD
Helsinki University Hospital, Helsinki, Finland

09:10 National guidelines in the treatment of distal radius fracture
Jarkko Vasenius, MD
Pohjola Hospital, Helsinki, Finland

09:30 High tech trauma. Dream or reality?
Endre Varga, MD, Prof.
University of Szeged, Szeged, Hungary

09:55 Coffee and technical exhibition

10:15 SESSION VI – All about the hip
Chairmen: Matti Seppänen, MD and Juha Kalske, MD

10:15 Imaging or imagining FAI?
Juha Kalske, MD
Helsinki University Hospital, Jorvi Hospital, Helsinki, Finland

10:35 Dysplacia of the acetabulum – What are your status findings?
Matti Seppänen, MD
Turku University Hospital, Turku, Finland

10:55 When joint preserving surgery is not enough – or you have done it too much
Petri Virolainen, MD
Turku University Hospital, Turku, Finland

11:15 Anything new in hip revision surgery?
Mikko Manninen, MD
ORTON Hospital, Helsinki, Finland

11:35 Discussion

12:30 Lunch and technical exhibition

16:00 Discussion in groups (Case presentations) 3:
Group I: Orthopaedics and trauma
Endre Varga, MD, Jouni Heikkilä, MD, Jarkko Vasenius, MD, Leena Raudasoja,MD
Group II: Hip
Petri Virolainen, MD, Matti Seppänen, MD Juha Kalske, MD, Mikko Manninen, MD

Thursday, January 26, 2017

08:00 SESSION VII – Free papers – Upper extremity
Chairmen: Mikko Manninen, MD and Jan Lindahl, MD

10:00 SESSION X – Free papers – Lower extremity
Chairmen: Eero Hirvensalo, MD and Juha Kalske, MD

12:00 END OF COURSE

Finnish-Austrian Orthopaedic Trauma Meetings: Schruns 1981, Bad Hofgastein 1983, Oberlech 1985, Ischgl 1987, Oberlech 1989, Obergurgl 1991, Obergurgl 1993, Oberlech 1995, Ischgl 1997, Ischgl 1999, Oberlech 2001, Oberlech 2003, Obertauern 2005, Serfaus 2007, Oberlech 2009, Zauchensee 2011, Oberlech 2013, Oberlech 2015.

Surgical Anatomy of the Shoulder

Axel Gänsslen
Klinikum Wolfsburg

Introduction

The prerequisite of surgery of proximal humerus fractures is the understanding of the basic surgical anatomy. This anatomical background is relevant, especially regarding indication of surgery, reduction and choice of implants and prognosis.

For surgical treatment of proximal humerus fractures, two main approaches are used: the standard anterior-lateral approach (deltoid-pectoral approach) and the deltoid split approach. Both approaches allow addressing the whole bony structures including fractured tubercula and accompanying injury to the rotator cuff muscles/tendons in different ways.

Several anatomic structures are at risk during surgery, and the bone morphology is relevant regarding implant position.

Anatomy of Deltoid-Pectoral Approach

Performing the standard deltoid-pectoral approach, a step-by-step preparation procedure is recommended (1,2):

- identification of relevant landmarks (coracoid process, deltopectoral groove, anterior mid arm)
- skin incision and identification of the underlying fascia
- identification of cephalic vein
- dissection of the interval between deltoid muscle and pectoralis major muscle
- identification of humeral head
- palpation/visualization of the conjoint tendon (short head of biceps brachii muscle, coracobrachialis muscle)
- possible partial dissection pectoralis major tendon
- identification of proximal humerus shaft
- identification/palpation of long head of biceps muscle/tendon between both tuberculae
- visualization of posterior humeral circumflex artery and axillary nerve

Anatomy of Deltoid-Split Approach

Performing the deltoid-split approach, a step-by-step preparation procedure is recommended (1-3):

- identification of relevant landmarks (coracoid process, acromion)
- 6cm skin incision and identification of the underlying fascia at the junction between anterior/middle part of deltoid muscle = anterior deltoid raphe
- identification of humeral head and major tubercle
- palpation of axillary nerve from tip of greater tubercle
- palpation or visualization of axillary nerve and vasa circumflexa
- identification and possible resection of bursa subacromialis
- identification of rotator cuff insertion (supraspinatus)
- mobilization of additional fractured tubercles

Osseous Anatomy

The majority of proximal humerus fractures occur in elderly people with relevant functional demands. Therefore, stable internal fixation is often necessary and it is essential to know the localization of the optimal bone quality in the proximal humerus, as this influences implant position, implant stability and surgical planning.

Analysis of the primary x-rays of the shoulder is focused on fracture understanding and analysis of present osteoporosis.

According to the basic work of Neer, four main fragments can be present in proximal humerus fractures: the shaft, the head and the minor and major tubercle. The relevance of these fragments is given due to muscular pull and therefore analysis of displacement. Several classification systems were developed to give prognostic recommendations, especially regarding adequate healing and implant failure. Thus, the bone quality itself is of relevance.

During preoperatively planning, easy assessment of the bone quality is one important part of analysis as the risk of osteoporosis can be estimated.

The mean cortical thickness (MCT) potentially can predict later implant or surgical failure. The thickness of both, the lateral and medial cortex is measured at two levels in the metaphyseal/proximal shaft region. Both levels have a distance in between of 2cm. The sum of all four thicknesses is divided by 4 to get the MCT value. A value <4mm is supposed to be a sign of reduced bone quality and therefore potentially predicts implant failure (4).

An estimation of the bone mineral density (BMD) can be made by analysis of the preoperative CT-scan. A linear correlation between BMD and Hounsfield Units in the middle of the humeral head (cancellous bone) was found (5) and even analysis of the contralateral side revealed high correlations for BMD of the proximal humerus (6).

The best bone quality is present in the humeral head in the posterior-medial region (lateral view), even in osteoporotic bone (7,8).

Screw application into the postero-medial region together with cement augmentation to the anterior region can potentially reduce the rate of secondary displacement after PHILOS plate osteosynthesis of proximal humerus fractures (9-10). Additionally, a clinical analysis confirmed, that loss of fixation was observed more frequently if the fixation did not include at least one screw within the superior-posterior region of the humeral head (11).

Considering an intramedullary approach, a straight nail is anatomically favored. The main areas of high BMD were directly located at the proximal (superior) cortex, at the medial head, whereas centrally in the tubercles a low BMD was present (12). Thus, when using a proximally curved nail, the proximal nail end runs through the low BMD zone, whereas straight nails have a theoretically better bone hold in areas with better BMD.

Vascular Supply of the Humeral Head

Gerber stated in 1990, that the main part of the humeral head is supplied from the ascendend branch of the anterior circumflex humeral artery (ACHA) (13). Others already stated, that some perfusion of the humeral head persists from posteromedial vessels (14-16). Brooks et al. simulated four-part fractures and found, that the perfusion of the humeral head was prevented in most cases. Additionally, if the head fragment extends distally below the medial articular surface, some perfusion of the head persists by the posteromedial vessels (9).

For long time, it was clearly stated, that the anterolateral branch of the anterior humeral circumflex artery (AHCA) provides the main blood supply to the humeral head. It courses along the bicipital groove and its terminal branch is the arcuate artery.

Gardner et al. analyzed these vessels and found, that the ascendend branch of the ACHA, which runs between both tubercles in the bicipital groove is the major vessel for the humeral head blood supply. Thus, injury to this ascendend branch can lead to AVN (17).

Typical risk factors were analyzed. Possible predictors of ischemia were the length of the metaphyseal head extension (>8 mm), the integrity of the medial hinge (<6mm) and specific fracture types (18). The combination of a length of the metaphyseal head extension <8mm, no integrity of the medial hinge >6mm and an anatomical neck fracture had a positive predictive value of 97 % to result in AVN.

Interestingly, resultant osteonecrosis was infrequent, if the artery was supposed to be disrupted, which was suspected in about 80% of proximal humeral fractures.

Anatomical dissections found larger posterior, than anterior vessels (19), indicating the potential relevance of posterior vessels, which are delivered from the axillary artery at the same level. Additionally, medial-inferior vessels from the PCHA seem to be of relevance for the overall humeral head blood supply (20). The ACHA and the PCHA. Meyer et al. revealed the importance of the posterior-medial vessels (21). The medial bone arteries were relevant for vascularization of the fracture fragments. After disruption of the arterial supply from the arcuate artery, the terminal branch of the ACHA, the vascularization of the head fragments was ensured by posterior-medial vessels.

It was stated, that main vessel of intraosseous anastomoses was the arcuate branch of the AHCA, penetrating the major tubercle and also a vascular network arising from the PHCA, penetrating medially is present.

In a detailed analysis by Hettrich et al., the ACHA was responsible to 36 % of the blood supply to the humeral head and the PHCA was responsible to 64 % of the blood supply to the humeral head. Significantly, the PCHA had more blood supply in superior and inferior quadrants of the humeral head (22).

From a practical perspective, the intraoperative localization of the ACHA is possible. The superior border of the anterior humeral circumflex artery is found approximately 2.5cm distally from the tip of the lesser tubercle (23). Alternatively, the distance between the inferior border of the medial acromion and the superior border of the anterior humeral circumflex artery is measured and found to be approximately 52 mm (23,24).

Axillary Nerve

The anatomy of the axillary nerve is of importance, as iatrogenic injury can lead to relevant functional impairments.

An anatomical study confirmed, that the entry point into the deltoid muscle is approximately 5cm distant from the humeral head and 6.8 cm from the acromion. Therefore, the safe distance from the acromion for surgical dissection using the deltoid-split approach is 6cm. The anterior-superior quadrant of the deltoid muscle is less innervated (25). This was conformed in another analysis, where the distance between mid-acromion and the nerve in neutral rotation was 66.6 mm (26).

During surgery, manipulation of the whole arm hast to be carefully performed. It is well known, that the axillary nerve can be stretched over the humeral head following shoulder dislocation (27).

Abduction lead to a reduction of the distance between mid-acromion and the nerve to 53.9 mm (26). In contrast, no relevant influence was detected for isolated forward flexion.

Performing PHILOS plate osteosynthesis jeopardizes the nerve, as the two most distal holes, where screws can be inserted into the humeral head, are always close to the nerve (25).

Additionally, antegrade humeral nailing takes the nerve to risk of iatrogenic injury as locking screws are close to the nerve stem (28-30).

The axillary nerve divides into two main branches. Röderer et al. reported that in 80 % a diversion into two anterior rami is present and in 20% there is a direct contact to the plate (31).

Intraoperatively, the localization of the axillary nerve can be analyzed. Chen et al., reported a distance from the tip of the major tubercle of 3.5cm and a distance from the anterior-inferior border of the acromion of 6.3 cm (19). Nijs et al. reported a distance to the lateral acromion in neutral rotation of 55.8 mm and a distance to oblique locking screw during humeral nailing of 1-2.7 mm (29). Liu et al., in a literature overview analyzing different shoulder approaches, recommended a safe zone of 6 cm from the anterior edge of the acromion and 5.7-7.2 cm from the lateral edge (32).

Radial Nerve

Even in classical plate osteosynthesis of proximal humerus fractures, the radial nerve is of potential risk during surgery. Garcia-Coirades et al. found a close relationship of the most distal plate screws using a short PHILOS plate to the radial nerve and the profunda brachii artery (PBA) (28). The nerve and the artery were at risk whenever a medial cortex violation happened, as both structures were located within 1cm of the exit point of the most distal locking screw (28).

Rotator Cuff Muscle Insertion

New anatomic data are available regarding footprints of the rotator cuff muscles.

The subscapularis insertes in a large comma-shaped pattern (33) on the minor tuberosity from 7 to 11 o'clock (right shoulder) (34). The average maximum length was 40 mm and the average maximum width was 20 mm. The distance from the articular surface is highly variable (0-18 mm). The most superior margin is purely tendinous (intra-articular) and the most inferior part is purely musculocapsular (34).

The footprint of the supraspinatus has a trapezoidal (34) or triangular shape (35). The anterior muscle part consists of a long tendinous portion which can insert either on the anteromedial region of the superior facet of the greater tuberosity and sometimes even on the superior-lateral aspect of the lesser tuberosity (21 %), bridging the bicipital groove (35). The insertion shows an average length of 23 mm and a width of 16 mm. A close insertion to the articular surface is frequent (0.9 mm in average) (34). In contrast, Mochizuki reported a smaller footprint, with a medial-to-lateral length of 6.9 mm and an anteroposterior width of 12.6 mm (35).

It was found that the posterior border of the supraspinatus was overlapped by the anterior border of the infraspinatus tendon (36). The latter was found to have a long anterior tendinous portion (35). This was confirmed by Curtis, who described an L-shaped insertion of the infraspinatus (34). The footprint of

the infraspinatus was trapezoidal (34,35). The size of the infraspinatus footprint is highly variable. Curtis described a length of 29 mm and a width of 19 mm (34) , whereas Mochizuki described a medial-to-lateral length of 10.2 mm and an anteroposterior width of 32.7 mm (35).

Mochizuki stated, that the supraspinatus footprint is smaller than previously known, and therefore, supraspinatus rotator tears can present with a substantial infraspinatus component (35).

The teres minor has a relatively large triangular shaped footprint: 29 mm length, 21 mm width. The distance from the articular surface to its insertion averaged 10 mm (34).

Summary

Knowledge of relevant surrounding structures around the proximal humerus is essential to avoid intra- and postoperative treatment failure. Thus, surgeons without anatomical knowledge are like moles - they work in the dark and the result of their work are mounds (F. Tiedemann, Anatomy Graz , Austria).

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Kiertäjäkalvosinoireyhtymä - Etiologia

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The rotator cuff is comprised of four muscles surrounding the shoulder joint. Their tendons and surrounding soft tissues occupy the subacromial space and are thought to be the most common origin of shoulder pain. Although traumatic events with subsequent macroscopic tendon damage are responsible for shoulder pain in a small group of patients, the main causes can be considered to be of a mostly functional and degenerative nature.

The true origin of non-traumatic shoulder pain is still insufficiently understood. It was traditionally attributed to structural alterations within the joint and surrounding structures identified in imaging of a painful joint. However, recent evidence has cast a serious concern over such reasoning, as studies have shown a high prevalence of 'abnormal imaging findings' even in asymptomatic individuals. Furthermore, surgical restoration of such 'deranged anatomy' does not show improved results over conservative treatment. The true origin of shoulder pain and the role of degenerative structural findings, as well their natural course, are still not fully understood, and further investigation is needed.

Tiivistelmä

Kiertäjäkalvosin muodostuu neljästä olkaniveltä ympäröivästä lihaksesta. Niiden jänteet ja ympäröivät pehmytkudokset täyttävät olkalisäkkeen alaisen tilan, ja olkakipu on useimmiten peräisin niistä. Vaikka pieni osa kivuista saattaa johtua traumasta ja sen seurauksena syntyvistä jänteen repeämistä, kipua aiheuttavat tekijät näyttävät useimmiten olevan toiminnallisia ja degeneratiivisia.

Ilman tapaturmaa syntyneen olkakivun todellista syytä ei vielä ymmärretä kovin hyvin. Sen on perinteisesti ajateltu johtuvan nivelen sisällä ja sitä ympäröivissä rakenteissa tapahtuneista muutoksista, jotka ovat nähtävissä kivuliaan nivelen kuvantamistutkimuksissa. Tämä yhteys saattaisi olla kuitenkin vähäisempi kun mitä on perinteisesti ajateltu, sillä tieteellisissä tutkimuksissa on saatu usein ”poikkeavia löydöksiä” oireettomiltakin ihmisiltä. Lisäksi tuollaisten ”anatomisten poikkeavuuksien” kirurginen hoito ei anna sen parempia tuloksia kuin konservatiivinenkaan hoito. Koska olkakivun todellista syytä ja degeneratiivisten rakenteellisten löydösten merkitystä ja niiden luonnollista kulkua ei vielä kovin hyvin ymmärretä, asiaa on syytä tutkia lisää.

Kiertäjäkalvosimen anatomia

Rotator cuff eli kiertäjäkalvosin muodostuu neljästä lihaksesta: m. subscapularis, m. supraspinatus, m. infraspinatus sekä m. teres minor. Nämä kaikki lihakset kulkevat lapaluusta olkaluuhun, ja niiden jänteet sekä alla oleva nivelkapseli muodostavat yhdessä olkanivelen etu-, ylä- ja takapintaa tukevan ”kalvosimen”. Kiertäjäkalvosimen jänteitä ei pysty erottamaan toisistaan, paitsi subscapularisjänteen, joka on erillinen ja yhteydessä muuhun kiertäjäkalvosimeen rotator cuff -intervallin kautta. Nämä jänteet ovat olkanive-

Taulukko 1: Olkalisäkkeen alainen kipuoireyhtymän taustatekijät

Extrinsic-teoria (Mekaaninen teoria)	***Intrinsic-teoria (Degeneratiivinen teoria)***
Akromionin muoto	Ikä
Akromioklavikulaarinen artroosi	Ylirasitus
Korakoakromiaalinen ligamentti	Kollageenimatriksin muutokset (cross link-molekyylit, Tyyppi I-III)
Os acromiale	Fibroosi
Olkapään instabiliteetti	Neoangiogeneesi
Olkanivelen kapselin kireys	Uudishermotus
Lapaluun toiminta / Skapulohumeraalinen rytmi	Geenit
Posteriosuperiorinen (sisäinen) impingement	

len tärkeimmät dynaamiset vakauttajat. M. supraspinatus kiinnittyy tuberculum majuksen yläfasettiin ja on tärkeä varsinkin olkanivelen abduktion alkuvaiheessa (käsivarren abduktion ensimmäiset 30º ovat pääasiassa sen vastuulla). Infraspinatuslihas kiinnittyy tuberculum majuksen keskimmäiseen fasettiin ja teres minor -lihas tuberculum majuksen alafasettiin ja sen kristaan. M. infraspinatus sekä m. teres minor ovat ainoat lihakset, jotka vastaavat olkavarren ulkorotaatiosta. Infraspinatuslihas tuottaa noin 70 % ulkorotaatiovoimasta mutta osallistuu melko paljon myös abduktioon (1). M. subscapularis on suurin ja vahvin kiertäjäkalvosimen lihaksista ja tuottaa noin puolet kiertäjäkalvosimen koko voimasta (2). Yhdessä teres major-, latissimus dorsi- ja pectoralis major -lihasten kanssa subscapularislihas vastaa olkapään sisäisestä kierrosta. Se kiinnittyy tuberculum minukseen ja sen kristan yläosaan.

Kiertäjäkalvosimen lihakset ovat tärkeimmät olkanivelen dynaamiset vakauttajat, ja niiden tärkeimpiin tehtäviin kuuluu lisäksi olkaluun pään keskittäminen lapaluun nivelpinnan maljakkoon, niin että m. deltoideus ja muut ympäröivät suuret voimaa tuottavat lihakset (m. pectoralis major, m. latissimus dorsi jne.) pystyvät välittämään tuottamansa liikevoiman yläraajaan optimaalisella tavalla. Etenkin m. subscapularis ja m. infraspinatus toimivat eräänlaisena lihasparina olkanivelen keskittämisessä ja vastustavat m. supraspinatuksen kanssa deltalihaksen dislokaatiovoimia superioriseen suuntaan.

Jännekivun etiologia

Tendiniitti-termiä käytetään usein, kun halutaan kuvailla rasitusperäisiä kiputiloja jänteiden alueella. Tarkalleen ottaen tendiniittidiagnoosi perustuu kuitenkin histologiseen löydökseen, jossa jännekudosnäytteessä todetaan tulehdussoluja, eikä kliiniseen oirekuvaan. Kirjallisuudessa varhaisimmat näytteet ihmisten jännekudoksista saatiin 4 kk kestäneen oireilun jälkeen (3, 4) ja niissä tutkimuksissa todettiin lähinnä degeneratiivisia muutoksia ilman tulehdussoluinfiltraatiota. Muutamissa eläinkokeissa pystyttiin löytämään tulehdussoluja ensimmäisten 2-3 viikon aikana jännevamman jälkeen, mutta ne katosivat kuitenkin viimeistään 3 viikon kohdalla (5, 6).

Tendinoosi on tenosyyttien ja kollageenisäikeiden rapautumista ilman histologisia tulehduksen merkkejä. Tendinoosi ei välttämättä aiheuta oireita, ja tämän vuoksi termiä tulee käyttää ainoastaan, kun kuvaillaan histopatologista löydöstä eikä kliinisiä oireita.

Tendinopatia: Ylikuormitusvammat kattavat noin 30-50 % kaikista urheiluvammoista, ja monissa kestävyyslajeissa jänteiden ylikuormitusvammat ovat kaikkein yleisimpiä. Esimerkiksi 10 prosentilla huippujuoksijoista on todettu akillesjänteen vaivoja (7). Mikäli halutaan kuvailla rasitusperäisiä oireitajänteen alueella, tendinopatia on oikea termi. Tämä kliinisiä oireita kuvaileva termi kattaa sekä varhaisvaiheen histologisen tendiniitin että kroonisen vaiheen tendinoosilöydökset. Tendinopatian etiologia on epäselvä. Sen katsotaan voivan johtua mekaanisista, vaskulaarisista

ja neuraalisista tekijöistä. Mekaaninen teoria perustuu siihen, että toistuva rasitus (vaikka se olisi fysiologisissa rajoissa) voi aiheuttaa jännekudosten väsymistä ja krooniset toistuvat jännevauriot akkumuloituvat ajan myötä. Tämä selittäisi, miksi ikä sekä urheilullinen tausta altistavat tendinopatialle. Vaskulaarinen teoria. Jännekudos on metabolisesti aktiivinen ja tarvitsee toisin kuin esim. lasirusto hyvän verenkierron. Kirjallisuudesta löytyy jonkin verran näyttöä siitä, että tietyt jänteet voivat olla toisia alttiimpia verenkiertoongelmille (8) esimerkiksi supraspinatusjänne, akillesjänne tai tibialis posterior –jänne (9-11). On hyvinkin mahdollista, että pitkä tai toistuva rasitus yhä pahentaa tätä verenkierrollista ongelmaa. Neuraalinen teoria. Jännekudos on hermotettu, ja hermopäätteiden lähellä on todettu sijaitsevan syöttösoluja. Krooninen jänteen rasitus voisi aiheuttaa liiallista neuraalista stimulaatiota ja syöttösolujen aktivaatiota. Syöttösolut vapauttavat välittäjäaineita, kuten P-ainetta. Kohonneita P-ainepitoisuuksia on pystytty osoittamaan kiertäjäkalvolihas-tendinopatiassa (12).

Tendinopatian patogeneesi: Fu et al. julkaisivat vuonna 2010 kolmivaiheisen mallin, joka kuvaa mahdollisen tendinopatian kehittymistä (13). Tapahtumasarjan alkuvaiheessa syntyy tapaturman tai ylirasituksen aiheuttama jännevamma. Sisäisten ja ulkoisten tekijöiden vaikutuksesta osa näistä vammoista ei korjaannu normaalin paranemisprosessin kautta. Pitkittynyt tai virheellinen korjausprosessi johtaa lopulta ”huo nolaatuisen”/”degeneratiivisen” jännekudoksen muodostumiseen, jonka kliininen lopputulos voi olla kipu tai makroskooppinen repeämä.

Olkalisäkkeen alainen kipuoireyhtymä

Extrinsic-teoria: Olkalisäkkeen alainen kipu (OAK) mainittiin ensimmäisen kerran kirjallisuudessa vuonna 1852 Adamsin ”Cyclopaedia of Anatomy and Physiology” oppikirjassa. Dr. Charles Neer käytti 1972 ensimmäisen kerran termiä ”subacromial impingement” ja loi samalla tuleville vuosikymmenille muotisanan olkapääkivun kuvailemiseksi (14). Neerin mukaan varsinkin etuelevaatioliikkeessä kiertäjäkalvosinlihakset joutuvat puristukseen akromionin etuosaa ja korakoakromiaaliligamenttia vasten. Neerin näkemys oli, että 100 % kaikista olkalisäkkeen alaisista pinnetiloista ja 95 % kaikista kiertäjäkalvosimen repeämistä johtuu akromionin muodosta (anatominen impingement). Nykyään tiedetään, että anatomisten tekijöiden sijaan etenkin toiminnalliset ongelmat voivat altistaa olkalisäkkeen alaiselle kivulle. Olkanivelen epävakauden (instabiliteetti) ajatellaan olevan pääasiallinen nuoren (alle 35-vuotiaan) potilaan olkapään olkalisäkkeen alaisen kipuoireyhtymän syy (15). Fysiologisessa olkanivelen liikkeessä olkavarren pään translaatioliike lapaluun maljakkoa kohti on vain muutamia millimetrejä (16). Mikäli olkapään stabiliteetti on häiriintynyt dynaamisen (kiertäjäkalvosinlihakset) tai staattisen (nivelkapseli, nivelsiteet) toiminnanvajauksen vuoksi.

humeruksen pään deltalihaksen aktivaatiosta johtuva superiorinen translaatioliike kasvaa ja voi aiheuttaa OAK-oireita (17). Myös varsinkin posteriorisen kapselikireyden vuoksi vähentynyt olkanivelen liikkuvuus voi aiheuttaa lisääntynyttä anterosuperiorista translaatioliikettä olkanivelen fleksiossa (16, 18, 19). OAK-potilailla myös lapaluun hallinta sekä skapulohumeraalinen rytmi voivat olla häiriintyneet. Tuolloin lapaluun abduktio ja posteriorinen kallistus on vähentynyt ja akromionin anterolateraalinen osa ei väistä normaalilla tavalla (kun yläraaja nostetaan vaakatason yläpuolelle) (20-22).

Intrinsic-teoria: Sisäiset tekijät ovat jännekudoksen sisällä tapahtuvia patologisia muutoksia, jotka käynnistyvät, kun mekaaniset vaatimukset jännekudokselle ylittävät endogeeniset korjausmekanismit. Sisäiset syyt johtuvat ikääntymisestä, ylirasituksesta ja toistuvista yliolanliikkeistä ja voivat johtaa kiertäjäkalvosimen jänteiden ja niiden yläpuolella olevan limapussin ärsytykseen, jänteiden degeneraatioon ja lopulta jänteiden repeämään. Histopatologiset muutokset näkyvät kollageenisäikeiden ohentumisena, cross link -ketjujen hajoamisena, lisääntyneenä tyypin III kollageenin muodostumisena (tyypin I kollageenin sijaan). Tämän lisäksi nähdään tenosyyttien apoptoosia, fibroosia, neoangiogeneesia ja uudishermotusta jänteen pintaa pitkin. Aihetta on käsitelty tarkemmin Tendinopatia-kappaleessa.

Kiertäjäkalvosimen repeämä

Kiertäjäkalvosimen patologiat ovat yleisin syy olkapään kipuun ja toiminnan ongelmiin aikuisilla (23). Kiertäjäkalvosimen repeämät voidaan jaotella sijainnin (supraspinatus, infraspinatus, subscapularis), repeämän vaikeusasteen (osittainen vai totaalinen), etiologian (akuutti, degeneratiivinen tai ”acute on chronic”) ja oireilun (oireeton vai oireinen) suhteen. Akuutin ja degeneratiivisen repeämän erottelu on haasteellista. Monilla kiertäjäkalvosimen repeämää sairastavilla

(40-88 %) on vamma tiedossa anamneesissa, mutta suurin osa niistä ei kuitenkaan täytä akuutin repeämän kriteerejä (24-28). Traumaattisen repeämän määritelmä on akuutti trauma anamneesissa ilman aikaisempia olkapäävaivoja ja siihen liittyvä reilu liikerajoitus ja kipu. Basset ja Cofield totesivat vuonna 1983 ja Lähteenmäki vuonna 2006, että vain 2,3 % ja 5,3 % potilaista täytti nämä kriteerit (29, 30). Tämän lisäksi oireettomat repeämät ovat väestössä yleisiä ja revenneen jänteen histopatologisessa tutkimuksessa todetaan lähes poikkeuksetta degeneratiivisia muutoksia (31). Tästä havainnosta Codman totesi jo vuonna 1934: ”En epäile, etteikö terveen jänteen traumaattinen repeäminen olisi mahdollista, mutta uskon että repeämiä tulee useimmin iäkkäisiin jänteisiin, joita liikakäyttö, ikä tai toksiset tekijät ovat heikentäneet.” Väestötutkimuksissa on myös todettu, että iso osa jännerepeämistä on oireettomia (ja oireettomien repeämien osuus nousee iän myötä) (32), ja olkapään kipeytyminen trauman yhteydessä ei siinä tapauksessa välttämättä ole lainkaan yhteydessä jänteen repeämään.

Osittainen kiertäjäkalvosimen repeämä: Osittaiset kiertäjäkalvosimen repeämät voidaan luokitella sijainnin ja syvyyden perusteella (Ellmanin luokitus) (33). Suurin osaa sijaitsee supraspinatuslihaksen jänteessä (34). Repeämät nivelen sisäpuolella ovat 2-3 kertaa yleisempiä kuin ulkopuolella (35), ja 97 %:ssa niistä on pystytty osoittamaan degeneratiivisia histopatologisia muutoksia (36). On ajateltu, että intrinsic-teoria selittäisi pääasiassa artikulaarisen puolen repeämät, kun taas bursan puolen repeämissä mekaanisella syyllä voi olla suurempi merkitys (37). Bursan puolelta alkavat repeämät ovat joidenkin tutkimusten mukaan kivuliaampia, ja tämän taustalla ovat mahdollisesti niihin liittyvä limapussin ärsytys ja kohonneet P-aineen pitoisuudet (12, 38). Osittaiset repeämät näyttäisivät olevan ylipäänsä kivuliaampia kuin totaalirepeämät, ehkä sen takia, että säilyneisiin jänteen säikeisiin kohdistuva jännitys on suurempi.

Totaalinen kiertäjäkalvosimen repeämä: Mikäli kiertäjäkalvosinjänne on koko paksuudeltaan poikki, puhutaan totaalirepeämästä. Repeämän arvioinnissa otetaan huomioon repeämän koko ja sijainti (Ellmanin luokitus), jänteen vetäytymä sekä lihaksen rasvoittuminen (Goutallier). Opsha et al. totesivat kirjallisuuskatsauksessaan vuonna 2008, että suurin osa kiertäjäkalvosimen repeämistä sijaitsee supraspinatusjänteen etuosassa tai alkaa sieltä (39). Toiseksi yleisin jännerepeämä sijaitse infraspinatusjänteessä. Suurimmassa osassa tapauksista tämä on jatkoa alkuperäisestä supraspinatusrepeämästä. Mikäli enemmän kuin kaksi jännettä on revennyt (eli yleensä supraspinatus- ja infraspinatusjänteen lisäksi myös subscapularisjänne), puhutaan massiivisesta kiertäjäkalvosimen repeämästä. Selvästi harvinaisempi on isoloitunut subscapularisrepeämä, joka voi esiintyä anteriorisen olkapääluksaation tai subkorakoidaalisen pinteen seurauksena.

Esiintyvyys: Olkapäätä kuten muitakin tuki- ja liikuntaelimistön osia kuvannettaessa saadaan degeneratiivisia löydöksiä usein myös oireettomilta ihmisiltä (40-49). Arviot kiertäjäkalvosimen repeämän esiintyvyydestä oireettomilla tutkittavilla vaihtelevat huomattavasti eri tutkimuksissa (6-33 %).

Koko kiertäjäkalvosimen läpi ulottuvien repeämien esiintyvyys vaihteli kahdessa väestötason japanilaisessa ultraääniseulontatutkimuksessa välillä 20,7-22,1 % (32, 50). Tutkimusten otoskoko oli hyvä, mutta niiden yleistettävyyttä on epäilty, koska naisten määrä oli niissä suhteettoman suuri (64 % ja 66,6 %), iän mediaani oli korkea (58 ja 70 vuotta) ja tutkimukset tehtiin maaseudulla, missä työ oli fyysisesti raskasta. Esiintyvyys on hyvin pieni alle 50-vuotiailla mutta lisääntyy tasaisesti ja voi 80-89-vuotiaiden ikäryhmässä olla jopa 50 %. Oireettomat repeämät ovat väestössä kaksi kertaa yleisempiä kuin oireiset, ja ikääntyessä oireettomien repeämien osuus kasvaa (32).

Luonnollinen kulku: Myös repeämien luonnollisesta kulusta on tutkimusnäyttöä. Yamaguchi ja kumppanit seurasivat 5 vuoden ajan ultraäänellä todettuja oireettomia kiertäjäkalvosimen totaalirepeämiä. 51 prosentille potilaista tuli oireita 2,8 vuoden aikana. Myös repeämien koko kasvoi, ja spontaania paranemista ei tapahtunut (51). Fucentese et al. seurasivat 3,5 vuoden ajan 24 potilasta, jolla oli oireinen supraspinatusrepeämä, ja totesivat, että potilastyytyväisyys oli hämmästyttävän hyvä eikä repeämien keskimääräinen koko kasvanut (52). Samantyyppisessä tutkimuksessa, joka koski kiertäjäkalvosimen massiivisen repeämän luonnollista kulkua 4 vuoden kuluessa, todettiin, että vaikka nivelen degeneratiiviset muutokset etenivät merkittävästi, olkapään toimintakyky pysyi tyydyttävänä (53).

Mikä muuttaa oireettoman repeämän oireilevaksi? Siihen kysymykseen ei ole vielä selvää vastausta. On huomattu, että oireettomat repeämät sijaitsevat melko usein supraspinatuslihaksessa, ja monet ovat kooltaan < 3 cm. Mahdollinen teoria olisi, että niissä ns. rotator cable -rakenne on vielä säilynyt, ja sen ansiosta normaalit subscapulariksen ja infraspinatuksen aikaansaa-

mat vastavoimat ovat vielä olemassa. Näin ollen kiertäjäkalvosin toimii vielä ainakin osittain anatomisesti (54).

Lopuksi

Atraumaattisen olkakivun todellinen syy on yhä epäselvä. Perinteinen ajattelu, että sille on aina joku mekaaninen tai rakenteellinen selitys, on kuitenkin syytä kyseenalaistaa. Toiminnallisten ja sisäisten tekijöiden lisäksi on syytä jatkossa myös kiinnittää enemmän huomiota muihin asioihin, jotka saattavat vaikuttaa yksilön kiputuntemukseen, kuten perussairauksiin, sosiaalisiin sekä psykologisiin tekijöihin (55, 56).

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Kiertäjäkalvosinoireyhtymä – Diagnostiikka ja hoitolinjan valinta

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Rotator cuff syndrome is the most common cause of shoulder pain, and it is also referred to as shoulder impingement. However, both terms can be misleading as far as pain etiology is concerned and some advocate the use of the more ubiquitous term, subacromial pain syndrome (SAPS). Current understanding has shifted away from Charles Neer's theory, whereby mechanical impingement is considered the main cause of shoulder pain, to a more multifactorial approach which takes functional and intrinsic factors into account also. Pain may not only originate from the rotator cuff tendons (due to tendinopathy or rotator cuff tears) but also from other structures occupying the subacromial space (such as bursa and long head of the biceps tendon). Therefore, a clear diagnosis is not always possible. As far as primary treatment is concerned, a specific diagnosis is usually not necessary because, according to scientific research, the primary treatment is conservative. The cornerstone of treatment involves isometric and concentric strengthening exercises to restore normal scapular and rotator cuff function. Clinical examination primarily aims at excluding rarer symptoms, such as an acutely restricted active range of motion or decreased muscle strength which may require further investigation or even operative treatment.

Tiivistelmä

Kiertäjäkalvosinoireyhtymä on yleisin olkapääkivun syy, ja siitä käytetään usein myös nimitystä ”olkapään pinneoireyhtymä”. Kumpikaan termi ei kuitenkaan nykykäsityksen mukaan ole kovin hyvä, ja parempi olisi käyttää termiä olkalisäkkeen alainen kipuoireyhtymä (OAK). Tämä sen takia, että kipu voi pohjautua muuhunkin kuin kiertäjäkalvosimen jänteisiin eikä kyseessä ole aina pehmytkudosten mekaaninen hankaus kahden luun välissä (mihin termi impingement viittaa). Oirekuvan taustalla voi olla olkapään instabiliteetti, nivelpussin ärsytys, kiertäjäkalvosimen jänteiden ärsytys, degeneraatio tai repeämiä. Erotusdiagnostiikka kliinisten tutkimusten perusteella voi olla vaikeaa, eikä spesifistä diagnoosia yleensä tarvita, koska tieteellisten tutkimusten valossa ensisijainen hoito on konservatiivinen. Hoidon kulmakivi on fysioterapeutin käynnillä annettu ohjaus päivittäiseen omatoimiseen liike- ja liikuntaharjoitteluun. Kliinisessä tutkimuksessa pyritään lähinnä poissulkemaan harvinaisemmat oireet, kuten vammaan liittyvä äkillinen liikerajoitus tai lihasvoiman heikentyminen, jotka saattaisivat vaatia lisätutkimuksia ja joskus operatiivistakin hoitoa.

Diagnostiikka

Anamneesi: Hyvän diagnostiikan kulmakivi on huolellinen anamneesi. Sen tiesi jo ”modernin lääketieteen isä”, kanadalainen Sir William Osler, joka totesi: ”Kuuntele potilastasi, hän kertoo sinulle diagnoosin”. Huolellinen anamneesi on myös hyvän potilas-lääkärisuhteen perusta ja luo edellytykset hyvälle hoitosuhteelle. Perusanamneesissa kartoitetaan olkalisäkkeen alaisen kipuoireyhtymän (OAK) mahdolliset riskite-

kijät: perussairaudet, elämäntavat (tupakointi), työnkuva ja vapaa-ajan harrastukset, aiemmat tapaturmat ja leikkaukset. Sen jälkeen tarkennetaan esitietoja nykysairauden osalta: onko olkapää aiemmin ollut oireeton, miten oireet ovat alkaneet (vähitellen vai äkillisesti? vamman yhteydessä?), oireiden kesto, kivun sijainti ja luonne. Oleellista on myös tietää aiemmin kokeillut hoidot.

OAK:n oireet alkavat usein vähitellen ja ovat yleisiä 40_50-vuotiailla. Iäkkäimmillä potilailla samankaltainen vaiva voi viitata degeneratiiviseen kiertäjäkalvosimen repeämään, kun taas nuorilla (alle 30-vuotiailla) olkalisäkkeen alle paikantuva kipu ja kipukaarioire johtuvat todennäköisemmin olkanivelen epävakaudesta. OAK:n tyypillisin oire on kipu, joka tuntuu epämääräisesti olkalihaksen alueella säteillen olkavarteen, mutta ei käytännössä koskaan kyynärnivelen ylitse.

Kliininen tutkimus: Tutkimuksen alussa potilasta pyydetään riisumaan ylävartalo paljaaksi, jotta voidaan toteuttaa asianmukainen inspektio ja palpaatio. Samalla nähdään olkapään toiminta tavanomaisessa, jokapäiväisessä tilanteessa. Perustutkimukseen kuuluu lisäksi passiivisten ja aktiivisten liikeratojen tarkistus sekä lihasvoiman ja stabiliteetin testaus. Spesifiset ortopediset testit täydentävät kliinistä arviota. Ortopedisiä erityistestejä on lukuisia. Hanchard et al. tekivät vuonna 2013 kliinisiä olkapään testejä koskevan Cochrane-katsauksen (1). Yhteenvetona todettiin, että useimpien tieteellisten tutkimusten laatu oli huono: menetelmät, joilla kliinisiä tutkimuksia verrattiin, vaihtelivat (UÄ/MRI/artroskopia), testien kuvauksissa oli vaihtelua samoin kuin positiivisten löydösten tulkinnassa (kipu tai lihasheikkous). Katsauksessa oli mukana yhteensä 31 julkaisua ja 170 eri testi-tauti-yhdistelmää. Yhdistelmistä vain 6 tulkittiin samalla tavalla kahdessa eri julkaisussa. Monien testien toistettavuus osoittautui myös huonoksi: näyttö testin vaikuttavuudesta oli usein vahva alkuperäistutkimuksessa, mutta heikkeni seuraavissa tutkimuksissa. Kliinisten testien tarkkuutta kiertäjäkalvosimen diagnostiikassa voidaan selvästi parantaa käyttämällä tiettyjä testiyhdistelmiä.

Kuvantaminen: Vaikka magneettikuvantamisen saatavuus on yhä parempi, natiiviröntgenkuvaa tulisi edelleen pitää ensisijaisena radiologisena tutkimuksena sekä traumaattisen että ei-traumaattisen olkavaivan selvittelyssä. Natiiviröntgenkuvan vahvuudet traumatapauksissa ovat ilmeiset, mutta myös ei-traumaattisissa tilanteissa natiivikuva antaa arvokasta tietoa, ja tutkimus on helposti saatavilla ja edullinen. OAK:n diagnostiikassa varsinkin sellaiset löydökset kuin glenohumeraalinen nivelrikko tai humeruksen pään kranialisoituminen (joka viittaa massiiviseen kiertäjäkalvosimen repeämään) ohjaavat pitkälle hoitolinjausta, ja natiiviröntgenkuvista saadaan myös tietoa lapaluun anatomiasta. Toisin kuin usein uskotaan, olkalisäkkeen muoto (Biglianin luokitus, ”koukkumainen akromion”) ei näytä vaikuttavan OAK:n tai kiertäjäkalvosimen repeämien esiintyvyyteen (2, 3).

Magneettiartrografiaa (MRA) käytetään, kun kliinisten tutkimusten perusteella epäillään, että operatiivinen hoito voi olla tarpeen. Varjoainetehosteinen MRI ei välttämättä tuo lisäarvoa kiertäjäkalvosimen jänteiden totaalirepeämien diagnostiikkaan verrattuna ultraääneen tai natiivimagneettikuvaukseen, mutta osittaisten repeämien diagnostiikassa varjoainetehosteisella MRA-tutkimuksella on vankka sija (4-6). MRA on erityisen hyvä kuvausmenetelmä nivelen puoleisissa osittaisrepeämissä, joita on suurin osa kaikista osittaisrepeämistä (7, 8). Vaikka osittaisten repeämien diagnostiikalla ei juuri ole kliinistä merkitystä, magneettikuvaus on korvaamaton arvioitaessa totaalirepeämän kokoa, lihasatrofian astetta, jänteen vetäytymää sekä jänteen päiden kuntoa (9, 10).

Ultraääni (UÄ) on usein käytetty kuvantamismenetelmä selviteltäessä olkapääkipua. Se on osa kiertäjäkalvosimen patologioiden ensilinjan diagnostiikkaa monilla nimekkäillä klinikoilla ympäri maailman. UÄ on edullinen, helposti saatavilla ja tarjoaa mahdollisuuden niveltä ympäröivien pehmytkudosten dynaamiseen tutkimiseen (11). Useiden kirjallisuuskatsauksien mukaan MRI (ilman varjoainetta) ja UÄ olivat yhtä tarkat kiertäjäkalvosimen repeämien havaitsemisessa, ja varjoainetehosteinen MRA parantaa osittaisten repeämien (sekä muiden intra-artikulaaristen rakenteiden) diagnostiikkaa (4-6). Ultraäänitutkimuksen luotettavuus riippuu suuresti tutkimuksen suorittajan taidoista ja kokemuksesta. Mahdollisuus nivelensisäisten rakenteiden tarkasteluun on myös rajallinen.

Tietokonetomografia (TT). Ennen MRI-teknologiaa artrografia ja myöhemmin myös TT-artrografia olivat kiertäjäkalvosimen repeämien kuvantamisen kulmakiviä. Ranskassa TT-artrografia (Computed Tomography Arthrography = CTA) on edelleen laajalti käytössä kiertäjäkalvosimen ensilinjan diagnostiikassa. Charoussel et al. osoittivat julkaisussaan vuonna 2005, että CTA:n tarkkuus kiertäjäkalvosimen repeämien havaitsemisessa oli magneetti- ja ultraäänikuvauksen

luokkaa (12). Useimmissa muissa maissa CTA:ta käytetään kiertäjäkalvosimen repeämän kuvantamiseen vain, jos magneettikuvaus on vasta-aiheinen, sitä ei ole saatavilla tai ultraäänitutkimusta tekemään ei ole saatavilla riittävän kokenutta tutkijaa.

Hoitolinjan valinta

Konservatiivinen hoito

Omahoidon ohjaus: Hoito alkaa yleensä lääkärin, fysioterapeutin tai muun terveydenhuollon ammattilaisen antamalla omahoidon ohjauksella. Ohjauksen tarkoituksena on auttaa potilasta ymmärtämään vaivaansa paremmin ja antaa hänelle keinot ottaa itse vastuuta omasta hoidostaan. Ohjattavia keinoja ovat esimerkiksi kuormituksen säätely, työasennon ja ryhdin korjaus, kylmä- ja lämpöhoidot sekä liikehoidot. Vaivojen alkuvaiheessa taustalla on usein liiallinen kuormitus ja siitä johtuva ärsytystila. On esitetty, että kylmähoito lievittää kipua ja vähentää kudosten turvotusta ja tulehdusta (13). Akuutissa tilanteessa myös kipua aiheuttavan työn/rasituksen välttäminen, tarvittaessa sairausloman avulla, on tärkeää kroonistumisen välttämiseksi (hillitään potilasta). Pitkittyneessä tilanteessä on taas tärkeää rohkaista potilasta käyttämään oireilevaa raajaa kivun sallimissa rajoissa (aktivoidaan potilasta). Kroonisessa kivussa lämpöhoito voi olla hyvä vaihtoehto kylmähoidon tilalle, sillä se laajentaa verisuonia ja lievittää lihaskireyttä.

Lääkehoito: Hyvä kipulääkitys ei pelkästään helpota potilaan arkielämää, vaan mahdollistaa myös asianmukaisen liikkuvuus- ja lihasvoimaharjoitusten suorittamisen. Ensisijainen kipulääke on parasetamoli ja myös paikallisista tulehduskipulääkegeeleistä saattaa olla hyötyä. Jos näiden teho ei riitä, siirrytään tablettimuotoisiin tulehduskipulääkkeisiin. Kovempina kipulääkkeinä voidaan ainakin väliaikaisesti harkita heikkoja opioideja (tramadoli tai kodeiini). Kipulääkkeen valinnassa on otettava huomioon ruoansulatuskanavaan kohdistuvat haittavaikutukset, sydän- ja verisuonitapahtumien riski sekä lääkeallergiat. Olkalisäkkeen alapuolisesta kortikosteroidi-injektiosta on raportoitu olevan lyhytaikaista apua tendinopatian alkuvaiheessa (oireiden kesto alle 8 viikkoa) (14, 15). Injektio mahdollistaa näin kuntoutuksen aloittamisen ja on myös osin diagnostinen (mikäli kipu injektion jälkeen helpottaa). Injektio voidaan toistaa 2_3 kertaa 2_4 viikon välein. Tutkimusnäytön perusteella glukokortikoidi-injektio ei näyttäisi olevan suun kautta otettua kipulääkettä tai fysioterapiaa tehokkaampi (15-18). Glukokortikoidi-injektion yleisiä haittavaikutuksia ovat ihoatrofia (9 %) ja lisääntynyt kipu (8 %), mutta vakavammat komplikaatiot, kuten esimerkiksi jännerepeämät, ovat harvinaisia (17). Satunnaistetun hoitotutkimuksen perusteella terapeuttinen harjoittelu yhdistettynä kortikoidi-injektioon on tehokkaampaa kuin pelkkä harjoittelu kuuteen viikon asti, mutta ei sen jälkeen (18).

Fysioterapia: Olkalisäkkeen alaisen kivun hoidon kulmakivi on asianmukaisesti toteutettu, progressiivisesti etenevä liike- ja liikuntahoito fysioterapeutin ohjaamana. Terapeuttisen harjoittelun tavoite on olkanivelen normaalin liikkuvuuden palauttaminen sekä olkapään, lavan ja keskivartalon lihasvoimien, asennon ja hallinnan parantaminen. Olkapään tendinopatiassa lapaluun kinematiikka on usein poikkeavaa (on edelleen epäselvää, onko tämä syy vai seuraus) (19). Spesifisen kiertäjäkalvosimen lihasvoimaharjoittelun lisäksi pyritään myös vaikuttamaan lapaluun asentoon ja hallintaan sekä keskivartalon lihasvoimiin. Harjoitteiden suorittamisessa on hyvä huomioida myös jarruttavan (eksentrisen) lihastyön osuus (20). Perusperiaatteisiin kuuluvat potilaan itsenäisen harjoittelun rohkaiseminen (fysioterapiakäyntien lisäksi), riittävän pitkä hoitojakso sekä harjoitteiden yksilöllinen progressio. Fysioterapeutin antamilla sähkö., laser- ja ultraäänihoidolla ei ole osoitettu vaikuttavuutta (21), ja niitä ei tulisi suositella.

Leikkaushoito

Akromioplastia: Tutkimusnäytön mukaan olkalisäkkeen avarrusleikkaus ei tuota lisähyötyä fysioterapeutin ohjaamaan harjoitteluun olkalisäkkeen alaisen kivun hoidossa (22-28). Käypä hoito suosituksen mukaan leikkaushoitoa voidaan poikkeustapauksissa harkita erikoislääkärin harkinnan mukaan, ellei asianmukaisesti ja pitkäkestoisesti toteutettu konservatiivinen hoito ole tuottanut riittävää helpotusta kipuun (29). Toimenpiteessä olkalisäkkeen alapuolista tilaa avarretaan poistamalla olkalisäkkeen etukulma ja alla oleva bursa. Leikkaus voidaan tehdä artroskooppisesti tai avoimesti. Prospektiivisissa satunnaistetuissa tutkimuksissa avoimen ja artroskooppisen akromioplastian tulokset ovat olleet yhdenvertaiset (30).

Kiertäjäkalvosimen ompelu: Olkalisäkkeen alainen kipu voi johtua myös kiertäjäkalvosimen repeämästä. Oireettomat repeämät ovat varsinkin ikäihmisil-

Taulukko 1: Olkalisäkkeen alaisen kivun progressiivisesti etenevä liike- ja liikuntahoito (52)

Harjoitteiden progressio	Tavoite
Viikot 0-3	• Kapselikireyksien helpottaminen • Aktiiviset avustetut harjoitteet • Submaksimaaliset isometriset harjoitteet ja lavan hallinta
Viikot 4-6	• Olkanivelen kapselin liikkeet • Maksimaaliset isometriset harjoitteet • Skapulothorakaaliset harjoitteet
Viikot 7-8	• Liikeharjoitteet kaikkiin suuntiin • lihasten venytys • Dynaamiset harjoitteet vastuskumilla lihasvoiman parantamiseksi.
Viikot 9-12	• Dynaamiset voimaharjoitteet lisäten intensiteettiä, lihasvenytykset.

Taulukko 2: Korjauskelvoton kiertäjäkalvosimen repeämä

Korjauskelvoton kiertäjäkalvosimen repeämä
• merkittävä nivelrikko röntgentutkimuksessa (53)
• revennyt jänteen pää vetäytynyt lapaluun nivelmaljan tasolle
• merkittävästi kaventunut olkalisäkkeen alainen tila röntgenkuvassa (54)

lä hyvin yleisiä. Usein tapaturmaperäistä repeämää ei voida luotettavasti erottaa kroonisesta rappeumaperäisestä repeämästä, jonka oireet pahenevat äkillisesti. Aiheesta on olemassa kolme satunnaistettua, vertailevaa tutkimusta (31-33), jossa harhan riski on pieni. Niiden 1 vuoden seurantatuloksista tehtiin hiljattain ensimmäinen meta-analyysi, jossa ei todettu Constant-pistemäärän ja kipujanan perusteella kliinisesti merkittävää eroa leikkauksen ja konservatiivisen hoidon välillä (34). Yhdestä tutkimuksesta on myös olemassa viiden vuoden seurantatuloksia, joissa todettiin lieviä mutta kuitenkin kliinisesti merkityksettömiä eroja kirurgisen hoidon hyväksi (32). On myös pidettävä mielessä, että repeämän koko on tärkeä hoitotulosta ennustava tekijä kiertäjäkalvosimen repeämän hoidossa. On todettu, että seurannassa repeämien koot yleensä kasvavat. Toisaalta on myös osoitettu, että onnistuneen kiertäjäkalvosimen korjauksen alustavat hyvät tulokset heikkenevät usein pitkäaikaisseurannassa (35). Jänteiden uudelleenrepeämät ovat suhteellisen yleisiä (36), mutta eivät välttämättä aiheuta oireita tai toimintakyvyn heikkenemistä (37). Joskus voidaan harkita kiertäjäkalvosimen korjausta myös rappeumaperäisessä tilanteessa, mikäli potilaalla on vaikeaa kipua tai toiminnallista vaivaa eikä konservatiivinen hoito ole riittävästi helpottanut oireita. Perinteisessä artroskooppisessa kiinnitysmenetelmässä käytettiin yhtä ankkuririviä, kun taas viime aikoina on esitelty myös kahden ankkuririvin menetelmä, jonka tarkoitus on jakaa kiinnityskohtaan kohdistuva voima laajemmalle alueelle. Samalla saadaan myös jänne-luukontakti isommalle alueelle. Näillä seikoilla pyritään edistämään kudoksien paranemista ja aikaansaamaan entistä kestävämpi kiinnitys. Toisaalta on myös näyttöä siitä, että mediaalisen ompelurivin reunaan kohdistuu yllättävän paljon jännitystä. Mikäli kahden rivin korjaus pettää, on jännekudosta vähemmän jäljellä ja uusintaleikkaus on haastavampi. Molemmilla menetelmillä on sekä hyviä että huonoja puolia, ja kliinisten tutkimuksien perusteella menetelmien välillä ei ole merkitseviä eroja (38-44). Samalla tavalla kuin akromioplastia myös artroskooppisesti tehty kiertäjäkalvosimen korjaus johtanee avotoimenpiteitä vastaaviin kliinisiin tuloksiin (45, 46). Kiertäjäkalvosimen repeämän korjausleikkaukseen kannattaa suhtautua pidättyvästi, mikäli saadaan taulukossa 2 mainitut löydökset.

Korjauskelvoton kiertäjäkalvosimen repeämä: Korjauskelvottomissa kiertäjäkalvosimen repeämissä on saatu hyviä tuloksia ohjatuilla hartialihaksen harjoitteilla (47). Harkituissa tapauksissa (nuorehkoille potilaille) voidaan tehdä latissimus dorsi -lihaksen jännesiirre olkapään ulkokierron parantamiseksi. Alkuperäinen tekniikka on avoleikkaus (48), mutta nykyään on käytössä myös mini-invasiivinen ja artroskooppinen menetelmä. Käänteistekonivel saattaa parantaa toimintakykyä ja lievittää kipua (49-51). Nuorilla potilailla käänteistekonivelen käyttöön on kuitenkin syytä suhtautua pidättyvästi, koska sen pitkäaikaistuloksia tunnetaan huonosti ja revisioleikkausmahdollisuudet ovat rajalliset.

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Säären alaosan murtumien hoito Töölön sairaalassa – 2 vuoden tulokset

Treatment of pilon tibiale fractures – 2 years of follow up

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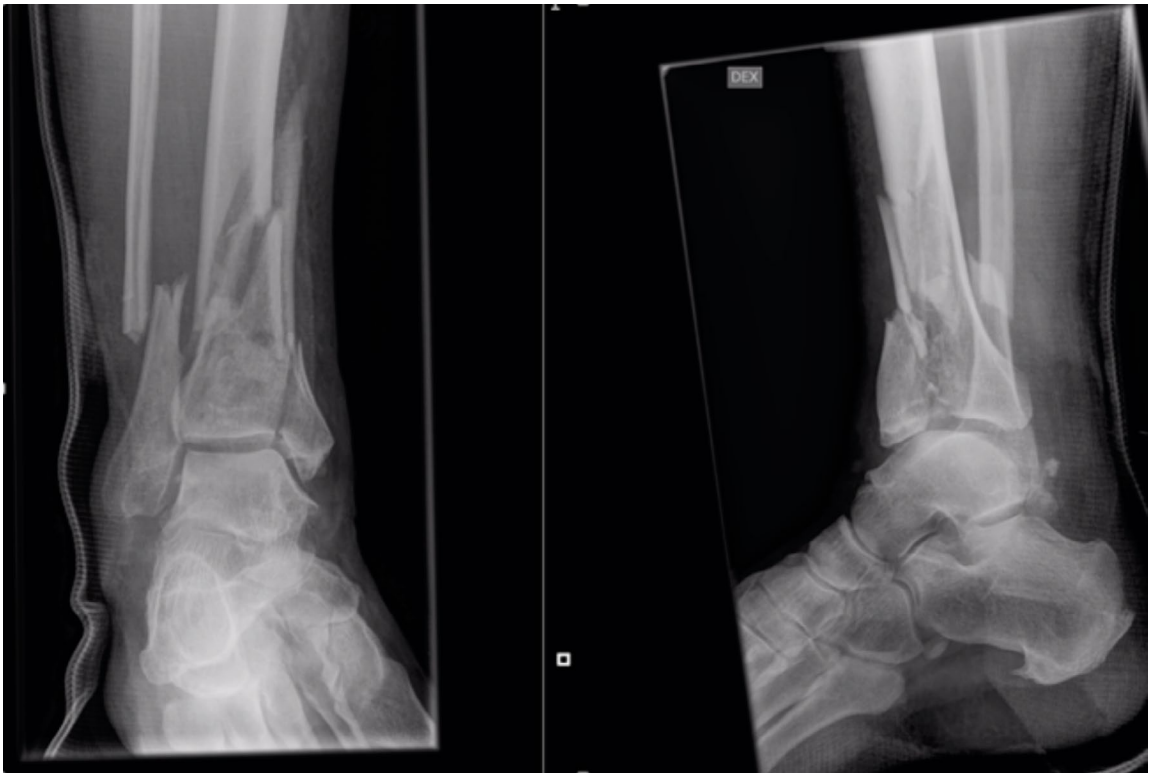
Distal tibial intra-articular fractures (pilon tibiale) account for 1 % of lower extremity fractures. Since it is caused most commonly by a high energy trauma it possesses problems with soft tissue injuries. A chart review of all patients with operatively treated distal tibial fractures in our level I trauma center during the years 2012-2013 was performed and 58 patients with pilon tibiale fractures were identified. Often more than one surgical operation was needed and definitive treatment with locking plate was usually performed in second stage (average 8.57 days from injury). Also plastic surgical expertise may be needed for a soft tissue reconstruction since every fifth patient (19 % in this study) has an open fracture.

Johdanto

Sääriluun alaosan vaikeita intra-artikulaarisia murtumia, ns. pilon tibiale-murtumia, on alle 1 % alaraajan murtumista ja 3-10 % sääriluun murtumista (1-3). Kyseessä on useimmiten korkea-energinen vamma, joista jopa viidesosa on avomurtumia ja näillä potilailla on usein myös muiden ruumiinosien vammoja (1-4). Vammamekanismina on usein liikenneonnettomuus tai korkealta putoaminen, mutta esimerkiksi haurasluisilla vanhuksilla yksinkertainen kaatuminenkin voi aiheuttaa pilon tibiale-murtuman. Murtuma on usein erittäin pirstaleinen ja pehmytkudosvammat ovat myös merkittävät (5). Tämän takia vamman korjaamiseksi tarvitaan useimmiten enemmän kuin yksi ortopedinen leikkaustoimenpide ja usein myös plastiikkakirurgista osaamista (6). Ensimmäisenä toimenpiteenä on yleensä käytetty ulkoista fiksaatiota, ja turvotuksen laskettua tehdään definitiivinen hoito lukkolevytyksellä (7-9).

Aineisto ja menetelmät

Kävimme retrospektiivisesti läpi HYKS Töölön sairaalassa säären alaosan murtuman vuoksi operatiivisesti hoidetut potilaat aikavälillä 1.1.2012-31.12.2013. Diagnoosikoodilla S82.3 (sääriluun alaosan murtuma) löytyi yhteensä 202 potilasta. Näistä 58 potilaalla oli preoperatiivisten CT kuvien perusteella pilon tibiale-murtuma (AO-luokitus B2-B3 ja C1-C3). B-tyypin murtuma oli 16 potilaalla (27.6 %), C-tyypin murtuma 38 potilaalla (65.5 %) (Kuva 1) ja neljällä potilaalla (6.9 %) oli samanaikainen molempien jalkojen pilon-murtuma. Potilaiden keski-ikä oli 43-vuotta (16-80 v.), miehiä 43 (74 %) ja naisia 15 (26 %). 9 potilaalla (16 %) oli tiedossa olevaa runsasta al-



Kuva 1. C3-tyypin pilon tibiale-murtuma. Preoperatiivinen natiivi rtg-kuva.

koholin käyttöä, 25 potilasta (43 %) tupakoi, 7 potilasta (12 %) käytti huumeita ja 17 potilaalla (29 %) oli psyykkinen sairaus. Yleisin vammamekanismi oli korkealta (>2m) putoaminen (27 potilasta, 46.5 %); muita vammamekanismeja olivat kaatuminen (22 potilasta, 38 %) ja moottoriajoneuvoon liittyvä loukkaantuminen (9 potilasta, 15.5 %). 11 potilaalla (19 %) oli avomurtuma; näistä viidellä Gustilo gradus 2 ja viidellä gradus 3 avomurtuma. 26 potilaalla (45 %) oli lisäksi jokin muu murtuma.

Potilaiden sairauskertomusmerkinnät käytiin läpi ja selvitimme demografisten tietojen lisäksi ulkoisen fiksaation käytön, definitiivisen leikkaukseen pääsyn viiveen ja leikkausmenetelmän, sekä mahdolliset komplikaatiot. Syvän infektion määritelmänä seuraavat kolme kriteeriä tuli täyttyä samanaikaisesti: kliiniset infektion merkit (punoitus, kuumotus, eritys), positiivinen bakteeriviljelynäyte haavasta tai verestä sekä yhteys levyyn (palpoiden, sondeeraten).

Tulokset

Yksivaiheinen leikkaus levytyksellä tai ruuvauksella pystyttiin tekemään 20 potilaalle (34.5 %). Loput 38 potilasta (65.5 %) tarvitsivat kaksivaiheisen toimenpiteen, jossa ensimmäisessä vaiheessa asetettiin ulkoinen fiksaatio ja turvotuksen laskettua tehtiin definitiivinen hoito. Toisen vaiheen toimenpiteenä oli 35 potilaalla tibian lukkolevytys, 2 potilaalla nilkkanivelen yli asetettu ulkoinen tukilaite (Orthofix) ja 1 potilaalla ruuvikiinnitys. Sään faskiotomiat jouduttiin tekemään 4 potilaalle (7 %), ja näistä yhdelle jouduttiin tekemään myöhemmin latissimus dorsi-lihaskieleke haavan peittämiseksi. Fibulamurtuma todettiin 46 potilaalla (79 %) ja näistä levytettiin 32 (70 %). Definitiivinen hoito toteutettiin turvotuksen laskettua keskimäärin 8 (0-20) päivän kohdalla vammasta. Autologista luunsiirrettä käytettiin 32 potilaalla (55 %) ja luunkorvikkeita 8 potilaalla (14 %).

Primaarihoidon yhteydessä viidelle potilaalle (9 %) tehtiin haavan peitoksi plastiikkakirurgien toimesta

paikallinen kielekerekonstruktio: kolme lihaskieleketä gradus 3 avomurtuman vuoksi ja kaksi iho-subcutiskieleketä, joista toisella oli gradus 3 avomurtuma. Lisäksi 4 potilasta (7 %) tarvitsi haavan peitoksi ihonsiirteen primäärihoidon yhteydessä. Potilaille tehtiin yhteensä keskimäärin 2 (1-7) leikkaustoimenpidettä. Sairaalahoidon kokonaispituus HUS:ssa oli keskimäärin 19 (2-61) päivää.

Pinnallinen haavainfektio todettiin 6 potilaalla (10 %) ja se hoidettiin paikallishoidoin sekä peroraalisella antimikrobilääkityksellä, lisäksi yhdelle potilaalle suoritettiin haavarevisio. Syvä haavainfektio todettiin 8 potilaalla (14 %). Syvät haavainfektiot hoidettiin antimikrobilääkityksellä, kirurgisella haavarevisiolla ja lisäksi kahdelle potilaalle tehtiin iho-subcutiskieleke ja yhdelle ihonsiirre. Yhdelle potilaalle tehtiin verisuonitoimenpide ASO-taudin ja haavan huonon paranemisen vuoksi. Kaikille syvän infektion saaneille potilaille tehtiin materiaalin poistoleikkaus 2 vuoden seurantaaikana.

Nilkkanivelen luudutusleikkaus jouduttiin tekemään 3 potilaalle (5 %) keskimäärin 17 kk kohdalla (15-22 kk). Näistä kahdelle potilaalle oli alun perin valittu ulkoinen fiksaatio (Orthofix) definitiiviseksi hoidoksi erittäin pirstaleisen nivelpinnan vuoksi.

Pohdinta

Säären alaosan murtuma on suhteellisen harvinainen vamma, jonka insidenssi on 15/100 000 (10), ja meidän materiaalissa pilon-murtumia oli näistä 28.7 %. Pilon tibiale-murtumien hoito on haasteellista. Murtuman hoitamiseksi tarvitaan yleensä useampi kuin yksi leikkaustoimenpide ja usein myös plastiikkakirurgisia pehmytkudostoimenpiteitä. Korkea vammaenergia ja murtumaluokituksen mukainen murtuman pirstaleisuus lisää definitiivisen hoidon viivettä, leikkausten lukumäärää ja sairaalahoidon kestoa. 14 %:lla potilaista todettiin syvä haavainfektio, joka vaati kirurgista hoitoa ja pitkän antimikrobihoidon. Pilon tibiale-murtumien definitiivinen hoito on perusteltua keskittää traumasairaaloihin, joissa sekä ortopeditraumatologi että plastiikkakirurgi ovat käytettävissä.

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Jalan murskavamma - Amputaatio vai rekonstruktio?

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Decision making between amputation and reconstruction after severe high-energy lower extremity trauma is a difficult question for a trauma surgeon. The best knowledge today is based on a series of publications from the Lower Extremity Assessment Project (LEAP). According to the publications by the LEAP Study Group no existing score is able to reliably predict the success of reconstruction. Patient related factors, rather than type of injury or method of treatment, seem to be more important regarding the outcome and patient satisfaction.

Päätöksenteko pahoin vammautuneen raajan amputaation ja rekonstruktion välillä kuuluu traumakirurgin vaikeimpiin velvollisuuksiin. Jokainen murskautunut raaja on vaurioiltaan omanlaatuisensa aivan kuin on jokainen murskavammapotilaskin. Murskavammojen harvinaisuus yhdistettynä suureen joukkoon päätöksentekoon vaikuttavia muuttujia on osoittanut päätöksentekoalgoritmien laatimisen vaikeaksi (1).

Huolimatta kirurgian ja lääketieteen kehityksestä amputaatiofrekvenssi vakavissa alaraajavammoissa ei ole laskenut viimeisen viidenkymmenen vuoden aikana perustuen yhdysvaltalaissotilaiden rekisteritutkimukseen (2). Traumaperäisten amputaatioiden kokonaismäärän Yhdysvalloissa on arvioitu noin puolitoistakertaistuvan vuoteen 2050 mennessä (3).

Viimeisten vuosikymmenten aikana on pyrkimyksenä ollut uusien kirurgisten keinojen turvin vähentää murskavammojen päätymistä amputaatioon. Raajan säilyttävän kirurgian funktionaalinen tulos saattaa kuitenkin olla pitkien ja raskaiden hoitojenkin jälkeen potilaan kannalta epätyydyttävä. Murskavammaa arvioitaessa olisi tärkeää jo alkuvaiheessa pystyä luotettavasti päättämään, onko raajan säästäminen ylipäätään mahdollista ja onko se lopputuloksen kannalta järkevää.

Päätöksenteon tueksi on kehitetty lukuisia algoritmeja, käytetyimpinä Hannover Fracture Scale (HFS98) (4,5), Mangled Extremity Severity Score (MESS) (6), Nerve injury, Ischemia, Soft Tissue, Skeletal, Shock, Age score (NISSSA) (7), Predective Salvage Index (PSI) (8), Limb Salvage Index (LSI) (9).

Laajin tutkimus vaikeista alaraajavammoista on Lower Extremity Assessment Project (LEAP). Prospektiivinen kontrolloimaton tutkimus vuosina 1994-1997, käsitti 601 korkea-energisesti alaraajavammautunutta potilasta kahdeksassa Level I traumakeskuksessa. Potilailla takajalan ja nilkan alueen vammoja oli yhteensä 174. Kirurginen hoito toteutettiin hoitavan kirurgin parhaan näkemyksen mukaan. Tulosta arvioitiin Sickness Impact Factorilla (SIP) ja seuranta-aika oli kaksi vuotta. Aineiston pohjalta on julkaistu kymmeniä osajulkaisuja.

Yllä mainittujen viiden algoritmin herkkyys ja tarkkuus todettiin huomattavasti heikommiksi kuin algoritmit esitelleissä alkuperäistutkimuksissa. Mikään algoritmeista ei osoittautunut käyttökelpoiseksi valinnassa amputaation ja rekonstruktion välillä (10).

Jalkapohjan tunnottomuutta (n. tibialis post.

vaurio) on pidetty perinteisesti primääriä amputaatiota puoltavana tekijänä. Tälle argumentille ei LEAP-tutkimuksen valossa ole perusteita. Ensiarviossa tunnottomista jalkapohjista 55 % kehitti seurannassa normaalin tunnon ja vain yksi jalka 29 lähtökohtaisesti tunnottomasta jalasta säilyi tunnottomana (11).

Kahden vuoden seurannassa merkitsevää eroa työhön paluussa ei rekonstruktio- ja amputaatioryhmien välillä ollut. Työhön paluuta selittivät kirurgista ratkaisua enemmän potilaskohtaiset syyt. Elinajalle laskettujen kustannusten kannalta rekonstruktio oli merkitsevästi amputaatiota edullisempi ($163,282 vs. $509,275) (12). Rekonstruktioiduilla potilailla oli kahden vuoden seurannassa merkitsevästi enemmän reoperaatioita, osteomyelittejä ja osastohoitojaksoja. Selkeästi huonompaa potilastyytyväisyyttä (SIP) ennusti vapaan kudossiirteen tai TC-deesin käyttö rekonstruktiossa (13).

Vamman laadulla ja valitulla hoidolla jalan murskavammoissa ei nykytiedon mukaan ole itsenäistä ennustearvoa potilastyytyväisyyteen. Koettuun lopputulokseen vaikutti merkitsevästi leikatun jalan kivuttomuus, saavutettu kävelyvauhti, korkeampi toimintakyky SIP-scoressa, masennuksen puuttuminen ja saavutettu töihinpaluu.

LEAP-tutkimus ei pystynyt esittämään yksiselitteistä algoritmia amputaatiopäätöksen tueksi. Potilaskohtaiset tekijät selittänevät kirurgisia toimenpiteitä paremmin koetun lopputuloksen. Tämän vuoksi on amputaatioharkinnan yhteydessä huolellisesti arvioitava potilaan psyykkisiä ja fyysisiä kykyjä selvitä rekonstruktiosta.

Amputaatiopäätös ennen pitkäkestoiseen rekontrukstiiviseen kirurgiaan ryhtymistä on vaikea, ja päätös on tehtävä moniammatillisessa (ortopedi-traumatologi, plastiikkakirurgi ja tarvittaessa anestesiologi) yhteistyössä.

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Management of soft tissue defects in foot and ankle

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Introduction

Soft tissue defects in foot and ankle area may be related to trauma, postoperative complications of elective surgery and treatment of soft tissue or bone tumors. Pressure ulcers, diabetic foot problems and necrotizing infections may also lead to difficult wound problems.

Soft tissue envelope in the ankle area is thin and vulnerable. Because of that even minor skin defects may lead to exposure of bone, tendons or implanted hardware.

Management of soft tissue defect in foot and ankle depends on its etiology, size, severity and location of the wound. In most cases staged treatment protocol is necessary: first debridement, secondly wound reconstruction when the wound and patient are optimized for surgery.

General principles

If direct closure of the wound or healing by secondary intention is not possible, skin grafting or flap surgery should be considered. In plantar weight-bearing areas the best reconstructive tissue is thick plantar glabrous skin and shock-absorbing fibro-fatty subcutaneous tissue (1, 2). In non-weight-bearing areas of the foot simple skin grafts work well if the wound bed is optimal.

In conjunction with soft tissue reconstruction biomechanical issues of the foot must be taken into consideration as well. Particularly in diabetic foot problems tendon balancing and fixing pathological bony anatomy may be necessary in order to prevent ulcer recurrences (3, 4).

Prerequisite for successful treatment is meticulous assessment of patient related issues, like vascular status of the extremity and overall morbidity of the patient. Before any operative interventions, assessment of peripheral circulation is mandatory. Handheld doppler device is useful tool for screening the distribution of the perfusion and detecting perforating vessels. If any doubt about vascular insufficiency or damage, vascular consultation should be arranged.

Wound bed preparation

Fresh and clean traumatic wounds may be closed primarily but in case of high energy injuries or contaminated or infected chronic wounds the primary operation is usually debridement of all non-vital and infected tissue and foreign material. In heavy contaminated wounds a pulsatile lavage irrigation may be helpful (5). Thereafter comes local wound care and optimizing patient´s underlying diseases, nutrition and vascular status of the extremity.

Primary task in wound management is to create a healthy and granulating wound bed to create optimal circumstances for definitive wound closure by conservative or surgical treatment (6).

Moist wound treatment is the basic principle (7). Modern materials allow dressing changes in 1-3 day intervals. During every dressing change the wound should be cleaned mechanically and irrigated. There are also many antibacterial dressings in the market but scientific evidence of their effectiveness is still scarce.

Negative pressure wound therapy (NPWT) has become a commonly used method in local wound care of different kinds of open soft tissue defects. Its favourable effects on wounds have been attributed to increase of local blood flow, decrease of tissue edema, reduction of bacterial count, as well as stimulation of angiogenesis and granulation tissue formation (8-10). NPWT also protects the wound from microbial contamination and supports the wound mechanically.

Traumatic wounds and open fractures

Fracture related open wounds may progress to larger soft tissue necrosis depending on the trauma severity and amount of the fracture dislocation. In high-energy injuries, it may take several days until the final soft tissue damage is clinically visible.

It has been generally recommended that primary wound debridement and operative stabilization of open fractures should be performed as early as possible, preferably within six hours. Fasciotomies should

be performed liberally in high energy injuries or if there are any signs of compartment syndrome. A second look procedure should be done after 48-72 hours if there is any doubt about adequacy of the primary debridement (11).

When dealing with polytraumatized patient, based on damage control principles, immediate operative procedures after trauma should be fast, effective and mini-invasive.

There is still some controversy regarding the timing of definitive soft tissue reconstruction. It seems that final reconstruction can be delayed safely beyond 72h, but not over 7 days (12-15).

Tumor surgery

The goal of modern sarcoma-surgery is a radical en bloc resection of the tumor with clear margins. This leads often to a major tissue defect and to functional problems as well, if bone, tendons or nerves have been resected. Therefore, in concomitant soft tissue reconstruction also those functional issues should be addressed. The soft tissue defect must be reconstructed by reliable tissue with good vascularity which tolerates adjuvant radiation and chemotherapy better than skin grafting or unstable direct closure (16).

Diabetic foot ulcer and other chronic wounds

Indication for operative treatment of a chronic wound may occur if healing by effective conservative treatment seems unlikely or expected healing time is long (several months). It is extremely important to diagnose and treat all potential etiological factors of the wound. This includes for example blood glucose balancing, management of edema, treatment of arterial or venous disorders of the leg and medical treatment of inflammatory ulcers like vasculitis or pyoderma. Correction of nutritional deficiencies and cessation of smoking have also an important impact on wound healing.

Response to adequate conservative treatment is usually followed at least for several weeks before reconstructive surgery is considered. In this time span it is also easier to see, if eventual healing is possible by conservative management only.

Selection of reconstructive option

The main principle in reconstructive surgery is to do the simplest possible operation which still gives a reliable functional and aesthetic result with minimal donor site morbidity. The final decision of best reconstructive option is always individual and depends on the size and nature of the defect and quality of surrounding tissues but very much also on the patient morbidity.

In case of bone, tendon or hardware exposure, vascular tissue is the best option for wound coverage. In medium sized low energy defects a local fasciocutaneous or muscle flap may be a reliable option, provided the flap donor site is optimal for that.

Primary or delayed closure of the wound may be option in small vital wounds in the absence of edema. Random-type skin flaps may be useful only in quite small defects if the surrounding skin is well perfused and pliable.

Large soft tissue defects require usually microvascular flap reconstruction.

Distal leg, ankle and hindfoot

In distal leg and ankle area distally based peroneus brevis muscle flap is a versatile option for small defects. One typical indication is exposed distal fibula after fracture surgery. Arc of rotation allows coverage of lateral malleolus, small anteromedial and posterior defects in the distal leg and ankle. It is simple to harvest and reliable. Pivot point should be at least three fingerbreadths proximal from the distal tip of the lateral malleolus. When peroneus longus is preserved, ankle instability is not expected (17, 18). Distally based medial hemisoleus flap has also been used to cover small to medium sized defects on the medial side of the distal leg and ankle (19).

In the lower leg there are three constant lines of perforating vessels from the deep main arterial trunks following the line of sensory nerves: sural nerve (peroneal artery), superficial peroneal nerve (terminating proximal branch of peroneal artery) and saphenous nerve (posterior tibial artery). Distally based neurocutaneus flaps may be harvested in the line of those perforating vessels to reconstruct soft tissue defects in the distal lower extremity. They are relatively fast and simple to harvest, do not sacrifice major source vessels and bring similar local tissue into a defect (19-20). Distally based sural neurofasciocutaneous flap is a ver-

satile tool for small to medium sized defects in distal leg, both sides of ankle and hindfoot. Its pedicle includes sural nerve and lesser saphenous vein and concomitant arterial network. The distal pivot point of the flap is designed at the lowest septocutaneous perforator from the peroneal artery of the posterolateral septum, about 5 cm above the lateral malleolus (22, 23).

Lateral supramalleolar flap is based on the ascending branch of the perforating branch of the peroneal artery. Its arc of rotation allows coverage of the anterior ankle, achilles area and even distal dorsum of the foot (24, 25).

Propeller flaps are based on a single perforator vessel, which becomes the pivot point for the skin island. The localization and the pivot point of the flap is planned by preoperative doppler examination. Flap is turned like a propeller up to 180 degrees to fill the wound. The other end of the flap is covering the donor site at least partially which reduces the need for skin grafting there (26).

Foot

In dorsal and other nonweightbearing areas of the foot, skin grafting is a good reconstructive option if wound bed is vascular and bone, tendons or hardware are not exposed. Otherwise flap surgery is necessary.

Whenever possible, plantar weigth-bearing areas´ defects should be covered by strong plantar tissue. Local rotation or advancement flaps are fast and simple to harvest and work usually well in smaller defects. Sensory fasciocutaneous plantaris medialis flap from instep area can be used as a pedicular or microvascular flap (27). It is an excellent but technically demanding flap especially to plantar hindfoot defects.

Intrinsic muscles of the foot can be used as local flaps for small defects exposing bone, tendons or hardware. They are quite fast and easy to rise and donor site morbidity is minimal. Abductor hallucis muscle flap can cover small defects on the area of medial malleolus and midtarsal area. On the lateral side of the foot abductor digiti minimi can reach to small midtarsal and calcaneal defects. Extensor digitorum brevis, flexor digitorum brevis and flexor digiti minimi are other intrinsic muscle options (28).

Smaller forefoot defects may be covered by VY-type advancement skin flaps from proximal plantar area. Another option is toe-fillet flap, but preferably not from the first toe. Partial distal foot amputation is sometimes the simplest reconstructive option in selected cases.

Microvascular flaps

Large defects with exposed bone and tendons are best covered by microvascular distant flaps. Vascular anastomosis should be done outside of the damaged tissue area ("zone of injury").

Muscular, musculocutaneous and fasciocutaneous flaps may be used. Flaps may include bone and sensory nerves. When selecting the most optimal flap, size and localization of the defect must be considered, also donor site morbidity. Anterolateral thigh flap, if not too fatty, is very suitable for covering defects in foot and ankle area.

Muscle and musculocutaneous flaps are often bulky and swollen immediately after reconstruction. During following months decreasing edema and muscle atrophy reduce the flap volume. Still later debulking or shaping operations may be necessary for better aesthetic and functional long term result.

Postoperative care

During the following days after flap surgery it is important to prevent edema and venous stasis by leg elevation.

If the reconstructed area is located on the weight bearing area of the foot, weight bearing is prohibited usually at least for six weeks. To avoid ulcer recurrence in deformed feet, custom made shoes may be necessary. This is the case especially with diabetic foot problems.

Discussion

Advancements in local wound care and better understanding of vascular anatomy of local flaps in lower extremity are main reasons for recent trend to step down in reconstructive ladder of lower extremity: to do more local flaps and less microvascular flaps. Discussion is continuing: what type of flap is most reliable and safest? Traditional microvascular or pedicular muscle and musculo-cutaneous flaps with constant vascular anatomy are reliable, failure rate in experienced teams is less than 5 %. But they are often bulky and donor site morbidity may be significant. On the other hand, pedicular fasciocutaneous flaps and perforator propeller flaps are faster to harvest, preserve

main arterial trunks and functional muscles and they are also suitable thin and pliable for ankle and foot area reconstruction. However, they are quite sensitive and venous stasis and partial flap losses are relatively common problems. Despite of this clinical implication, there is not clear scientific evidence supporting superiority of one or the other flap type in final success of coverage (29).

For the surgeon, it is important to be aware of limitations and advantages of each flap type in different clinical situations. Better results are expected when using flaps with which the surgeon has more experience.

In chronic wounds reconstructive principles are the same as in traumatic wounds but a special attention should be payed to asses and fix patient morbidity and local vascularity of the extremity before final surgery.

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Timing of fracture surgery in multiply injured patients

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Introduction

The time window for treating extremity fractures and injuries of the axial skeleton is still under debate. From empirical experience, several injuries are supposed to be urgently or early treated.

Unstable fractures generate pain, discomfort and are supposed to increase the risk of immobility-resultant and soft-tissue complications until reduction of fractures and stabilization is performed. These injuries can lead to a higher risk of pulmonary compromise, systemic inflammation and immune dysfunction response. Stabilization of fractures allows mobility in a pain-acceptable way (1).

It is well accepted to stabilize unstable femoral shaft fractures, unstable pelvic injuries or spinal injuries (2-6) to avoid pulmonary and septic complications. Multiply injured patients show a larger benefit from early stabilization than patients with isolated injuries (4,7,8).

For decades, the concept of early total care was favored. In the 90ies the Damage Control Concept in Orthopedics (DCO) was introduced, to avoid harmful procedures in multiply injured patients.

Early Total Care vs. Damage Control Orthpopaedics

The "Early Total Care" concept (ETC) was often interpreted for early definitive management of all fractures. In selected patients groups, it was thought, that surgery resulted in additional hemorrhage, an increased systemic inflammatory response, which lead to a "second hit phenomenon, resulting in higher complication rates (9-11). It was misunderstood, that "early" had to be defined as within 24 hours, "total" means all relevant injuries and "care" means treatment or stabilization. It was not mentioned, to definitively treat every fracture.

This misunderstanding lead to the development of the DCO concept, as it was shown, that selected patients benefit from temporary external fixation of pelvic and long bone fractures.

Recently, the DCO concept was modified to an Early Appropriate Care concept (12). Early hemorrhage control, aggressive resuscitation and control of the lethal triad of death, especially controlling coagulopathy is mandatory. Early definitive stabilization is possible and favored in resuscitated patients.

Soft-tissue Management

A clear urgent indication is stated regarding fasciotomy of suspected compartment syndrome (13).

Early surgery in calcaneus fractures is associated with relevant soft-tissue complications (skin flap necrosis, infection) due to the tenuous soft tissue envelope (14).

Open Fracture Treatment

The main goal in treating open fractures is to avoid infections. Present standard procedures include emergent irrigation and debridement within 6 to 8 hours (15). These recommendations are based on an experimental work from 1898 by Paul Leopold Friedrich, who stated in a swine model, that a profit was observed, when dusted wounds were surgically debrided (16). However, no human studies support this concept (14). In contrast, initial debridement with radical removal of all devitalized tissues is still proposed (17).

Some other data exist regarding reduction of infection rates (14). The main results were:

- early antibiotic administration decreases infection rates (18)
- the fracture grade influences the infection risk (increased with higher fracture grades) (19)
- debridement after 13h showed a trend to higher infection rates (20)
- longer time of injury to admission was associated with higher infection rates (20)

A recent literature review stated, that a debridement within 6h was not associated with lower infection rates than debridement within 6-24 h (16). This was confirmed recently with more or less identical infection rates analyzing the 6 h rule (21).

In conclusion, debridement should be performed within 24 hours after injury but as soon as possible!

Wound Closure Timing in Open Fractures

There is still debate regarding the optimal time of wound closure in open fractures (14).

Primary closure is recommended in clean wounds when atraumatic closure is possible. Delayed closure has to be considered, when a reduced soft-tissue quality is present after initial irrigation and debridement (14).

Only few data are available regarding treatment concepts. Rajasekaran et al. proposed primary wound closure, when the following parameters were present (22):

- debridement, performed within 12 hours
- no primary or secondary to debridement skin loss
- possible atraumatic skin closure
- no substantial wound contamination
- no vascular soft-tissue impairment

Lenarz et al. proposed the following microbiology-based concept (23):

1 wound irrigation, debridement and fracture stabilization
2 primary open wound treatment
3 bacterial cultures
4 planned revision after 48h
5 if bacteriology is positive: 1-4 until negative bacteriology
6 wound closure only in negative microbiology culture

Using this concept, an overall 3.6 % wound infection rate was observed. Only after Gustillo IIIC injuries a 21 % rate was observed (23).

Overall, despite no clear scientific data on benefit of a wound concept, a step-by-step concept seems to be useful.

Flap Coverage of Open Wounds

Primary and secondary flap coverage is recommended in the literature. An early treatment is favored, as free flap coverage within 72 hours after injury lead to earlier bone healing and reduced infection rates (24). Correspondingly, delayed flap coverage resulted in increased infection rates (25).

Recent analyzes confirmed these results and integrated the concept of early vacuum-assisted wound treatment:

- flap coverage within 72 hours lead to decreased infection rates (26)
- primary decreases the flap size (27)
- prolonged vacuum-assisted wound closure treatment is associated with increased infection and amputation rates (27)
- vacuum-assisted wound closure treatment and flap coverage resulted in lower infection rates and faster graft incorporation (28)

Thus, definitive wound closure should be bridged by vacuum-assisted wound closure techniques until definitive flap coverage is performed within 3 days after trauma.

Special Fracture Types

For several fracture types, urgent or early treatment is recommended. These include prognostic relevant extremity fractures (e.g. talar fracture dislocation, pilon tibiale fractures, proximal tibia fractures, distal femur fractures, femoral shaft fractures, displaced femoral neck fractures, distal humerus fractures, other upper extremity fracture dislocations) and truncal fractures (e.g. pelvic and spinal fractures).

Talar fractures

The prognosis seems to be independent of the time of surgery or reduction. Osteosynthesis after an average of 13 days was associated without an increase of the risk of avascular necrosis (29). Presently no clear data are available, regarding the influence of comminution zones, fracture dislocation or subtalar dislocation on prognosis (29-31).

Pilon tibiale fractures

The time of treating pilon tibiale fractures depends on the soft-tissue situation. Complication rates, espe-

cially the incidence of non-unions, can be decreased by a two-stage procedure (32). Recent analyses proposed early ORIF within 36 h, if soft tissue conditions are acceptable, with reported similar to better rates of wound complication, fracture union and functional results (33).

Proximal tibia fractures

Early fixation is associated with a high rate of wound complications and even osteomyelitis.

Treating high grade proximal tibial fractures, no differences were observed in definitive surgery within 12 h versus secondary stabilization, regarding duration of surgery, complications, healing time and functional result (34).

The optimal surgical timing was proposed to be within 4 hours after trauma, when no relevant swelling was observed. This was followed by surgical time window within 5-8 days, when swelling was subsided (35).

Distal femur fractures

In open distal femur fractures primary (within 24 h) locking plate fixation was recommended, followed by secondary bone grafting, BMP application, and/or medial column support to create rigid fixation (36). Krettek et al., recommended, that definitive surgery should be postponed until it is safest. Only in completely stable patients with perfect circumstances, definitive osteosynthesis in the primary period was advocated. If primary surgery has to be delayed more than a few hours, bridging external fixation is recommended (37).

Femoral neck fractures

The AVN risk is supposed to be approximately 30 % to 35 %. Early anatomic reduction and decompression of the intracapsular hematoma are potential factors influencing the prognosis.

Urgent osteosynthesis of displaced femoral neck fractures is clearly recommended, whereas no evidence exists regarding routine capsulotomy (38).

Distal humerus fractures

A recent analysis found no differences comparing primary definitive osteosynthesis within 6 h versus secondary stabilization after 4 d in average with regard to outcome and complication rate. Early open reduction and internal fixation of open distal articular humerus fractures only reduces the hospital stay (39).

Spinal Injuries

The effect of emergent early treatment of spinal injuries on the neurological outcome remains unclear (40). Kerwin et al. recommended operative fixation within 3 days (41), whereas Pakzad et al. observed a 8-fold higher complication rate with stabilizations performed after 24 h (42). Recently, Stahel et al. proposed a Spine Damage Control concept consisting of posterior reduction and instrumentation on day 1 followed by anterior corpectomy and fusion, if indicated, after day 3 (43). Immediate day 1 surgery resulted in lower complication rates.

Pelvic injuries

Clear recommendations exist regarding early/immediate external fixation of unstable pelvic fractures (44). Definitive fixation is not recommended in the early phase in multiply traumatized patients (45).

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Knee dislocations – Acute treatment

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Complete dislocation of the knee (KD) is an uncommon injury (1,2). Because of the potentially severe neurovascular damage, knee dislocation can be limb-threatening, and it is important to make the correct diagnosis without delay. Presentation with the knee still dislocated gives a correct diagnosis. However, knee dislocation might spontaneously reduce before initial evaluation, in which case, the severity of the ligamentous disruption may be underestimated.

Dislocation of the knee usually results from high-energy trauma such as motorcycle and motor vehicle accidents or a sports-related injury (1-3). However, if the knee dislocation is due to an unusual cause, such as a simple fall in an obese patient, the correct diagnosis may be more difficult to make (4).

Dislocation involves injury to multiple ligaments of the knee. Dislocation usually involves injury to both anterior cruciate ligament (ACL) and posterior cruciate ligament (PCL). In addition a disruption of the medial collateral ligament (MCL) and/or posteromedial complex or lateral collateral ligament (LCL) and/or posterior lateral complex (PLC) are general (5). Associated neurovascular, meniscal, and osteochondral injuries are often present and complicate treatment.

Classification

Anatomical classifications are based on either the position of the displaced tibia on the femur, as described by Kennedy (6), or on the pattern of ligamentous and associated injuries as described by Schenck (7) and others (2,8,9). In Kennedy's classification system, five types of dislocation are described: anterior, posterior, medial, lateral, or rotational. Dislocation usually involves injury to both cruciate ligaments and therefore rupture of both cruciates should be considered as a knee dislocation (8). A rotatory knee dislocation occurs around one of the collateral ligaments (LCL) leading to a combined ACL and PCL injury and a rupture of the remaining collateral ligament. Knee dislocations that spontaneously reduce are difficult to classify with this system.

A more recent anatomic classification system assesses the pattern of ligamentous disruption and the presence or absence of an associated intra-articular fracture (Table 1), providing a clearer guide to the nature and severity of the injury and options for treatment.

Dislocation of the knee may be regarded as acute (seen < 3 weeks), or chronic (>3 weeks).

Initial evaluation and management

The vascular status of the limb must be determined quickly and managed appropriately. The knee should be reduced immediately through gentle traction-countertraction with the patient under anesthesia. After reduction, vascular examination should be repeated. The most effective method for rapidly and accurately diagnosing arterial injury remains controversial.

Conventional angiography was once the gold standard for diagnosis vascular injury and was routinely ordered after knee dislocation. Now many authors recommend selective angiography for those patients with abnormal pulses or ankle-brachial indexes (ABIs) (3,10-12). Mills et al. showed in their prospective study that ABI can accurately predict whether patients with knee dislocations have sustained vascular injury (10). In their study, 11 patients with an ABI lower than 0.90 underwent angiography. All 11 had arterial injury requiring surgical treatment. The remaining 27 patients had an ABI of 0.90 or higher. None had vascular injury detectable by serial clinical examination or duplex ultrasonography.

CT angiography has now become the study of choice over conventional angiography and has been noted to be 100% sensitive and specific (13). MR angiography is the third imaging modality for diagnosis vascular injury (14). Pedal pulse examination alone or arterial duplex ultrasound alone are not sensitive enough and might fail to identify significant vascular injury because of rich collateral circulation.

If the limb is ischemic, emergent surgical exploration and revascularisation is required. Postreduction

Table 1. Anatomic knee dislocation classification system based on the extent of ligamentous injury originally described by Schenck[7] and modified by Wascher et al.[8] and Stannard et al.[9]

Classification	*Subclass*	*Injury pattern*
KD-I		Single cruciate dislocation (associated with MCL/POL and/or LCL/PLC)
KD-II		Bicruciate injury only: ACL and PCL
KD-III		Bicruciate with medial or lateral disruption
	KD-IIIM	Bicruciate with medial injury: ACL, PCL, MCL/POL
	KD-IIIL	Bicruciate with lateral injury: ACL, PCL, LCL/PLC
KD-IV		Bicruciate with medial and lateral injuries: ACL, PCL, MCL/POL, LCL/PLC
KD-V		Knee dislocation with associated fracture
	KD-V1	ACL or PCL with associated fracture
	KD-V2	ACL and PCL with associated fracture
	KD-V3M	ACL, PCL, and MCL/POL with associated fracture
	KD-V3L	ACL, PCL, and LCL/PLC with associated fracture
	KD-V4	ACL, PCL, MCL/POL, and LCL/PLC and associated fracture

a formal angiography, CT angiography, or MR angiography should be done especially if the patient has a high velocity injury, is polytraumatized or have altered mental status and the clinical evaluation of the vitality of the leg is uncertain. The vascular repair should be performed within 6 to 8 hours from the time of injury, because after that the patient is at significant risk of critical ischaemia in the lower leg, which can result in limb loss (15). Fasciotomies are made after vascular reconstruction. Open knee dislocation, compartment syndrome, and irreducible dislocation are other indications for emergent surgery.

Other potential complications seen in KDs include deep vein thrombosis, and neurologic injury. The common peroneal nerve is most commonly injured with a reported incidence of 25 % in a systematic review by Medina et al. (14). The presence of peroneal palsy should alert the examiner to the potential for multiple ligament disruption and potential vascular injury. In addition, Merritt and Wahl found in their material of 90 consecutive KDs that 38 % of patients presenting with a peroneal palsy suffered from a concomitant arterial injury (12).

A spontaneously reduced knee dislocation can be overlooked especially when evaluating a multiply traumatized patient. A complete physical examination of the knee, including neurovascular assessment, is essential for all high-energy trauma victims. If laxity of two or more of the major ligaments of the knee is found, even in low energy trauma cases, a probable diagnosis of knee dislocation should be made. The physical signs of these cases include a large knee effusion, and overall swelling of the extremity, an abnormal degree of recurvatum, varus/valgus instability with the knee in full extension, and grossly abnormal Lachman test in both directions.

After closed reduction the knee joint is stabilized with a ligament brace. In overweight patients, especially in morbid obese patients, the use of a brace might be difficult and it does not stabilize the knee enough. In these cases a synthetic plaster cast is a better option for provisional stabilization of the knee joint. The cast should be open in front which make it possible to take it away every day and start knee range-of-motion exercises. Provisional stabilization with spanning external fixator is used after vascular reconstruction and fasciotomies.

Definitive treatment

Many authors have noted superior results of surgical treatment of knee dislocation when compared to nonsurgical treatment (5,16-18). In most cases early ligament surgery (on the second or third week post injury) seems to produce better results compared to late reconstructions (19,20). However, Engebretsen et al. (21) reported lower knee function in patients with high energy trauma compared to low energy trauma, but acute vs. chronic surgery did not have an effect on the outcome. The management of knee dislocations remains controversial. Controversies persist regarding surgical timing, surgical technique, graft selection, and rehabilitation. The goal of operative treatment is to retain knee stability, motion, and function.

The most common injury patterns include both cruciate ligaments and either medial collateral ligament (MCL) and posteromedial structures or lateral collateral ligament (LCL) and/or posterolateral structures (PLC). Less commonly both cruciates and both collateral ligaments are disrupted. Our policy has been early (from 7 to 21 days) simultaneous reconstruction of both cruciate ligaments and repairing or reconstruction of grade III LCL and PLC injuries. Most of acute grade III MCL tears are successfully treated with brace treatment when ACL and PCL are reconstructed early (17,20).

Most cruciate ligament injuries are midsubstance tears that need to be reconstructed with tendon autografts or allografts (5,11). Repairs can be done in cases of bony avulsion of cruciate ligaments or grade III avulsion injuries of the collaterals or capsular injuries. Intrasubstance grade III tears of the LCL might be possible to repair (in early state), but often need to be augmented with tendon allograft. The PLC and the popliteofibular ligament are reconstructed with tendon allografts (22).

Conclusions

- KDs continue to represent a diagnostic and therapeutic challenge to trauma surgeons.
- KDs are orthopaedic emergencies because they might have associated neurovascular damage.
- The dislocation should be reduced as soon as it is recognized.
- Dislocation usually involves injury to both cruciate ligaments, and they are often combined with a disruption of the MCL and posteromedial structures or LCL and posterolateral complex.
- KDs often spontaneously reduce before initial evaluation, in which case, the severity of the injury may be underestimated.
- The vascular repair should be performed within 6 to 8 hours from the time of injury.

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Management of medial side injuries in knee dislocations - Clinical and radiological outcomes

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Knee dislocation is a rare event caused in Finland most often from a fall on ground level (1). Because of a possible vascular lesion, it may represent an acute emergency (2-4). Knee dislocation leads most often to a complete rupture of both cruciate ligaments and therefore rupture of both cruciates should be considered as a knee dislocation (4). A total MCL rupture solely or combined with a ACL reconstruction can be treated conservatively (5, 6). Operative treatment of both cruciates also seems to lead to a good outcome in the acute phase (7-10). However, treatment of a rupture of medial collateral ligament with concomitant bicruciate reconstruction remains controversial with good results reported with both nonoperative and operative treatments (9, 11, 12). There is still paucity in the literature regarding the treatment of knee dislocation with a medial side injury (12, 13). Recent studies have compared outcomes between different types of knee dislocation patterns according to Schenk´s classification (11, 12). However, to our knowledge there are no studies comparing clinical and radiological results of nonoperative and operative treatments of medial side injury with concomitant bicruciate ligament reconstruction. Therefore we conducted a study in order to review all bicruciate reconstructed knee injuries with a grade III medial side ligament rupture.

Materials and methods

Between 2004-2014 a total of 119 patients with knee dislocation and bicruciate ligament injury were treated at Helsinki University Hospital Trauma Center (Töölö Hospital). Our institution is a level 1 trauma center in the Helsinki region and tertiary referral center for severely injured patients including knee dislocations in the southern part of Finland, with a catchment area of 1.8 million people.

An inclusion criterion was a KD3M injury according to Schenck´s classification treated with arthroscopic bicruciate ligament reconstruction and operative or nonoperative treatments of medial collateral ligament rupture: Exclusion criteria were: 1) previous knee ligament injury, 2) bilateral knee ligament injury, 3) open knee dislocation, 4) severe polytrauma, 5) combined medial and lateral side injury (KD4), 6) operative treatment received primarily at an other institution.

Forty-eight patients had a KD3M injury, eleven were excluded leaving a total of thirty-seven patients. Out of these patients, ten were injured in high-energy trauma (i.e. fall > 3m, collision with motor vehicle) and twenty-seven in low-energy trauma (fall < 2m, sports related injury). Ten patients were initially assessed with knee dislocation that was reduced in hospital. Remaining had dislocation either spontaneously reduced or reduced at the scene of trauma. Five patients out of thirty-seven had radiographically verified knee dislocation. Eleven patients had impression fracture on either femoral or tibial articular surface visible on MRI but not on knee x-ray. Fourteen patients had menisceal injury (3 medial, 9 lateral, 2 both) and these were treated with partial resection (3 medial, 3 lateral, 2 both) or with suturation (6 lateral). The patient characteristics are presented in table 1a.

Among these thirty-seven patients, there were two popliteal artery injuries that required a bypass graft and 1 posterior tibial nerve lesion that was treated conservatively. Twenty-nine MCL injuries were treated conservatively (Group 1). Eight patients had their MCL operated (Group 2: 7 MCL suturation, 1 PMC reconstruction).

Final clinical assessment of knee ligaments was performed under anesthesia to verify MRI findings. Orthopaedic surgeons experienced in arthroscopic knee surgery performed all knee ligament reconstructions. Both ACL and PCL were reconstructed with auto- or allograft tendon grafts. In seven patients MCL was

Table 1 a Patient characteristics

	Group 1 (n=16)	Group 2 (n=7)	
Age (Years)	39 (22-65)	51 (17-68)	.397 (n.s.)
Sex (Female/Male)	7F/9M	5F/2M	.221 (n.s.)
Injury mechanism low/high energy	13Low/3High	4Low/3High	.226 (n.s.)
Menisceal injuries	2 Medial	1 Medial	.665 (n.s.)
	2 Lateral	2 Lateral	
	1 Medial + Lateral		

Table 1 b Surgery

	Group 1 (n=16)	Group 2 (n=7)	
Timing of ligament reconstruction	12 Acute	3 Acute	.197 (n.s.)
	4 Chronic	4 Chronic	

Table 2 a Objective and subjective outcomes

	Group 1 (n=16)	Group 2 (n=7)	p value
Follow-up months (median ± SD)	92 ± 31	61 ± 19	.470 (n.s.)
IKDC Subjective (Median ±SD)	77 ± 11,8	63 ± 19,8	.244 (n.s.)
Lysholm (Median ± SD)	88,0 ± 12,7	79 ± 23,5	.403 (n.s.)
Tegner Δ (Median ± SD)*	3 ± 1,5	3 ± 1,0	.545 (n.s.)
IKDC Objective A, B, C, D	2, 5, 6, 0	0, 5, 1, 1	.240 (n.s.)
**No post-injury Tegner level was higher than pre-injury level*			

Table 2 b Radiological outcomes with TELOS

	Group 1 (n=16)	Group 2 (n=7)	p value
TELOS side-to-side difference mm (median ± SD)			
Valgus stress	1.3 ± 2,7	2,5 ± 1,8	.483 (n.s.)
Varus stress	0,0 ± 2,0	0,6 ± 1,6	.482 (n.s.)
Anterior stress	2,1 ± 5,7	2,3 ± 3,6	.548 (n.s.)
Posterior stress	0,4 ± 4,5	2,9 ± 2,7	.385 (n.s.)

sutured primarily and in one it was reconstructed with tendon autograft.

All patients received a ligament brace and knee range-of-motion exercises were started on the first postoperative day. Full weight bearing was achieved within 6 weeks postoperatively. After 12 weeks, the brace was discontinued.

An independent author (M.J) did all the assessments during final follow-up. Lysholm and Tegner scores, as well as IKDC subjective and examination forms were recorded. Clinical evaluation was performed according to the IKDC examination form (14, 15). Knee range of motion was evaluated with goniometer. Antero-posterior laxity was measured with Telos device (Telos machine, SAMO, Bologna, Italy) and measurements were done according to the previously published guidelines (16, 17). Telos device varus and valgus stress radiographs were also obtained ac-

cordingly and side-to-side difference was calculated by comparison to the uninjured side (18). All radiographs were evaluated by a musculoskeletal radiologist with 13 years of sub-specialty experience (M.K.). Arthrofibrosis was defined as a knee flexion deficiency of more than 15 and extension deficiency more than 10 degrees.

A non-parametric Mann-Whitney U-test and chi-square test were used to compare groups. This was done with SPSS 24 (IBM Corp. IBM SPSS Statistics for Machintosh, Version 24.0. Armonk, NY: IBM Corp.)

All patients received an information letter and signed an informed consent. This study was approved by our institutional ethics committee.

Results

Twenty-three patients were available for final follow-up (Group 1: n=16; Group 2: n=7). Median age of the patients was 40 years (range, 18 to 68). Median time from injury to surgery was 3 weeks (mean 19, range 1 to 159). Fifteen patients were operated in acute (within four weeks) and eight in chronic (over four weeks) phase and there was no statistical difference between the two groups (table 1b).

The mean IKDC2000 subjective score was 78 out of 100 (range, 56 to 99) in group 1 and 67 (range, 39 to 92) in group 2. The mean Lysholm score was 84,2 out of 100 (range, 55 to 99) in group 1 and 72,7 (range, 44 to 99) in group 2. IKDC2000 objective scores were 2A, 6B and 8C in group 1 and 5B, 1C and 1D in group 2. (Tables 1a and 2a).

The mean medial knee laxity assessed with Telos radiographs (side-to-side difference) was 1,3mm (range, -1,8 to 4,2) in group 1 and 2,2mm (range, -0,2 to 4,8) in group 2. The mean anterior laxity was 2,6mm (range, -5,2 to 19,0) and 3,2mm (range, -2,5 to 8,2), the mean posterior laxity was 0,3mm (range, -7,9 to 7,4) and 2,3mm (range, -2,3 to 6,8) in groups 1 and 2 respectively (Table 2b). Two patients in group 1 and one patient in group 2 had knee flexion deficit over 15 degrees. One patient in group 2 had extension deficit greater than 10 degrees.

7 revision operations were performed according to medical charts among these patients: 1 lavation due to an acute Staph. Aureus infection and 6 late revisions due to a ligament laxity: 2 ACL + PCL, 1 PCL + MCL reconstruction, 1 PCL, 1 MCL reconstruction, 1 MCL refixation. Reoperation rates were 14 % in group 1 and 25 % in Group 2.

Discussion

This study was conducted in order to evaluate outcomes of treatment of medial side injury in the setting of concomitant bicruciate reconstruction. In recent years, relevant anatomy of the medial side has been investigated for thorough understanding of the anatomical structures (19-21). Acute MCL ruptures solely or combined with ACL reconstruction can be treated conservatively (6, 22). Yet again it remains controversial, if acute grade III MCL ruptures could be treated conservatively. Repair of the medial side seems to yield inferior outcome compared to reconstruction (23, 24).

In a study by Stannard et al. patients who had repair of the medial side had higher failure rates compared to reconstruction with auto- or allograft (20 % vs. 3,7 and 4,8 %). These patients were however mostly KD4s according to Schenck´s classification (23).

In a study, by King et al, a total of 56 patients were reviewed. Comparison was made between medial repair/reconstruction and lateral reconstruction in patients with KD3M or KD3L dislocation. Inferior results were observed in MCL repair group. However, the decision whether to repair or reconstruct the medial side was unclear. Also, the number of patients in the repair group was small, only six patients (24).

In the present study no statistically significant difference was detected between the groups. There was a tendency towards poorer outcome in repair group (Group 2). This is in line with previous published results comparing repair and reconstruction of the medial collateral ligament (23, 25). However, in recent literature measured outcomes (IKDC2000, Lysholm, valgus laxity) in group 1 were equal compared to those treated with reconstruction (23-25). In the present study posttraumatic arthrofibrosis and restricted range of motion was detected in both study groups in some patients. Our figures were slightly higher than those in the study by Engebretsen et al. (2009), who reported 6 % occurring mainly with surgically treated medial side injury (26).

The major weakness of our study was its retrospective nature. The study populations in both groups were rather small for statistical analysis. These are mainly due to the rare nature of knee dislocations. In addition, the follow-up was 62 % leaving a chance of selection bias. Therefore it is possible, that patients doing

worse than observed in this study were not included.

This study has some strengths. First, patients in this study consisted merely of KD3M injuries according to Schenck´s classification. This resulted in a more homogeneous population making comparison between groups more accurate. To our knowledge, this is the first study to compare conservative and operative treatment of the medial side injuries among patients with concomitant bicruciate reconstruction. Second, we assessed all knees with stress radiographs in order to improve quantification of medial gapping as it has been suggested (27).

Conclusion

Treatment of acute medial side grade III rupture with concomitant reconstructed bicruciate injury remains controversial. The findings of this study suggest, that good and comparable results could be achieved with conservative treatment with a hinged brace. Further investigations are needed for defining the knee dislocation patients who would benefit from primary reconstruction instead of conservative treatment of medial side in acute phase.

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Results of Operative Acetabular Fracture Management

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Introduction

Acetabular fractures of the pelvis remain a big challenge to the orthopedic trauma surgeon. It is a potentially life threatening condition typically caused by high energy trauma in young patients and low energy trauma in fragile bone of elderly patients. High energy trauma still accounts for most of the acetabular fractures but the age related incidence has a bimodal distribution with a rising portion of elderly patients sustaining this injury (1, 2). Fracture patterns differ in these groups with anterior column fractures and patterns predicting poor outcome being more common in the elderly compared to younger patients (3). These heterogeneous fractures are relatively rare with a prevalence of approximately 3 per 100 000 inhabitants (4). Surgery is challenging owing to their complex nature and difficult access. Acetabular fractures are described and classified according to the work of Judet and Letournel (5), which provides a framework for understanding the complexity of acetabulum fractures.

Despite advances in acetabular fracture surgery over the last decades, significant disability can still affect patients. Displaced fractures of the acetabulum are comparable to other articular fractures with joint displacements of greater than 2 mm accepted as indication for operative treatment. Accurate reduction and fixation of the weight bearing acetabular dome is crucial in preventing secondary (post-traumatic) arthritis of the joint (6-8).

Pioneering work at the Töölö hospital has led to a systematic operative approach to displaced acetabular fractures since the late 1980's (9). The anterior intrapelvic approach provides an extraperitoneal approach to fracture reduction and fixation to the anterior, superior and lateral aspects of acetabulum. This intrapelvic approach has been utilized routinely in combination with the lateral iliac-window and posterior Kocher-Langenbeck approaches as necessitated by the fracture pattern. In this paper we aim to review the results of operative displaced acetabular fracture management at our tertiary level 1 trauma center.

Materials and Methods

Between 1998 and 2009, patients undergoing acetabular fracture surgery for displaced fractures were identified and followed up for a minimum of 2 years. Basic demographics along with injury mechanisms, fracture details and surgical details including time delays and operative approaches were recorded. Primary outcome measures included accuracy of surgical reduction on post-operative radiographs as well as Harris Hip Score (HHS) as a clinical measure of functional results. Secondary outcome measures included mortality, complications of treatment and need for subsequent hip arthroplasty.

Surgical management was performed mainly by pelvic surgeons with orthopedic trauma surgeons familiar with pelvic surgery also contributing. Fracture tables with traction on the ipsilateral limb along with routine perioperative antibiotic prophylaxis was used. Hemo-vac drains were utilized as needed while antithrombotic LMWH prophylaxis was routine postoperatively. Passive mobilization of hip was started 24-48 hours postoperatively with touch weight bearing maintained for the first 8-12 weeks. Clinical and radiographic follow up was performed for a minimum of 2 years at which point HHS were measured.

Results

Between the years 1998-2009, 390 patients with a total of 391 displaced acetabular fractures were operatively treated at the Töölö Helsinki University Hospital. The mean patient age was 52,4 years (range 14-98, SD 20) with male patients dominating at 290 (74 %) patients. High energy injury mechanisms accounted for 278 (71 %) cases with motor vehicle accidents and falls from heights greater than 1.5 m accounting for 131(34 %) and 87 (22 %) respectively. Low energy mechanism from low or same level falls accounted for 112 (29 %) cases. The mean age of patients sustaining low energy injuries was 70,7 years, were as high energy injuries had a mean age of 44,8 years. 107 (27 %) pa-

Table 1

Fracture pattern	***Our results***		***Giannoudis***
	n=	***%***	***%***
Posterior wall	66	16,9	23,6
Posterior column	6	1,5	3,5
Anterior wall	4	1,0	1,7
Anterior column	36	9,2	3,9
Transverse	16	4,1	8,3
T-type	55	14,1	9,3
Posterior wall & posterior column	8	2,0	5,7
Transverse & posterior wall	33	8,4	17,4
Anterior column & posterior hemitransverse	40	10,2	5,0
Both column	127	32,5	21,7

Table 2

Radiological reduction	***n=***	***%***
0-1 mm	***367***	***93.9***
2-3 mm	***10***	***2.6***
> 3 mm	***14***	***3.6***

tients were older than 65 years and 65 % of these were caused by low energy injuries. Fracture patterns by types and relative frequencies are given in Table 1 and are compared to those reported in the meta-analysis by Giannoudis (10).

Femoral head dislocation was seen in 168 (43 %) patients with central and posterior dislocations accounting for 71 and 97 cases respectively. Acetabular dome impaction (seagull sign) was identified in 50 (13 %) cases. Surgical management was performed at a mean of 5,9 days (range 0-60, SD 5,5) through anterior approach in 143 cases and posterior approach in 124 while a combined anterior and posterior approach was utilized in 122 cases. An ilioinguinal approach alone was used in a single case. Reasons for surgical delay included stabilization of severely injured polytrauma patients and optimization of elderly patients due to concurrent co-morbidities such as pneumonia and delirium. Long delays typically resulted from delayed patient transfers from other hospitals particularly following acetabular fractures abroad.

A total of 79 early post-operative complications were seen in 57 (15 %) patients. These included 29 fixation failures with 18 patients not abiding to touch weight bearing due to delirium or dementia. Early surgical revision was performed for one patient with screw penetration of the hip joint and one patient with unacceptable malreduction. Post-operative nerve injuries were documented in nine patients. Five patients died within 30 days of surgery and 4 patients suffered thromboembolic complications.

Radiological analysis of post-operative reduction showed anatomic reduction in 367 patients with residual fracture displacement of 2-3 mm in 10 cases.

These represent excellent and good radiological results. Poor reduction with residual displacement of more than 3 mm was seen in 14 cases. See Table 2.

The mean follow-up time was 35,7 months (range 0-94, SD 20,9). Within that time 63 (16 %) patients had died and late complications were identified in 121 (31 %) patients with a total of 134 recorded complications. The most frequent complications seen following acetabular fractures were post-traumatic arthritis (n=57), avascular necrosis (AVN) of the head of the femur (n=44) and heterotrophic ossification (n=31). A complete list of late complications is given in table 5. A total of 51 (13 %) patients had total hip arthroplasty performed for arthritis or AVN although these complications were seen in 101 (26 %) cases.

A total of 131 patients failed to complete the HHS clinical outcome measure at 2-years follow up. This was due to 32 patients being lost to follow-up and 51 patients dying. HHS were also not recorded for patients having undergone ipsilateral hip arthroplasty prior to 2 year follow up (n=44). Patients with hip arthroplasty prior to their acetabular fracture and those for whom Girdlestone procedures were done were also excluded from HHS assessment. Harris Hip Scores were completed by 259 patients with a mean of 87,7 and median of 94 (range 31-100, SD13,5).

Conclusions

Our tertiary referral level 1 trauma center operatively treats an average of 35 acetabular fractures per year. These patients represent a bimodal distribution of injury patterns with ¾ resulting from high energy injuries in younger patients and ¼ low energy injuries in elderly patients. Our results are similar to other epidemiological data reports in recent literature, as is the ratio of male to female patients. The acetabular fracture patterns seen in our unit are also comparable to other published data (10). Early post-operative complications were not common. Approximately 15 % of the patients followed developed posttraumatic arthritis and 11 % developed an AVN of the femoral head. The HHS result was reasonable at 87,7 considering all acetabular fractures irrespective of concomitant injuries were included in our study.

These good results support our belief that ORIF should be the treatment of choice for acetabular fractures in all age groups. The complexity of these fractures and the surgical challenge they pose, demands an experienced surgical team. We also believe the treatment of acetabular fractures should be regionally centralized to optimize operative outcomes.

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Neurophysiology and neuromythology - a short introduction

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The diagnosis of focal peripheral neuropathies with electroneuromyography (ENMG) is one of the most important tasks in the routine of a specialist in clinical neurophysiology. Patients are referred for testing by virtually all medical specialties, a large proportion of patients are referred by orthopedic surgeons and handsurgeons. Focal peripheral neuropathies can be caused by entrapment neuropathies, temporary compression, trauma, iatrogenic procedures, Parsonage-Turner sdr (neuralgic amyotrophy), infections (herpes zoster) and peripheral nerve tumors. As a concept entrapment neuropathy is a relatively recent concept. It was coined in 1963 by Kopell and Thompson in their book Peripheral Entrapment Neuropathies (The William and Wilkins Company, Baltimore, 1963). They defined entrapment neuropathy as a region of localized injury and inflammation in a peripheral nerve that is caused by mechanical irritation from some impinging anatomical neighbor. In simple terms entrapment neuropathy is a focal chronic neuropathy caused by compressive from surrounding anatomical structures. Often general practitioners use the term entrapment neuropathy carelessly to describe any focal neuropathy. However, it is important to distinguish neuropathies caused by temporary external compression from entrapment neuropathies. "Saturday night palsy", an acute radial nerve neuropathy in the middle of the upper arm, is caused by temporary compression while sleeping after a party. Neuropathies caused by temporary compression usually recover well with conservative treatment. Entrapment neuropathies, like carpal tunnel syndrome, often require surgical therapy.

In the literature, a total of 55 entrapment neuropathies have been described. Many of them are poorly documented and mostly based on clinical and surgical findings. A few entrapment neuropathies are well documented and universally accepted (Table 1). These neuropathies can reliably be diagnosed based on symptoms, clinical findings, ENMG and imaging (ultrasound and MRI).

Table 1. Established entrapment neuropathies

Carpal tunnel syndrome
Ulnar neuropathy at the elbow
Costoclavicular entrapment of the plexus brachialis (TOS syndrome)
Meralgia paresthetica
Entrapment of plantar digital nerves (Morton's metatarsalgia)

There is, however, a number of poorly document entities that lack evidence based studies. These can be found in popular textbooks and we still see them used in our clinical practice still today. A list of the most important ones is given in Table 2.

Table 2. Common controversial (neuromythological) entrapment neuropathies

Pronator syndrome
Anterior interosseus syndrome
Posterior interosseus syndrome
Suprascapular nerve entrapments
Plexus brachialis (Scalenus anticus, pectoralis minor)
Piriformis syndrome
Tarsal tunnel syndrome
Anterior tarsal tunnel syndrome

The evolution of all these controversial entities follow similar paths. They are usually born in surgical medical journals. The diagnosis is based only on symptoms and clinical findings. ENMG findings are always negative and these neuropathies cannot be diagnosed with neurophysiological methods. The diagnosis usually supported by subjective impression during surgery and surgical results. There are no controlled studies. As time passes the entities become "legitimate" syndromes that are included in many textbooks, although critical evaluation does not support the concepts.

The presentation will illustrate features of the established entrapment neuropathies and discuss the evolution of the concepts behind the controversial entities.

The importance of radiological results in distal radius fracture operations: functional outcome after l Long term (6.5 y) follow up.

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This follow-up study was to research long term results of surgically treated distal radius fractures, especially the correlation between radiological and functional results. One hundred consecutive patients (mean age 55 y, 77 % female) operated due to a distal radius fracture were called for follow-up mean 6,5 y after operation. Sixty patients (63 wrists) participated. Most (59) were operated with volar locking plate with additional K-wires in 12 cases. In three wrists fixation was with K-wires only. Patients were evaluated both radiologically and clinically. The QDASH -score and PRWE served as outcome measures. The X –rays were evaluated in PA and lateral projections. Radius shortening and possible step-off on radius articular surface were measured in mm and the dorsal inclination of distal radius in degrees. When variables were compared between two independent groups, Mann-Whitney U test was used. Correlations between continuous variables were analyzed using Spearman rank-correlation. In 34 out of 63 wrists an exact anatomic result was achieved according to radiology (54 %) . There were still dorsal (or volar) tilt in radius in 13 wrists (21 %, -15 -22 º) , radius shortening compared to ulna in 15 wrists (24 %, 1-11 mm) and step on joint surface in 11 wrists (17 %, 1-3 mm) Dorsal inclination of distal radius showed no significant correlation with PRWE (median 6 vs 5, p= 0.70) or QDASH (med 6,8 vs 4,5, p=0.30). Radius shortening of 1 mm or more (15 wrists) seemed to have statistically significant correlation with PRWE (p =0.033) and QDASH (p= 0.034) in correlation analysis. Step-off on the joint surface (11 wrists) caused worse results in PRWE (17,5 vs 4,5 , p=0.025) but not significantly in QDASH (p=0.24. 11,4 vs 4,5). Fracture of ulnar styloid (basal or tip) had no affect with the clinical results PRWE (5,5 vs 6,5 p=0.83) and QDASH (6,8 vs 4,5, p=0.47). 10 complications related to surgery (16 %) were noted. Three re-operations were needed due to unsatisfactory primary reduction. In 2 patients hardware had to be removed because of screw penetration into the joint. 3 tendons ruptured: 2 EPL and 1 FPL. One median nerve compression was released and one hemostasis was done. Complications did have significant effect on QDASH and PRWE (med 4,5 vs 13,6 p=0.038 , and 5 vs 17,5 p=0.029). In addition to previous, 16 wrists were later treated surgically: Hardware removal for 6 and K- wire removal for 10. Our study showed that inaccurate radiologic results correlate with worse clinical results. However, moderate dorsal tilt does not seem to affect the clinical outcome. Complications are not rare in radius fracture surgery (10, 16 %) and reoperations are common (26 in this group).

Johdanto

Distaalinen radiusmurtuma on yksi yleisimmistä luuston murtumista ja insidenssi lisääntyy väestön vanhetessa. Esiintyvyydestä Suomessa on tehty arvio Oulussa (1), ja insidenssiksi on arvioitu 258/100 000 henkilövuotta. Naisilla murtumien esiintyvyys kasvaa progressiiviseti perimenopausaalisesta iästä lähtien, heidän insidenssinsä on 360-370 / 100 000/v ja miehillä 140-170/100 000 / v (2) .

HUS piirin alueella on 1,6 milj asukasta joten rannemurtumia tästä arvioiden olisi noin 3000- 4000/ v. Murtuman aiheuttama kipu sekä tauko käden käytössä ja käden toiminnan huononeminen invalidisoi murtuman saaneita. Nuoremmassa väestössä murtuman aiheuttaa yleensä suurienergisempi tapaturma kuin vanhuksilla. Etenkin aktiivisesti kättä käyttävillä henkilöillä (joko työssä tai vapaa-aikana) voi huonoon asentoon luutunut murtuma aiheuttaa huomattavaa haittaa ja jopa työkyvyttömyyttä.

Kun markkinoille on tullut 2000-luvulla volaarisia lukkolevyjä (3,4), ovat murtumien hoitolinjat huomattavasti muuttuneet, ja murtumia on alettu hoitaa leikkauksella ja levytyksellä huomattavasti aiempaa aktiivisemmin (5).

Tämä hoitolinjan muutos aiheuttaa huomattavasti lisää välittömiä kustannuksia: fiksaatiomateriaalien, leikkaussalin käytön ja sairaalapäivien sekä poliklinikkakäyntien lisääntymisen muodossa. Kuitenkin, jos leikkausaktiivisuudella saadaan aikaan se, että rannevamma ei aiheuta pitkällistä tai pysyvää työkyvyttömyyttä, tai että rannevamma ei aiheuta vanhukselle joutumista laitoshoitoon tai hoivattavaksi, ovat hoidot taloudellisesti ja yhteiskunnallisesti hyödyllisiä. Lisäksi myös vanhempi väestö haluaa nykyisin harrastaa aktiivisesti ja työskennellä vielä eläkeiässäkin monenlaisissa aktiviteeteissa, joissa käden normaali tai lähes normaali toiminta on tarpeellista.

HUS :ssa leikataan noin 300 distaalista rannemurtumaa vuodessa , joten noin joka kymmenes radiusmurtuma päätyy leikkaukseen arvioiden laskennallisen insidenssin perusteella. Klinikassamme pirstaleiset murtumat hoidetaan useimmiten joko erikoistuvan tai erikoistuneen käsikirurgien toimesta, osan murtumista leikkaa ortopedi. Muissa HUS:n sairaaloissa värttinäluumurtumia operoidaan muutama kymmen vuodessa. Töölön sairaalaan tulevat potilaat on lähetetty nimenomaan leikkausharkintaa varten. Noin puolet lähetetyistä potilaista hoidetaan kuitenkin konsultaation jälkeen konservatiivisesti: 2010-2011ei-leikkauksellisesti hoidettuja akuutteja murtumia oli noin 500/ 2 vuotta.

Täysin selkeää ei ole, (4,6) onko värttinäluun murtumien leikkaushoito hyödyllistä. Leikkaushoidossa pyritään eksaktiin tai lähes eksaktiin anatomiseen lopputulokseen (7) . Perinteisen ajattelutavan mukaan hyvä anatominen lopputulos tuottaa myös hyvän kliinisen lopputuloksen. Tutkimuksessamme on selvitetty miten radiologinen ja kliininen lopputulos korreloivat keskenään. Lisäksi pyrimme arvioimaan, kuinka paljon leikkaushoito aiheuttaa ongelmia komplikaatioiden ja uusintaleikkausten vuoksi.

Aineisto ja menetelmät

Aineistoon kerättiin 100 peräkkäistä aikavälillä 1.1.2009-22.4.2009 distaalisen rannemurtuman (S 52.5) vuoksi Töölön sairaalassa leikattua potilasta (103 murtumaa). Potilaat kutsuttiin v. 2015 seurantatarkastukseen (keskimäärin 6,5 v kuluttua hoidosta). Tutkimuksen saapui 60 potilasta (63 rannetta). 9 potilasta oli kuollut, 5 asui väestörekisterikeskuksen tietojen perusteella ulkomailla, 2 oli saatujen tietojen mukaan laitoshoidossa tai liian heikossa kunnossa osallistumaan tutkimukseen. 12 ei tavoitettu ja 11 jäi tulematta.

Potilaiden keski-ikä vamman sattuessa oli 55 v. (23-78 v.) ja ikä seurantatutkimukseen tullessa 61 v. (29-84, SD 14,6). Naisten (n= 46, 77 %) keski-ikä jälkitutkimuksen aikana oli 64,8 v. (37-84, SD 12,2) ja miesten keski-ikä 49,2 v. (29-72, SD 15.7) . A-O-luokituksen mukaan C-tyypin murtumia (intraartikulaarisia metafyysialueen murtumia) oli 39 kappaletta (62 %). Dominantissa kädessä vammoista oli 32 (51 %).

Suuri osa murtumista oli leikattu volaarista lukkolevyä käyttäen (59 kpl), 12 ranteessa lisäfiksaationa olivat K-piikit (joko värttinäluun murtuman lisätukena tai ulnan processus styloideuksen fiksaationa). 3 rannetta fiksoitiin ainoastaan K-piikein.

Seurantakäynnillä ranteiden tilanne arvioitiin radiologisesti (radiuksen lyhentymä, dorsaalinen kallistuma ja nivelpintaan jäänyt pykälä sekä PSU:n luutuminen) oirehaastattelulla sekä kliinisellä tutkimuksella (ranteiden ekstensio, fleksio, supinaatio ja pronaatio verrattuna toiseen ranteeseen). Puristusvoima verrattiin terveen käden puristusvoimaan huomioon ottaen dominantin/ei-dominantin käden 10 % puristusvoimaero. Potilaat täyttivät QuickDASH –kyselykaavakkeen ja PRWE (Patient-Rated Wrist Evaluation)

–kaavakkeen (8).Lisäksi selvitettiin mahdolliset murtumaan tai hoitoon liittyneet komplikaatiot, uusintaleikkaukset sekä työkyky.

Tilastoanalyysi: Kun jatkuvia muuttujia vertailtiin kahden itsenäisen ryhmän välillä, käytettiin Mann-Whitney U-testiä. Korrelaatiota jatkuvien muuttujien välillä analysoitiin käyttämällä Spearmanin korrelaatioanalyysia. Vinosti jakautuneissa tuloksissa raportoidaan mediaani ja kvartiililuvut, muissa keskiarvo ja standardideviaatio. Analyysit tehtiin NCSS 8 –ohjelmalla :Hintze, J. (2012). NCSS 8. NCSS, LLC. Kaysville, Utah, USA. www.ncss.com

Tulokset

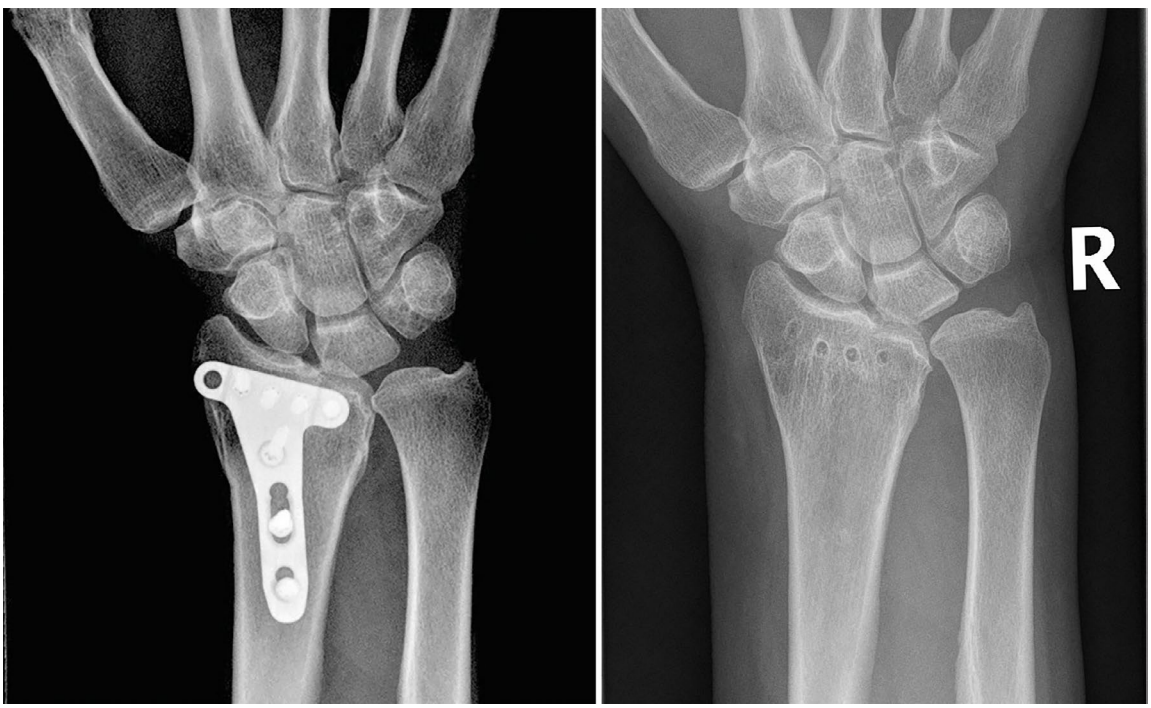
34 ranteeseen 63:sta oli saavutettu eksakti anatominen asento radiologisilla muuttujilla arvioituna (54 %). Dorsaalista kallistusta tai normaalista poikkeavaa volaarista kallistusta oli jäänyt edelleen 13 ranteeseen (21 %, mediaani 6 mm, vaihtelu -15-22o), radiuksen lyhenemää ulnaan nähden 15 ranteeseen (24 %, mediaani 3 mm, vaihtelu 1-11 mm) ja nivelpintaan oli jäänyt mitattavaa pykälää 11 ranteeseen (17 %, mediaani 1,8 mm ,vaihtelu 1-3 mm). PSU oli jäänyt luutumatta 20 ranteessa 36:sta alkutilanteessa olleesta processus styloideus ulnae`n murtumasta. 10 PSU:ta oli fiksoitu ja ne olivat luutuneet.

Tilastollisessa analyysissä (Mann-Whitney`n U-testi) ei todettu merkittävää vaikutusta radiuksen dorsaalisella tai volaarisella kallistumalla PRWE (mediaani 6,75 versus 5 ,p =0,70) tai QDASH tuloksiin (mediaani 6,8 versus 4,5 , p= 0,31).

Radiuksen lyhentymällä ulnaan nähden todettiin korrelaatio Spearman`n korrelaatioanalyysissa PRWE p= 0,033 sekä korrelaatio QDASH huonontuneisiin tuloksiin p=0.034. Radiuksen nivelpinnan pykälä heikensi merkitsevästi PRWE tuloksia (mediaani 17,5 versus 4,5 , p= 0,025). QDASH tuloksiin merkitsevää vaikutusta ei todettu (mediaani 11,4 versus 4,54, p= 0.24) (kuva 1).

Processus styloideus ulnae`n murtumalla ja sen luutumisella (mukaanlaskien kaikki PSU:n murtumatyypit, 36 kpl) ei ollut vaikutusta kliinisiin lopputuloksiin PRWE (mediaani 6,5 versus 5,5, p=0.83.) eikä QDASH (mediaani 6,8 versus 4,5, p= 0.47) tuloksiin.

Kuva 1. Radiusmurtuma, johon on jäänyt reduktiosta huolimatta pykälä (2,5 mm) nivelpintaan. Myöhemmin levy on poistettu. PRWE =67,5, QDASH= 63,4.



Kuva 2. Radiusmurtuma joka on redusoitu fiksoitu levyllä. PSU on jäänyt irtokappaleeksi. PRWE = 0. QDASH =0

Ekstensiovajetta mitattiin seurantatutkimuksessa 43 ranteessa keskimäärin 13 º(5-30 º, SD 8), fleksiovajetta 35 ranteessa keskimäärin 10 º (5-20 º, SD 5) supinaatiovajetta 8 ranteessa keskimäärin 20 º (10-50º, SD 14) ja pronaatiovajetta 5:ssä keskimäärin 15º (10-20 º , SD 5). Näillä liikevajauksilla ei ollut merkittävää vaikutusta PRWE tai QDASH tuloksiin Spearmanin korrelaatioanalyysissa.

Puristusvoima oli 89 % verrattuna terveeseen puoleen (SD 16), vaihteluväli 45-127 %. 6:lla potilaalla oli puristusvoima operoidulla puolella parempi kuin ei-leikatulla. Puristusvoimalla ja radiologisilla virheasennoilla ei ollut korrelaatiota keskenään.

Artroosia (joko johtuen murtumasta tai muista syistä) todettiin seurantakäynnillä röntgenkuvissa 28 ranteessa. Sillä ei ollut merkitsevää vaikutusta PRWE (mediaani 5,5 versus 16, p= 0.127). QDASH (mediaani oli 6,8 versus 6,8, p arvo 0.295).

10 komplikaatiota (16 %) hoidettiin leikkauksella: 3 epätyydyttävää primaarireduktiota re-redusoitiin. 2 potilaalla jouduttiin poistamaan niveleen ulottunut ruuvi. 3 jännevammaa tapahtui: 2 peukalon ojentajajännevammaa ja 1 peukalon koukistajajänne. Yksi medianushermo vapautettiin ja yksi hemostaasi tehtiin.

Komplikaatioilla oli merkitsevä vaikutus PRWE ja QDASH tuloksiin (PRWE mediaani 17,5 versus 5, p= 0.029. QDASH 13,6 versus 4,5 p=0.038). Uusintaleikkauksiin joutui edellä mainittujen lisäksi 16 rannetta: 6:lta poistettiin levy ja 10:ltä K –piikki/piikkejä (joka suureksi osaksi kuului metodiin ja suunnitelmaan). 33 66:sta jälkitarkastuksessa käyneestä potilaasta oli eläkkeellä (55 %) Heistä kukaan ei ollut jäänyt pois työelämästä rannemurtuman vuoksi. Entiseen työhönsä oli palannut 26, ja yksi (molemminpuolisen rannemurtuman saanut) kouluttautui toiseen ammattiin.

Pohdinta

Radiologinen hyvä lopputulos korreloi keskimäärin hyvään toiminnalliseen lopputulokseen ja taas radiologiset virheasennot korreloivat ongelmiin: Radiuksen lyhentymällä ulnaan nähden oli huonontava vaikutus kliiniseen lopputulokseen. Spearmanin korrelaatioanalyysilla mitaten. Nivelpintaan jäänyt pykälä heikensi toiminnallista lopputulosta. Radiuksen dorsaalikallistumalla (joka tässä aineistossa oli keskimäärin lievähkö) ei ollut merkittävää yhteyttä kliinisiin oireisiin mitattuna PRWE ja QDASH pisteytyksillä. Processus styloideus ulnae`n murtumalla ei ollut merkittävää vaikutusta kliinisiin lopputuloksiin. Tosin PSU murtumia ei oltu aineistossa jaoteltu murtuman sijainnin mukaan, eikä mahdollista PSU murtumaan liittyvää DRUJ: n instabiliteettia oltu kirjattu. Hyväksyttävän asennon kriteerit ovat Käypä Hoito –suosituksen mukaan konservatiivisessa hoidossa dorsaali/volaarikallistumaa enintään 15 º /20 º, lyhentymää 3 mm tai alle ja nivelpinnan pykälää sallitaan enintään 1 mm. Aineistossamme radiuksen dorsaalinen tai volaarinen kallistuma oli maltillista, eikä aiheuttanut merkittäviä kliinisiä jälkiongelmia. Radiuksen lyhentymää ei aineistossa oltu jaoteltu vähäiseen (3 mm tai alle) ja suurempaan. Kokonaisuudessaan lyhentymä aiheutti kliinisten tulosten huononemista korrelaatioanalyysissa. Nivelpinnan pykälä käsiteltiin yhtenäisenä ryhmänä (1 mm tai yli) ja se huononsi lopputuloksia. Vähäisellä nivelpinnan epätasaisuudella ja diastaasilla vaikutti olevan (kuvien analyysin perusteella) remo-

dellaatiotaipumus.

Komplikaatiot värttinäluumurtumakirurgiassa eivät ole harvinaisia (tässä aineistossa 16 %) ja osa potilaista ajautuu uusintatoimenpiteisiin tai leikkauksiin, yhteensä 26 leikkausta (41 %) , joista tosin 10 olivat polikliinisiä K-piikin poistoja.

Kun suunnitellaan leikkausta, on syytä muistaa, että murtuman leikkaushoito johtaa osalla potilaita uuteen kirurgiseen toimenpiteeseen (joko levyn poistoon tai K piikkien poistoon). Lisäksi pehmytkudos- tai fiksaatiomateriaaliin liittyvät komplikaatiot ovat yleisiä. Etenkin iäkkäämmän väestön ollessa kyseessä tulisi tarkkaan harkita, hyötyykö potilas leikkaushoidosta (6). PSU murtuman merkitys lopputuloksen on vähäinen ja jos ranne on stabiili, ei PSUn fiksaatiosta ole välttämättä hyötyä (10).

Kiitokset: DI Timo Pessi, statistiikka-analyysista. Tutkimushoitaja Leena Caravitis, tutkimuspoliklinikan toiminnan käytännön järjestelyistä.

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Aikuisten distaalisten radiusmurtumien kansalliset hoitosuositukset

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Guidelines in the treatment of adult distal radius fractures of American Association of Orthopaedic Surgery (AAOS), British, Danish, Finnish and Norwegian national health authorities were compared. Smith fractures, AO type B fractures (Barton and Chauffeur fractures) and high energy trauma were excluded. None of the recommendations were based on strong evidence, few on moderate, most on weak evidence or on consensus of the work group. All guidelines except the British recommended operative treatment of unstable fractures with dorsal tilt more than 10-15 degrees, ulnar variance more than 2-3 mm and articular step off more than 1-2 mm. According to Danish and Norwegian guidelines one should be cautious about the use of surgical intervention in patients of any age with a low level of function. Finnish guidelines recommended conservative treatment of unstable fractures of patients over 65 years of age unless they present high level of physical activity on their daily living while the Norwegian guidelines recommended operative treatment also for patients older that 65 years if indications for operative treatment are met. AAOS guidelines were unable to recommend for or against operative treatment for patients over age 55 with distal radius fractures. If operative treatment was considered Danish and Norwegian guidelines recommended open reduction and volar plating with locking screws while the American and Finnish guidelines were not able to prefer any method over another. British guidelines recommended K-wire fixation for economical purposes whenever it is possible. Timing of the surgery was considered non urgent. As volar plate fixation is a demanding operation it should wait for an experienced surgeon or referred to another clinic with more competence (Norwegian guidelines). In conservative treatment well reduced fractures with dorsal comminution were recommended to be followed by ongoing radiographic evaluation for 2-3 weeks and at cessation of immobilization, but operative treatment was also considered a treatment option. Routine CT scan was not recommended unless more information to regular radiographs were considered necessary. After treatment of distal radius fracture it was considered as good practice to offer guidance and practical instruction concerning self-rehabilitation but routine rehabilitation given by occupational therapist or physiotherapist was not recommended.

Johdanto

Hoitosuositusten tarkoituksena on helpottaa kliinikkoja tekemään ratkaisuja tutkimusten ja hoitomuotojen valinnoissa. Distaalisen radiusmurtuman ollessa yksi tavallisimmista murtumista, sen hoitoon on kaivattu kansallisia hoitosuosituksia jo useita vuosia. Riittävän korkealaatuisten satunnaistettujen tutkimusten vähäisyyden vuoksi suosituksille ei ole saatu tarvittavaa tieteellistä pohjaa, mutta viimeisten viiden vuoden aikana tehdyt Cochrane-katsaukset ja muutamat satunnaistetut kontrolloidut tutkimukset ovat mahdollistaneet hoitosuositusten teon. Suomalainen distaalisten radiusmurtumien Käypä hoito- suositus saatiin valmiiksi vuoden 2016 keväällä. Tähän vertailuun saatiin kotimaisen suosituksen lisäksi Englannin (2015), Norjan (2015) ja Tanskan (2016) kansallisten työryhmien ja Yhdysvaltojen ortopediyhdistyksen (AAOS) (2009) hoitosuositukset.

Menetelmät

Suomen ja Tanskan hoitosuositukset laadittiin hyvin saman tyyppistä protokollaan noudattaen, sillä kummassakin maassa on kliinisiä hoitosuosituksia varten valmis järjestelmä, Suomessa Käypä hoito- järjestelmä ja Tanskassa ”Nationale kliniske retningslinjer”.

Hoitosuositusten laatimista varten tehtiin hoitoratkaisuihin liittyvät kysymykset (esim. ”Mitkä radiologiset tai muut tekijät ennustavat huonoa funktionaalista lopputulosta?”), joihin haettiin kirjallisuudesta vastauksia ja sitä kautta väittämät (Esim. ”Nivelen ulkopuoleinen virheasento saattaa lisätä distaalisen radiusmurtuman huonon toiminnallisen tuloksen riskiä kaiken ikäisillä, mutta riski laskee iän myötä.”). Toiminnallisen tuloksen arviointi tuli perustua tieteellisesti validoitujen mittarien (DASH, PRWE, SF-12) käyttöön.

Kuhunkin väittämään liittyvään kirjallisuuteen tehtiin näytönastekatsaus, jolla saatiin tukea väittämälle tai kumottiin väittämä. Kotimaisessa työryhmässä julkaisut luokiteltiin asteikolle A-D (A= vahva tutkimusnäyttö), B= kohtalainen tutkimusnäyttö, C=niukka tutkimusnäyttö ja D=ei tutkimusnäyttöä).

Yhdysvaltalainen hoitosuositus perustui 29:ään väittämään, joille on haettiin tilastollinen voima asteikolla vahva – kohtalainen – matala/rajoittunut - riittämätön – työryhmän konsensus. Riittämättömällä näytöllä työtyhmä ei asettanut kumpaakaan hoitomuotoa toisen edelle ja korosti potilaan omaa tahtoa. Norjan hoitosuositus perustui kirjallisuuden meta-analyysiin (Kvernmo et Krukhaug 2013) sekä tanskalaisten aiemmin laatimaan suositukseen. Tanskalainen ja norjalainen työryhmä antoi selvät suositukset, vaikka näyttö toisen hoitomuodon eduksi jäi niukaksi. Englantilainen hoitosuositus oli osana laajempaa komplisoitumattomien murtumien hoito-ohjetta, jossa oli asetettu voimakas painoarvo mm. kivun hoidolle ja taloudellisille näkökulmille, joita muut työryhmät eivät huomioineet samalla laajuudella suosituksissaan.

Tulokset

Diagnostiikka ja konservatiivinen hoito

Distaalisten radiusmurtumien diagnostiikka perustuu hyvälaatuisiin röntgenkuviin (AP- ja suora sivukuva), josta arvioidaan murtuman mahdollisesti aiheuttama virheasento ennen alustavaa hoitopäätöstä ja mahdollisen suljetun reposition ja kipsauksen jälkeen. Niiden perusteella arvioidaan jatkohoito. Rutiininomaista CT-kuvausta ei suositettu missään hoitosuosituksessa, mutta sen todettiin antavan arvokasta lisätietoa niveleen ulottuvissa murtumissa ja jos röntgenkuvien perusteella on vaikeuksia ratkaista sopivaa hoitomenetelmää. Mikäli päädytään konservatiiviseen hoitoon, englantilainen työryhmä suosittaa laskimopuudutuksessa tehtävää repositiota, kun taas suomalainen työryhmä suosittaa paikallispuudutusta. Muut työryhmät eivät ota tähän kantaa. Reponoidun murtuman asentoa tulisi seurata röntgenkuvin ensimmäisen 2-3 viikon ajan. Vain suomalainen työryhmä suosittaa tarkkoja seuranta-ajankohtia (1,2 ja 5 viikkoa kipsauksesta) ja ottaa varovaisesti kantaa uusintarepositioita vastaan, jos hyväksyttävä asento todetaan menetetyksi 1-2 viikon kontrollikuvissa etenkin vanhemmassa väestössä.

Leikkausindikaatiot

Leikkaushoidon radiologisissa kriteereissä oli pieniä kansallisia eroja (Taulukko 1). Taulukko 1:ssa mainittujen kolmen kriteerin lisäksi tanskalaisessa ja norjalaisessa suosituksessa leikkaushoidon indikaatioksi katsottaan distaalisen radioulnaarinivelen (DRUJ) epämuotoisuus tai dislokaatio sekä dorsaalisen korteksin pirstaleisuus. Englantilainen työryhmä ei löydä kirjallisuudesta riittävää näyttöä sille, mitkä dorsaalisesti dislosoituneet murtumat kannattaisi leikata ja mitkä konservatiivisesti. Norjan ja tanskan työryhmät suosittavat kaiken ikäisten indikaatiot täyttävien murtumien

Taulukko 1. Maakohtaiset radiologiset kriteerit leikkaushoidolle

	Maa				
Parametri	Englanti	Norja	Suomi	Tanska	Yhdysvallat
Dorsaalinen kallistus (astetta)	-	>10	>15	>10	>10
Ulna plus (mm)	-	>2	>3	>2	> 3
Nivelpinnan pykälä (mm)	-	>2	>1	>2	>2

leikkaushoitoa, mutta kumpikin kehottaa noudattamaan huomattavaa varovaisuutta kaiken ikäisten pysyvästi matalan fyysisen toimintakyvyn omaavien kohdalla ja niiden kohdalla, jotka eivät selviä päivittäisitä askareistaan itsenäisesti. AAOS:n työtyhmä ei kykene näytön puuttuessa ottamaan kantaa yli 55-vuotiaiden potilaiden leikkausindikaatiot täyttävien murtumien leikkaushoidon puolesta tai vastaan. Hoitoratkaisua valittaessa painotettaan potilaan omia toiveita. Kotimainen työryhmä totesi, että yli 65-vuotiaiden vastaavien murtumien leikkaushoidosta ei ehkä ole hyötyä. Kirurgista hoitoa voidaan kuitenkin harkita myös aktiivisilla ikääntyvillä, joilla on suuret vaatimukset yläraajan toimintakykyä kohtaan. Kirurgisen hoidon tarve tulee harkita näillä potilailla huolellisesti ja tapauskohtaisesti.

Leikkausmenetelmä

Englantilainen työryhmä suosittaa lähinnä talousperustein Kirschner-piikkien käyttöä aina, kun murtuman aiheuttama virheasento ja radiokarpaalinivel ovat korjattavissa suljetusti. Jos näin ei ole, se suosittaa avointa reduktiosta ja sisäistä kiinnitystä menetelmästä riippumatta. Norjalainen ja tanskalainen työryhmä suosittaa konsensuspohjalta volaarisen lukkoruuvein kiinnitettävän levyn käyttöä. Jos näitä ei ole käytettävissä, he suosittavat ennemmin K-piikkien kuin ulkoisen kiinnittimen käyttöä. AAOS:n ja Suomen työryhmät eivät riittävän näytön puuttuessa kyenneet suosittamaan yhtään kiinnitysmenetelmää enempää kuin toista. Luunsiirteille tai luun korvikkeille ei nähdä sijaa tyyppimurtumien hoidossa tosin riittämättömällä näytöllä (AAOS).

Leikkausajankohta

Sekä norjalainen että tanskalainen työryhmä pitää hyvänä käytäntönä, ettei komplisoitumatonta distaalista radiusmurtumaa leikata kiireellisenä toimenpiteenä, vaan se tehdään päiväsaikaan kokeneen, asiaan perehtyneen kollegan ollessa käytettävissä.

Liitännäisvammojen hoito

Kotimainen työryhmä suosittaa distaalisen radiusmurtuman yhteydessä esiintyvän keskihermon vaurion tai pinnetilan samanaikaista leikkaushoitoa murtuman leikkauksen yhteydessä, mutta AAOS:n työryhmä ei pysty antamaan suositusta hermon vapautuksen puolesta eikä sitä vastaan näytön puuttuessa. DRUJ:n instabiliteetin välittömän korjauksen hyödystä ei löydy tieteellistä näyttöä AAOS:n eikä kotimaisen työryhmän arviossa. Sen sijaan kumpikin työryhmä näkee scapholunaariligamentin täydellisen repeämän korjauksen hyväksi vaihtoehdoksi rajallisella tieteellisellä näytöllä. AAOS:n ja Suomen työryhmät pitävät artroskopiaa hyvänä apuna niveleen ulottuvien murtumien leikkaushoidon yhteydessä. AAOS:n ja Suomen työryhmät eivät suosita ulnan puikkolisäkkeen murtuman kiinnitystä ellei DRUJ ole epätukeva. Sen sijaan Norjan työryhmä suosittaa distaalisen ulnan dislosoituneen murtuman operatiivista kiinnitystä heikosta tieteellisestä näytöstä huolimatta.

Jatkohoito ja kuntoutus

Volaarisen levytyksen jälkeen suositettaan (Norja, Tanska ja Suomi) enintään kahden viikon immobilisaatiota, mutta yksikään työryhmä ei suosita leikkauksen jälkeistä välitöntä ranteen mobilisaatiota (AAOS, Norja, Suomi, Tanska). Rutiinin omaista fysio- tai toimintaterapeutin antamaa fysioterapiaa ei pidetä hyödyllisenä, mutta kipsin poiston jälkeinen omatoimisen harjoitusohjelman ohjaus ja kirjallinen ohjeistus nähdään hyvänä hoitokäytäntönä. Poikkeuksellisen kivuliaat potilaat suositetaan pidettävän seurannassa. AAOS:n ja Suomen työryhmät pitävät C-vitamiinin määräämistä näille potilaille mahdollisesti hyödyllisenä.

Pohdinta

Vaikka hoitosuositukset perustuvat käytännössä samaan kirjallisuuteen, niiden johtopäätökset poik-

keavat toisistaan jonkin verran. Laadukkaidenkin tutkimusten johtopäätösten tulkinnoissa on kansallisia eroja ja joissain työryhmissä pidättäydytään suosittamasta mitään yksittäistä hoitomuotoa ellei riittävää näyttöä saada kirjallisuudesta. Toisissa työryhmissä taas heikkokin näyttö riittää hoitomuodon suosittamiseen. Kansalliset hoitosuositukset eivät ole juridisesti sitovia ja potilasta hoitavan lääkärin tulee tehdä hoitoratkaisunsa potilaskohtaisesti informoiden häntä riittävästi eri hoitovaihtoehdoista ja niihin liittyvistä mahdollisista riskeistä sekä huomioiden potilaan hoitoon liittyvät toiveet.

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When Joint Preserving Surgery is not Enough – or You Have Done it Too Much

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Joint preservation is rapidly growing field in orthopedics. Twenty years ago, almost everybody with degenerative hip problem had a total hip replacement and osteotomies and other joint preserving techniques were almost abandoned. One reason for this was that total hips were believed to be very successful. New prosthetic designs with hard bearing couples and larger heads were thought to solve the problems with wear and instability. However, we have now seen many problems related to these new and also old prosthetic designs. Metal ion release, formation of pseudotumors, trunnion corrosion and noise just to mention few.

The idea of joint preserving surgery is to avoid these problems. It is movement toward more natural hip function. In fact, introduction of resurfacing arthroplasty was the first patient driven pursuit of restoration of normal hip function. Femoroacetabular impingement was very seldomly diagnosed twenty year ago, but today it is one of the most known reason for hip pain in young patient population. More aggressive joint preservation treatment of young adults with joint dysfunction resulting from hip dysplasia and sequelae of pediatric hip disease, such as Legg-Calvé-Perthes disease and slipped capital femoral epiphysis, is increasingly more attractive and accepted by patients and surgeons.

The true reason for the explosive need for joint preserving surgery is not the poor results of total joint arthroplasties. In fact, the results of arthroplasties are better than expected. Those who we were trained as orthopedic surgeons during the change of century know that the common knowledge at time was that the arthroplasty was expected to last for ten years and after that the revision operation is likely needed. It was a reason that delayed the operation as far as possible. Patients were expected to have very severe symptoms before operation was considered. Joint arthroplasty was also accompanied with quite strict limitation in normal life. However, the good results expanded the use of arthroplasty and the indications were significantly widened during the early years of this century.

The true reason for the need of preserving joint surgery is new indication. We have now world wide a new generation that is entering their 50s and 60s with painful arthritic hips and knees. This generation has been far more active and healthier than same age generations earlier. Also, they have high functional expectations, and the explosion of information technology has generated strong interest in more kinematically normal joint replacement and nonprosthetic joint preserving alternatives. Also we have a growing numbers of young adults who are seeking reasons for their hip pain that limits their very active sporting life style.

Total joint arthroplasty is still very good option for the treatment of degenerative hip disease called arthrosis. For primary hip arthrosis it is the best known, so far. However, there is lot of discussion about the determination of primary and secondary arthrosis. Based on current literature it seems that there are age dependent alternations in signaling pathways of chondrocytes that have an effect on joint cartilage (1). Whether we can really delay arthrosis is still contradicted. In knee various operative techniques have been introduced to delay arthrosis during the last 30 years. However, today we know that knee debridement or repair of degenerative meniscal tears or even ACL surgery does not seem to delay the arthrosis, although they maybe beneficial for other reasons. This may very well be the case with hip as well. Arthroplasty should be preserved for patients who have a clear arthrosis. This means both the clinical symptoms and radiological findings of the disease.

Total hip arthroplasty is increasingly performed in younger, more active patients. Sporting activity potentially risks premature failure of the implant, and there is no international consensus or guidelines for total hip arthroplasty in sporting patients. The British Hip Society asked their members about their practice (2). Thirty-five percent of their patients were involved in sports preoperatively, and a desire to return to sporting activity was a major expectation of surgery. The

majority of respondents (33 %) would perform uncemented arthroplasty, 29.1 % would perform hybrid, 15.5 % would perform fully cemented, and 11.7 % would perform a resurfacing hip arthroplasty for sporting patients. The preferred approach is the standard posterior (68.9 %) and preferred bearing couples are ceramic-on-ceramic (39.8 %) and ceramic-on-polyethylene (36.9 %). Half of respondents would opt for a femoral head smaller than 36 mm, whereas 22.3 % would use a head 36 mm or larger. A third would allow patients to return to sports between 6 and 12 weeks after surgery, whereas 43.7 % advise patients to wait until 3 months postoperatively. All respondents allow patients to return to low-impact activities, but significant caution is exercised with regard to taking part in high-impact activities.

Howie et al. (3) showed in their article that larger articulations reduce the risk of dislocation following primary total hip arthroplasty but do not have an effect on wear production. Fifty-six elderly patients undergoing primary total hip arthroplasty were randomized intraoperatively to receive either a 36-mm or 28-mm metal-on-XLPE articulation. Mean annual proximal wear rates between 1 and 3 years were 0.00 and 0.01 mm/yr for the 36 and 28-mm articulation cohorts, respectively. No patient had a proximal wear rate of >0.1 mm/yr. Mean wear was very low in all directions, and the wear rate of 36-mm articulations was not significantly greater than that of 28-mm articulations on the basis of proximal, medial 2-dimensional, and 3-dimensional wear.

Kim et al (4) introduced their results of third-generation of alumina-on-alumina ceramic bearing using clinical and radiologic outcome, prevalence of osteolysis detected with radiographs and computerized tomographic scan, and survivorship as determinants. 871 patients (1131 hips) underwent a cementless total hip arthroplasty when they were aged 65 years or younger at the time of surgery. The most common diagnoses were osteonecrosis (53 %) and osteoarthritis (20 %). Harris hip score, Western Ontario and McMaster Universities Osteoarthritis Index, and University of California, Los Angeles activity scores were recorded. Radiographic and computerized tomographic evaluations were used to evaluate implant fixation and osteolysis. The mean follow-up interval was 18.8 years (range, 15-20 years). At the time of final follow-up, the mean Harris hip score, Western Ontario and McMaster Universities Osteoarthritis Index score, and University of California, Los Angeles activity score were 90 points, 15 points, and 8 points, respectively. All the femoral stem and acetabular components were well-fixed at the time of final follow-up. No hip had aseptic loosening or osteolysis or fracture of ceramic material at the time of the final follow-up.

These are few examples which show that total hip arthroplasty still is very viable option also for young patients for the treatment of hip arthroplasty. However, it should be noticed that other kind of outcomes have also been reported. Tsukanaka et al (5) reported 70 % of ten year survival rate as revision as end point for patient under 20 years. These patients had hip dysplasia as a reason for arthroplasty and the writers concluded that despite of 30 % revision rate the patients performed well. However, the results of osteotomies after 42 years are quite impressive in this patient group (6).

Patients that have hip or knee pain at the age of 50 years and under are a serious clinical problem. They often have findings that resemble arthrosis but are not quite typical it. Their expectations are high and they will continue active and often sporting lifestyle. The satisfaction for arthroplasty is generally low (7). For these patients new treatment option are very welcome. New techniques should not only be tested and studied using RCT protocols, but all patients should be followed by using some kind of registers. This is the only way to get information about the true benefit and value of these techniques.

There is a definite need for joint preserving surgery. However, it should not be seen as an alternative for joint arthroplasty, but rather a treatment option for something that we have not had a good treatment option earlier. Arthroplasty is still the golden standard for clear arthrosis. It is a disease dependent, not an age dependent, issue. Although, it is very important for all orthopedic doctors to be aware of new joint preserving techniques, it is very important to realize their limitations as well. We have seen with various other operative techniques an early rapid increase in number of procedures, which declines after more information is in use. When diagnosing a joint problem and deciding on the best course of treatment, orthopaedic surgeons need to remember that just because they can do a procedure does not necessarily make it the best option for the patient.

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Anything new in hip revision surgery?

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Severe periprothetic bone loss and pelvic discontinuity are always a challenge in treating a total hip arthroplasty (THA) revision. On the femoral side, reconstruction stems and total femurs have been used for decades but on the acetabular side new digital 3D techniques have opened new possibilities in hip revision surgery.

On the acetabular side, biologic bony ingrowth to the component is essential for successful reconstruction, especially in the presence of an unstable fracture of the pelvic ring. Multi-dimensional bone defect makes it difficult to achieve a large and a stable enough contact area between host bone and hemispherical cup.

When trabecular tantalum cups and augments were introduced (1) the results of reconstruction of the pelvic bone defects improved a lot, but still the transverse acetabular fractures combined with bone lost remained difficult to repair. Different methods from massive bony allografts,mega cups, and Kerboul reinforcement devices to cup cages have been used with or without bone grafts, plates, and screws. One of the latest innovations has been a revision cup where modular ilium flanges and obturator foramen hook could be modified and fixed to the cup during surgery to give more stability to the pelvic fracture.

Modern computed tomography techniques with metal artefact removal software enable exact modelling of the damaged periprothetic bone tissue. It is possible to create 3D models of the pelvis and acetabular region, which can be employed to construct very accurate custom-made (CM) implants. For example, as early as 2002 Joshi et al. (2) reported their experience with a triflanged custom-made acetabular implants in the management of complex major acetabular deficiency in revision of THA in 27 patients. After 58 (48-72) months FU they reported that 6 patients had had complications and two underwent a second revision surgery. They concluded that this procedure should be restricted to patients for whom a Girdlestone pseudoarthrosis is the only alternative.

Subsequently, 3D modelling, porous titanium surfaces, and even 3D titanium printing have advanced considerably. Nowadays, triflanged CM implants can be produced by cast molding and surface sintering or by 3D printing. Naturally, experience of the first method is longer and fatigue strength of the manufactured implants is better known. With the 3D printing method macroporosity of the surface of the cup and the flanges can be achieved to confirm good bony ingrowth to implant. 3D printing is a quicker manufacturing method than cast molding.

Short-term results (10-58 months FU) of six AAOS type 3 (3) and 4 (3) bone defect reconstructions have been good; no revisions or failures happened (3). A custom-made drilling jig was used to optimize screw positioning. In a retrospective series of 19 CM triflanged acetabular components for Paprosky 3A/B defects with FU of 31 (16-59) months Wind et al. (4) reported one component failure and two re-revisions. Three patients had a pelvic discontinuity, bony union was achieved in all these three cases.

Barlow et al. (5) reported 63 Paprosky 3B defect reconstructions using custom triflange acetabular components (CTAC). The average FU was 52 months, revision or removal of the implant or > 3mm radiolucent line or > 5mm displacement in serial radiographs. The failure rate was 13,5 %. Failures happened more for those cases in which the hip center was more lateralized.

In our hospital, we have performed two CM implant revisions for challenging bone defect THA revisions. In the first case host bone was very thin because of cup migration but the pelvic ring was intact. She recovered well. The latest case, 79-years old and physically active lady with AAOS type 4 bone defect, loose revision cup and pelvic discontinuity because of a fatigue fracture, was operated on using CM triflanged, macroporous 3D-printed revision cup. Stem was intact and in good position so only revision of the acetabulum and fixation of the instable pelvic ring was needed. CM jigs for drilling were used for cancellous AO-screws; 8 to ilium, 5 to ischium and 2 to pubis. Primary fixation was excellent and postop-

Figure 1. AP radiograph of a 79-years old female patient's left THA after a fatigue fracture of the acetabulum

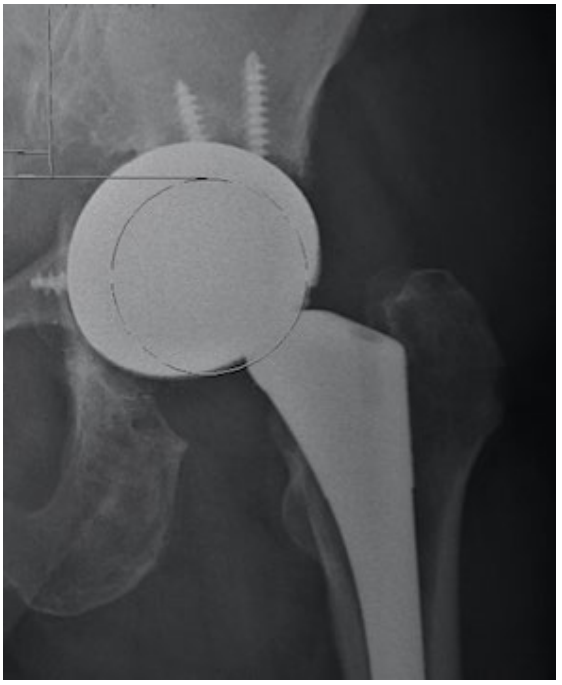

Figure 2. AP radiograph at 6 weeks shows stable implant and good screw positions.

erative radiographs showed good contact between the component and host bone as well as excellent screw positions. Only partial weight-bearing was allowed and at six weeks FU patient was very satisfied because of pain free hip and radiographs showed unchanged situation around the component (Figures 1 and 2).

These "prefabricated element" triflanged CM cups provide many benefits for the surgeon when compared to old building methods with supporting cages, cups, screws, and plates, especially in pelvic discontinuity cases. They contain both non-cemented CM shaped porous titanium cup and porous coated plates offering stable fixation to all three acetabular bones (ilium, pubis, and ischium). This technique minimizes cup wall thickness thus leaving enough space inside the cup for big liner with maximum head size and stability. Preplanned screw directions and lengths help surgeon to optimize stability. Shorter operation time reduces peroperative complication risk and helps to optimize OR scheduling.

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