

# INJURY

## International Journal of the Care of the Injured

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# OSTEOSYNTHESE INTERNATIONAL 2012

19-22 SEPTEMBER, ROSTOCK, GERMANY



PROGRAMME & ABSTRACT BOOK

ANNUAL CONGRESS OF THE GERHARD KÜNTSCHER SOCIETY

[www.osteosynthese2012.com](http://www.osteosynthese2012.com)

## Congress Faculty

PD Dr Med Hans-Werner Stedtfeld <i>President of Küntscher Society</i>	University of Rostock, Germany
Prof Dr Med Georg Gradl <i>Congress President</i>	University of Rostock, Germany
Prof Dr Med Thomas Mittlmeier <i>Congress President</i>	University of Rostock, Germany
Prof Dr Med Kemal Aktuglu	Ege University Hospital, Turkey
Dr Med Michel Brax	Centre Hospitalier Haguenau, France
Prof Dr Med Karl-Heinz Frosch	Asklepios Hospital St. Georg, Germany
Prof Dr Med Christoph Josten	University of Leipzig, Germany
Dr Med Martin Kloub	Hospital Ceske Budejovice, Czech Republic
Prof Dr Med Pol Rommens	University of Mainz, Germany
Prof Dr Med David Seligson	University of Louisville, USA
Prof Dr Med Patrick Simon	Centre Hospitalier St Joseph St Luc, France

## Organisation

Dr Med Anica Eschler <i>Congress Secretary</i>	University of Rostock, Germany
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## Welcome Message of Congress Presidents

Dear colleagues and friends of the Gerhard Küntscher Society,

Since the first steps intramedullary nailing developed into a widely applicable standard procedure in modern fracture care. We can assume that the technique still has a promising future potential having in mind the recent achievements of intramedullary fixation of metaphyseal and joint fractures.

Actual trends, developments and the differential indication for intramedullary versus extramedullary fixation will be in the focus of our upcoming meeting.

We welcome you as active participants of the 2012 Annual Meeting of the Gerhard Küntscher Society and hope that you will enjoy the stimulating atmosphere in Rostock which is one of the most exciting places in Northeast Germany in the vicinity of the Baltic Sea.

The image shows two handwritten signatures in black ink. The first signature on the left is 'Georg Gradl' written in a cursive style. The second signature on the right is 'Thomas Mittlmeier', also in a cursive style, with a long horizontal stroke at the end.

Georg Gradl and Thomas Mittlmeier  
*Congress Presidents*



## Welcome Message of President of the Küntscher Society

Dear friends of the Gerhard Küntscher Society,  
Dear Colleagues in Trauma and Orthopaedics,

About one year ago we faced the sudden dilemma that the congress we had planned in France was cancelled. With a spontaneous and courageous decision Professor Georg Gradl stepped into the breach and declared his and his colleagues willingness to organise the Congress instead.

Now, we have the impressive program of the Rostock Congress "Osteosynthese International 2012" in our hands. With great admiration we see the fruits of the tremendous efforts of the team around Professor Thomas Mittlmeier.

The highly attractive scientific topics, they have composed in cooperation with an International Faculty, will give us the opportunity to get together again and enjoy lively discussions about new ideas in trauma care within a friendly atmosphere and at a very pleasant spot in the North of Germany.

As President of the Gerhard Küntscher Society it is my rewarding task to invite you, the interested in modern fracture care, to come to Rostock and share three invaluable days of surprise, inspiration and friendship with the Gerhard Küntscher Society.



Hans-Werner Stedtfeld  
*President of Küntscher Society*





# INJURY

## International Journal of the Care of the Injured

Official Journal of the British Trauma Society, the Australasian Trauma Society and the Saudi Orthopaedic Association in Trauma, and affiliated with the Hellenic Association of Orthopaedic Surgery and Traumatology, the Italian Society of Orthopaedics and Traumatology, the Gerhard Küntscher Society, the Spanish Society of Orthopaedic Surgery and Traumatology (SECOT), the Turkish Orthopaedic Trauma Society, AOTrauma, Groupe d'Etude en Traumatologie Ostéoarticulaire and the Croatian Trauma Society.

**Volume 43 Supplement 1, September 2012**

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# SCIENTIFIC PROGRAMME

## WEDNESDAY, 19 SEPTEMBER 2012

16.00 **Registrations Opening**

18.00 - 19.30 **Board Meeting**

20.00 **Board Dinner** exclusively sponsored by I.T.S. GmbH

## THURSDAY, 20 SEPTEMBER 2012

8.00 - 9.00 **Registration**

9.00 - 9.20 **Congress Opening**  
G. Gradl, T. Mittlmeier, H.-W. Stedtfeld

**Special lecture: Küntscher's Inspirations**  
P. Procter

9.20 - 10.50 **Nailing around the foot** T1  
Chairmen: H. Zwipp, P. Simon

**Locking nailing for displaced articular fractures of the calcaneus: an innovative procedure with the Calcanail®.** L-T1.1

P. Simon<sup>1</sup>, M. Goldzak<sup>2</sup>.

<sup>1</sup> Chirurgie orthopédique et traumatologique, Centre hospitalier St. Joseph St. Luc, Lyon, France, <sup>2</sup> Clinique de l'Union, St. Jean, France

**Calcaneal fractures. Biomechanical comparative study comparing plating vs. Calcanail in cadaveric bones.** L-T1.2

M. Goldzak<sup>1</sup>, M. Chaussemier<sup>2</sup>, R. Chieragatti<sup>2</sup>.

<sup>1</sup> Clinique de l'Union, Saint Jean, France, <sup>2</sup> l'Institut Supérieur de l'Aéronautique et de l'Espace, Toulouse, France

**Closed reduction and percutaneous screw fixation of comminuted calcaneal fractures.** L-T1.3  
F. Ortner.

Department of Traumatology, Landeskrankenhaus Wiener Neustadt, Vienna, Austria

**Calcaneal nail (C-NAIL)** L-T1.4

M. Pompach<sup>1</sup>, H. Zwipp<sup>2</sup>, M. Amlang<sup>2</sup>, L. Zilka<sup>3</sup>, M. Carda<sup>1</sup>.

<sup>1</sup> Pardubická krajská nemocnice, Department of traumatology, Pardubice, Czech Republic, <sup>2</sup> Department of traumatology, Universitätsklinikum Carl Gustav Carus, Dresden, Germany, <sup>3</sup> MEDIN a.s., Nove Mesto Na Morave, Czech Republic

**Intramedullary medial collum support for Charcot arthropathy – is that sufficient?** L-T1.5

A. Eschler, B. Ulmar, T. Mittlmeier, G. Gradl.

Department for Trauma and Reconstructive Surgery, University of Rostock, Rostock, Germany

**Ankle fractures in older patients: the use of augmented fixation techniques.** L-T1.6

N. Viens, G. Sutter, D. Mangiapani, S. Adams, R. Zura.

Orthopaedics Department, Duke, Durham, USA

10.10 - 10.20 **Discussion**

# SCIENTIFIC PROGRAMME

	<p><b>Initial experience with the application of ankle arthrodesis nail.</b></p> <p><u>N. Tzachev</u><sup>1</sup>, A. Baltov<sup>1</sup>, D. Lilyanov<sup>1</sup>, I. Gerov<sup>2</sup>, A. Iotov<sup>1</sup>.</p> <p>1 Department of Orthopaedic and Trauma, Military Hospital, Sofia, Bulgaria, 2 Department of Orthopaedic and Trauma, Tokuda Hospital, Sofia, Bulgaria</p>	R-T1.1
	<p><b>A new plate for the treatment of Lisfranc's fracture.</b></p> <p>D. Seligson, <u>C. Bowlin</u>, C. Vanlaningham.</p> <p>Department of Orthopaedics, University of Louisville Hospital, Louisville, USA</p>	R-T1.2
10.30 - 10.50	<p><b>Key-note lecture: Nailing in foot surgery</b></p> <p>H. Zwipp</p>	
10.50 - 11.20	<p><b>Coffee Break</b></p>	
11.20 - 12.35	<p><b>Nailing in reconstructive surgery and non-unions</b></p> <p>Chairmen: P. V. Giannoudis, A. Rücker, A. N. Chelnokov</p>	T2
	<p><b>Closed nailing in valgus intertrochanteric osteotomy.</b></p> <p><u>A. N. Chelnokov</u>, A. Shalin, A. Bogatkin.</p> <p>Orthopaedic Trauma, Ural Scientific Institute of Traumatology and Orthopaedics, Ekaterinburg, Russia</p>	L-T2.1
	<p><b>The acute correction of deformities of the tibia with tibial nail using the new Monobloc Distal Bolt Locking Screw (MDBLS).</b></p> <p><u>T. Kurtulmus</u>, N. Saglam, G. Saka, S. Yeniocak, E. Demirel, F. Akpinar.</p> <p>Department of Orthopaedics and Traumatology, Umraniye Education and Research Hospital, Istanbul, Turkey</p>	L-T2.2
	<p><b>Long-term results with re-nailing for non-unions of the femoral shaft.</b></p> <p>I. Gerov<sup>1</sup>, N. Tzachev<sup>2</sup>.</p> <p>1 Orthopaedic Surgery, Tokuda Hospital, Sofia, Bulgaria, 2 Orthopaedic Trauma, Military Hospital, Sofia, Bulgaria</p>	L-T2.3
	<p><b>The treatment of the long bone non-unions with intramedullary nail.</b></p> <p>N. Saglam, <u>T. Kurtulmus</u>, G. Saka, E. Demirel, M. Imam, F. Akpinar.</p> <p>Orthopaedics and Traumatology, Umraniye Education and Research Hospital, Istanbul, Turkey</p>	L-T2.4
	<p><b>The long telegraph nail for humeral shaft fractures – how to avoid non-union.</b></p> <p><u>C. Cuny</u>, M'B. Irrazi, A. Berrichi, N. Ionescu, P.-Y. Le Coadou, P. Beau.</p> <p>Department of Orthopaedics, CHR Metz-Thionville, Metz, France</p>	L-T2.5
12.00 - 12.10	<p><b>Discussion</b></p>	
	<p><b>The treatment of adult forearm non-unions with modified Nicoll's Technique and newly designed Ulna-A and Radius-A Nails.</b></p> <p>N. Saglam, G. Saka, <u>T. Kurtulmus</u>, U. Bakir, B. Kibar, F. Akpinar.</p> <p>Department of Orthopaedics and Traumatology, Umraniye Education and Research Hospital, Istanbul, Turkey</p>	R-T2.1
12.15 - 12.35	<p><b>Key-note lecture: Nailing in reconstructive surgery and non-unions</b></p> <p>P. V. Giannoudis</p>	
12.35 - 14.30	<p><b>Lunch Break, Lunch Workshops:</b></p> <ul style="list-style-type: none"> <li>- How to do best tibial nailing</li> <li>- How to do best calcaneal nailing</li> </ul>	

# SCIENTIFIC PROGRAMME

14.30 - 15.50	<b>New Concepts</b> Chairmen: T. Mittlmeier, M. Wich	T3
	<b>Development of the telegraph nail for proximal humeral fractures.</b> <u>C. Cuny</u> <sup>1</sup> , T. Goetzmann <sup>1</sup> , M'B. Irrazi <sup>1</sup> , A. Berrichi <sup>1</sup> , D. Dedome <sup>1</sup> , D. Mainard <sup>2</sup> . 1 Department of Orthopaedics, CHR Metz-Thionville, Metz, France, 2 Department of Orthopaedics, CHU de Nancy, Nancy, France	L-T3.1
	<b>Morphological analysis of a novel poly-axial intramedullary nailing concept for the treatment of proximal humerus fractures.</b> <u>S. Döbele</u> <sup>1</sup> , S. Eichhorn <sup>2</sup> , A. Lenich <sup>3</sup> , O. M. Trapp <sup>4</sup> , U. Schreiber <sup>2</sup> , U. Stöckle <sup>1</sup> . 1 BG Trauma Center Tübingen, Tübingen, Germany, 2 University of Applied Science, Munich, Germany, 3 Clinic for Trauma Surgery, Klinikum rechts der Isar, Technische Universität München, Munich, Germany, 4 BG Trauma Center Murnau, Murnau, Germany	L-T3.2
	<b>Press-on interlocking – a new concept of fracture near fixation leads to early callus mineralization. An experimental study.</b> <u>G. Gradl</u> , P. Herlyn, J. Emmrich, U. Friebe, T. Mittlmeier. Department for Trauma and Reconstructive Surgery, University of Rostock, Rostock, Germany	L-T3.3
	<b>Evaluation of an innovative combined magnetic and manual targeting device for distal locking of intramedullary nails.</b> <u>L. L. Negrin</u> , V. Vécsei. Department of Trauma Surgery, Medical University of Vienna, Himgberg/Vienna, Austria	L-T3.4
15.00 - 15.10	<b>Discussion</b>	
	<b>Early clinical outcomes of a new and different designed detection method: Applying minimal invasiveness, allowing sliding compression and effective antirrotator in adult collum femoris fractures.</b> G. Saka, <u>T. Kurtulmus</u> , N. Saglam, S. Yeniocak, Z. Yalcin, F. Akpınar. Department of Orthopaedics, Umranlye Training and Research Hospital, Istanbul, Turkey	R-T3.1
	<b>Percutaneous and minimally invasive screw fixation of acetabular fractures with 3D-fluoroscopy-based navigation.</b> <u>P. Schwabe</u> , N. Haas, S. Maerdian, C. Druschel, K. Schaser. Centre for Musculoskeletal Surgery, Charité - University Medicine Berlin, Berlin, Germany	R-T3.2
	<b>The use of intraarticular semi-extended technique for treatment of tibial fractures.</b> C. Herren, <u>M. Graf</u> . Medizinisches Zentrum Städte Region Aachen GmbH, Klinik für Unfall-, Hand- und Wiederherstellungschirurgie, Würselen, Germany	R-T3.3
	<b>The PolyAxNail; Development and evaluation of a novel poly-axial and angle-stable intramedullary nailing concept for the proximal humerus.</b> <u>A. Lenich</u> <sup>1</sup> , U. Schreiber <sup>2</sup> , S. Eichhorn <sup>1</sup> , S. Döbele <sup>3</sup> , R. Burgkart <sup>1</sup> , A. Imhoff <sup>1</sup> . 1 Orthopaedics, Klinikum rechts der Isar, Technische Universität München, Munich, Germany, 2 University of Applied Science, Munich, Germany, 3 BG Trauma Center Tübingen, Tübingen, Germany	R-T3.4
15.30 - 15.50	<b>Key-note lecture: Revolutionary technologies and their clinical impact. From K nails to Glue.</b> P. Procter	
15.50 - 16.20	<b>Coffee Break</b>	
16.20 - 18.10	<b>Nailing of the tibia</b> Chairmen: P. Rommens, C. Josten, K.-H. Frosch	T4

# SCIENTIFIC PROGRAMME

	<p><b>Long-term stability of angle-stable versus conventional locked intramedullary nails in a distal tibia fracture model.</b> L-T4.1</p> <p>D. Wähnert<sup>1</sup>, Y. Stolarczyk<sup>2</sup>, T. Mückley<sup>2</sup>, G. Hofmann<sup>2</sup>, C. Kösters<sup>1</sup>, M. Raschke<sup>1</sup>.</p> <p>1 Trauma, Hand and Reconstructive Surgery, University Hospital Münster, Münster, Germany, 2 Trauma, Hand and Reconstructive Surgery, University Hospital Jena, Jena, Germany</p>
	<p><b>Treatment of tibia fractures with unreamed and reamed intramedullary nailing in adults.</b> L-T4.2</p> <p><u>T. Kurtulmus</u>, N. Saglam, G. Saka, U. Ozturk, M. Imam, F. Akpinar.</p> <p>Department of Orthopaedics and Traumatology, Umraniye Education and Research Hospital, Istanbul, Turkey</p>
	<p><b>Nailing for pilon fractures in disadvantaged patients.</b> L-T4.3</p> <p><u>B. Hartley</u>, L. Douglas, D. Seligson.</p> <p>Department of Orthopaedics, University of Louisville Hospital, Louisville, USA</p>
	<p><b>Angle-stable versus conventional distal tibia nail locking screws – a biomechanical study on fatigue performance.</b> L-T4.4</p> <p><u>M. Lenz</u><sup>1</sup>, B. Gueorguiev<sup>1</sup>, R. G. Richards<sup>1</sup>, G. O. Hofmann<sup>2</sup>, D. Höntzsch<sup>3</sup>, M. Windolf<sup>1</sup>.</p> <p>1 AO Research Institute Davos, AO Foundation, Davos, Switzerland, 2 Department of Traumatology, Hand and Reconstructive Surgery, Friedrich-Schiller-University Jena, Jena, Germany, 3 Department of Medical Technology Development, BG Trauma Hospital Tübingen, Tübingen, Germany</p>
	<p><b>Prevalence and risk factors of reinterventions following reamed intramedullary tibia nailing.</b> L-T4.5</p> <p><u>P. Z. Stavrou</u>, S. Theocharakis, S. Gudipati, V. Ciriello, N. Kanakaris, P. V. Giannoudis.</p> <p>Academic Department of Trauma &amp; Orthopaedics, Leeds General Infirmary, Leeds, United Kingdom</p>
17.00 - 17.10	<p><b>Discussion</b></p>
	<p><b>Treatment of tibia fractures with titanium elastic intramedullary nail in children.</b> R-T4.1</p> <p><u>T. Kurtulmus</u>, N. Saglam, G. Saka, S. Yeniocak, M. Abughalwa, F. Akpinar.</p> <p>Department of Orthopaedics and Traumatology, Umraniye Education and Research Hospital, Istanbul, Turkey</p>
	<p><b>Infection in tibial fractures treated with I.N.</b> R-T4.2</p> <p><u>M. Savvidis</u>, T. Michail, I. Bisbinas, I. Theodoroudis, G. Gkouvas.</p> <p>A' Orth. Department, 424 Gen. Military Hospital, Thessaloniki, Greece</p>
	<p><b>Tibial head fractures: results after angular stable plate osteosynthesis.</b> R-T4.3</p> <p><u>S. Märdian</u>, M. Hufeland, M. Dahne, P. Schwabe, N. Haas, K.-D. Schaser.</p> <p>Centre for Musculoskeletal, Charité - University Medicine Berlin, Berlin, Germany</p>
	<p><b>A tibia nail for human identification – a local forensic case.</b> R-T4.4</p> <p><u>A. Dietze</u><sup>1</sup>, J. Manhart<sup>2</sup>, A. Büttner<sup>2</sup>.</p> <p>1 Department for Trauma and Reconstructive Surgery, University of Rostock, Rostock, Germany, 2 Forensic Pathology, University of Rostock, Rostock, Germany</p>
17.30 - 18.10	<p><b>Key-note lecture: How to do the best distal tibial nailing</b></p> <p>P. Rommens</p>
	<p><b>Key-note lecture: How to do the best proximal tibial nailing</b></p> <p>K.-H. Frosch</p>
19.30 - 20.15	<p><b>Opening Ceremony</b></p> <p>H.-W. Stedtfeld, C. Josten, G. Gradl, T. Mittlmeier</p>
	<p><b>Special lecture: Who was Müller-Meernach?</b> EX-T2</p> <p><u>D. Seligson</u><sup>1</sup>, L. Douglas<sup>1</sup>, L. Negrin<sup>2</sup>.</p> <p>1 Department of Orthopaedics, University of Louisville Hospital, Louisville, USA, 2 Unfallchirurgie, AKH, Wien, Austria</p>
20.15	<p><b>Welcome Reception</b></p> <p>Radisson BW Hotel</p>

# SCIENTIFIC PROGRAMME

FRIDAY, 21 SEPTEMBER 2012

9.00 - 10.15

## Nailing of the humerus

F1

Chairman: M. Savvidis, H.-W. Stedtfeld, R. Haase

### Experimental examination of factors influencing the deformation cut out risk in locked nail osteosynthesis of proximal humerus fractures. L-F1.1

W. Friedl<sup>1</sup>, M. Rinner<sup>2</sup>.

<sup>1</sup> Klinikum Aschaffenburg, Aschaffenburg, Germany, <sup>2</sup> Plus Orthopaedics Aarau, Aarau, Switzerland

### Biomechanical evaluation of locking plate fixation of proximal humeral fractures augmented with calcium phosphate cement. L-F1.2

G. Gradl<sup>1</sup>, M. Knobe<sup>1</sup>, M. Stoffel<sup>2</sup>, A. Prescher<sup>3</sup>, T. Dirrichs<sup>4</sup>, H.-C. Pape<sup>1</sup>.

<sup>1</sup> Department for Trauma Surgery, University Hospital Aachen, Aachen, Germany, <sup>2</sup> Institute of General Mechanics, University of Aachen, Aachen, Germany, <sup>3</sup> Institute of molecular and cellular anatomy, University Hospital Aachen, Aachen, Germany, <sup>4</sup> Department for Diagnostic and Interventional Radiology, University Hospital Aachen, Aachen, Germany

### Operative treatment of humeral shaft fractures with an antegrade locking nail (Targon PH Long, Fa. Aesculap). A retrospective study – preliminary results. L-F1.3

A. Dietze, A. Strübing, H.-W. Stedtfeld, T. Mittlmeier.

Department for Trauma and Reconstructive Surgery, University of Rostock, Rostock, Germany

### Complications after interlocked intramedullary nailing of the humeral shaft fractures. L-F1.4

A. Baltov.

Department of Orthopaedics and Traumatology, Military Medical Academy, Sofia, Bulgaria

9.30 - 9.40

## Discussion

### Proximal humeral fractures: Discrepancies between a predetermined clinical pathway and the actual clinical decision. R-F1.1

J. Weber, J. Westphal, M. Schoen.

Department of Trauma, Orthopaedic and Hand Surgery, Klinikum Südstadt, Rostock, Germany

### Antegrade nailing in the distal third humeral fractures. R-F1.2

A. N. Chelnokov, A. Bazhenov.

Orthopaedic Trauma, Ural Scientific Institute of Traumatology and Orthopaedics, Ekaterinburg, Russia

### An innovative technique for entry hole creation in retrograde humeral nailing. R-F1.3

R. Biber<sup>1</sup>, H.-J. Bail<sup>1</sup>, B. Zirngibl<sup>1</sup>, H.-W. Stedtfeld<sup>2</sup>.

<sup>1</sup> Department for Trauma and Orthopaedic Surgery, Klinikum Nürnberg, Nürnberg, Germany, <sup>2</sup> Department for Trauma and Reconstructive Surgery, University of Rostock, Rostock, Germany

9.55 - 10.15

### Key-note lecture: Twelve years of antegrade proximal humeral nailing – a résumé.

H.-W. Stedtfeld

10.15 - 10.45

## Coffee Break

10.45 - 11.45

## Fracture fixation for implant associated fractures and how to avoid complications F2

Chairmen: H. Tarutis, L. Großterlinden

### The Periprosthetic Fracture Plus: What they didn't teach you in Vancouver. L-F2.1

L. Douglas, B. Hartley, D. Seligson.

Department of Orthopaedics, University of Louisville Hospital, Louisville, USA

# SCIENTIFIC PROGRAMME

	<p><b>Periprosthetic fractures after TKA: management and results.</b></p> <p><u>S. Märdian</u>, P. Schwabe, M. Dahne, G. Matziolis, N. Haas, K.-D. Schaser. Centre for Musculoskeletal Surgery, Charité - University Medicine Berlin, Berlin, Germany</p>	L-F2.2
	<p><b>Fracture Fixation around intramedullary implants – a biomechanical study on different cerclage looping techniques.</b></p> <p><u>M. Lenz</u><sup>1</sup>, S. M. Perren<sup>1</sup>, B. Gueorguiev<sup>1</sup>, R. G. Richards<sup>1</sup>, G. O. Hofmann<sup>2</sup>, M. Windolf<sup>1</sup>. 1 AO Research Institute Davos, AO Foundation, Davos, Switzerland, 2 Department of Traumatology, Hand and Reconstructive Surgery, Friedrich-Schiller-University Jena, Jena, Germany</p>	L-F2.3
11.10 - 11.20	<b>Discussion</b>	
	<p><b>Periprosthetic fracture after MIPO for femoral stress fracture at tracker of computer-navigated total knee replacement.</b></p> <p>K. S. R. K. Prasad, K. K. Karras, R. Kumar, A. Sharma. Prince Charles Hospital, Merthyr Tydfil, United Kingdom</p>	R-F2.1
11.25 - 11.45	<p><b>Key-note lecture: Intramedullary nailing for treatment of complications</b></p> <p><u>H. Tarutis</u>, M. Bendala, F. Remmler. Klinik für Unfallchirurgie und Orthopädie, Klinikum Spandau, Spandau, Germany</p>	KN-F2
11.45 - 11.55	<b>Break</b>	
11.55 - 12.35	<p><b>Nailing of the femur, session I femur shaft</b></p> <p>Chairman: K. Aktuglu, P. Rommens, K.-K. Dittel</p>	F3
	<p><b>The intramedullary nailing of adult femoral shaft fracture by the way of open reduction is a disadvantage or not?</b></p> <p><u>H. Burc</u>, T. Atay, D. Demirci, Y. B. Baykal, V. Kirdemir, H. Yorgancigil. Department of Orthopaedics and Traumatologie, Suleyman Demirel University, Medical School, Isparta, Turkey</p>	L-F3.1
	<p><b>Factors affecting the closed reduction of diaphyseal fractures of the femur.</b></p> <p>Y. A. Kati<sup>1</sup>, <u>A. O. Yildirim</u><sup>2</sup>, O. F. Oken<sup>2</sup>, A. Ucaner<sup>2</sup>. 1 Department for Orthopaedics and Traumatology, Can State Hospital, Canakkale, Turkey, 2 Ankara Numune Training and Research Hospital, Ankara, Turkey</p>	L-F3.2
	<p><b>The patellofemoral kinematics following locked intramedullary nailing treatment for femur shaft fracture.</b></p> <p>A. O. Yildirim<sup>1</sup>, <u>E. Aksahin</u><sup>1</sup>, Y. A. Kati<sup>1</sup>, B. Sakman<sup>2</sup>, A. Ucaner<sup>1</sup>, A. Bicimoglu<sup>1</sup>. 1 Orthopaedics and Traumatology, Numune Education and Research Hospital, Ankara, Turkey, 2 Radiology Clinic, Numune Education and Research Hospital, Ankara, Turkey</p>	L-F3.3
	<p><b>Treatment of femoral shaft fractures with interlocking intramedullary nailing in adults.</b></p> <p>N. Saglam, <u>T. Kurtulmus</u>, G. Saka, M. Imam, M. Abughalwa, F. Akpınar. Department of Orthopaedics and Traumatology, Umraniye Education and Research Hospital, Istanbul, Turkey</p>	L-F3.4
12.25 - 12.35	<b>Discussion</b>	
12.35 - 14.30	<p><b>Lunch Break, Lunch Workshops:</b></p> <ul style="list-style-type: none"> <li>- How to do best proximal humeral nailing</li> <li>- How to do best femoral nailing</li> </ul>	

# SCIENTIFIC PROGRAMME

14.30 - 15.50	<b>Nailing of the femur, session II proximal femur</b> Chairmen: M. Brax, M. Kloub, J.P.A.M. Verbruggen	F4
	<b>Clinical and functional outcomes of internal fixation with intertrochanteric antegrade nail in older patients with proximal extracapsular femoral fractures: a case series.</b> M. Galli <sup>1</sup> , L. Bocchino <sup>1</sup> , <u>V. Ciriello</u> <sup>2</sup> , P. Z. Stavrou <sup>2</sup> , E. Marzetti <sup>1</sup> . 1 Department of Trauma and Orthopaedic Surgery, University Cattolica del Sacro Cuore, Rome, Italy, 2 Department of Trauma and Orthopaedic Surgery, University of Leeds, Leeds, England	L-F4.1
	<b>Internal fixation of intracapsular hip fractures with a new dynamic locking plate Targon FN®.</b> Y. Chammai, <u>M. Brax</u> , N. Robial, D. Borcos, D. Mochel. Traumatology and Orthopaedic Surgery, Hospital of Haguenau, Haguenau, France	L-F4.2
	<b>“Japanese finger” type – rare pertrochanteric fractures.</b> <u>N. Tzachev</u> <sup>1</sup> , A. Baltov <sup>1</sup> , D. Kostov <sup>1</sup> , I. Gerov <sup>2</sup> , A. Iotov <sup>1</sup> . 1 Department of Orthopaedic and Trauma, Military Hospital, Sofia, Bulgaria, 2 Department of Orthopaedic and Trauma, Tokuda Hospital, Sofia, Bulgaria	L-F4.3
	<b>Retrospective analysis of total hip arthroplasty for displaced, intracapsular neck of femur fractures, in a tertiary referral centre.</b> <u>Z. Gamie</u> , J. Neale, D. Shields, J. Claydon, S. Hazarika, A. Gray. Department of Trauma and Orthopaedic Surgery, Royal Victoria Infirmary, Newcastle upon Tyne, United Kingdom	L-F4.4
15.00 - 15.10	<b>Discussion</b>	
	<b>The Trigen® intertan nail (Smith&amp;Nephew Co.) for treatment of proximal femoral fractures.</b> C. Herren, <u>M. Graf</u> . Medizinisches Zentrum Städte Region Aachen GmbH, Klinik für Unfall-, Hand- und Wiederherstellungschirurgie, Würselen, Germany	R-F4.1
	<b>Proximal femoral nailing with continuous manual traction.</b> N. Saglam, <u>T. Kurtulmus</u> , G. Saka, B. Kibar, U. Ozturk, F. Akpinar. Department of Orthopaedics and Traumatology, Umraniye Education and Research Hospital, Istanbul, Turkey	R-F4.2
	<b>Neck of femur fractures in patients aged over 85 years – are they a unique subset?</b> <u>A. Moon</u> , A. Grey, D. Deehan. Orthopaedic Trauma Unit, Newcastle upon Tyne Hospitals, Newcastle upon Tyne England	R-F4.3
	<b>The effectiveness of a distal target device in the use of long gamma nail.</b> S. Paraschou*, <u>M. Savvidis</u> *, G. Chatziliadis, G. Gkouvas, A. Karanikolas. A'Orth. Department, Kilkis General Hospital, Kilkis/Thessaloniki, Greece	R-F4.4
15.30 - 15.50	<b>Key-note lecture: How to do the best proximal femoral nailing.</b> M. Kloub	
15.50 - 16.20	<b>Coffee Break</b>	
16.20 - 17.40	<b>Session III hints, pitfalls and complication management in proximal femur nailing</b> Chairmen: R. Zura, W. Friedl, G. Gradl	F5
	<b>Complications and techniques of proximal femoral fractures with the TARGON® PF.</b> <u>N. Takigawa</u> , H. Moriuchi, M. Abe, K. Yasui, H. Eshiro, M. Kinoshita. Orthopaedics, Nishinomiya Kyoritsu Neurosurgical Hospital, Nishinomiya, Japan	L-F5.1
	<b>Failure of proximal femur fractures after intramedullary stabilisation with Gamma 3 nail, a retrospective analysis.</b> P. Haar. Zentrum für Orthopädie/Unfall- und Handchirurgie, Klinikum Südstadt, Rostock, Germany	L-F5.2



# SCIENTIFIC PROGRAMME

	<p><b>Femoral neck collapse after internal fixation of intracapsular hip fractures.</b></p> <p>M. Parker. Orthopaedic Department, Peterborough City Hospital, Peterborough, United Kingdom</p>	L-F5.3
	<p><b>Z-effect after intramedullary nailing systems for trochanteric femur fractures.</b></p> <p><u>S. J. M. Smeets</u>, G. Kuijt, P. van Eerten. Department of Surgery, Maxima Medical Centre, Veldhofen, The Netherlands</p>	L-F5.4
	<p><b>Lateral cortical notching in specific cases of delayed unions or non-unions after intertrochanteric and reversed fractures.</b></p> <p><u>H.-W. Stedtfeld</u><sup>1</sup>, H. J. Bail<sup>2</sup>, R. Biber<sup>2</sup>. 1 Department for Trauma and Reconstructive Surgery, University of Rostock, Rostock, Germany, 2 Department for Trauma and Orthopaedic Surgery, Klinikum Nürnberg, Nürnberg, Germany</p>	L-F5.5
17.00 - 17.10	<b>Discussion</b>	
	<p><b>Is proximal femoral nailing a good procedure for teaching in orthogeriatrics?</b></p> <p><u>R. Biber</u><sup>1</sup>, S. Grüniger<sup>1</sup>, K. Singler<sup>2</sup>, C. Sieber<sup>2</sup>, H.-J. Bail<sup>1</sup>. 1 Department for Trauma and Orthopaedic Surgery, Klinikum Nürnberg, Nürnberg, Germany, 2 Department for Geriatrics, Klinikum Nürnberg, Nürnberg, Germany</p>	R-F5.1
	<p><b>Rotation instability and micromovements are independent prognostic factors for the failure rate of dislocated medial femur neck fractures.</b></p> <p><u>W. Friedl</u><sup>1</sup>, P. Stürzenhofecker<sup>2</sup>. 1 Klinikum Aschaffenburg, Aschaffenburg, Germany, 2 University of Würzburg, Würzburg, Germany</p>	R-F5.2
17.20 - 17.40	<p><b>Key-note lecture: Cutting out. A main problem in the management of trochanteric fractures. Experimental and clinical examination.</b></p> <p>W. Friedl. Klinikum Aschaffenburg, Aschaffenburg, Germany</p>	KN-F5
17.40 - 17.50	<b>Break</b>	
17.50 - 18.30	<b>Perioperative management</b>	F6
	<p>Chairmen: D. Seligson, W. Lehmann</p>	
	<p><b>Death by trauma 2010: Mortality and trauma mechanisms in Berlin, Germany.</b></p> <p>C. Kleber<sup>1</sup>, <u>M. Giesecke</u><sup>1</sup>, C. T. Buschmann<sup>2</sup>, M. Tsokos<sup>2</sup>, N. P. Haas<sup>1</sup>. 1 Centre for Musculoskeletal Surgery, Charité-Universitätsmedizin, Berlin, Germany, 2 Institute for Legal Medicine and Forensic Science, Charité-Universitätsmedizin, Berlin, Germany</p>	L-F6.1
	<p><b>Injury, opioids and incarceration.</b></p> <p>D. Preston. Psychiatry, Centre for Cognitive Therapy, Louisville, USA</p>	L-F6.2
	<p><b>Relationship between pre-fracture characteristics and perioperative complications in the elderly hip fracture patient, predictors of LOS.</b></p> <p>R. Zura. Orthopaedics Department, Duke, Durham, USA</p>	L-F6.3
18.15 - 18.25	<b>Discussion</b>	
	<p><b>The effects of blood transfusion on perioperative complications and survival after hip fracture surgery.</b></p> <p><u>S. J. M. Smeets</u><sup>1</sup>, M. Poeze<sup>2</sup>, J. P. A. M. Verbruggen<sup>2</sup>. 1 Department of Surgery, Maxima Medical Centre, Veldhofen, The Netherlands, 2 Department of Surgery, Maastricht University Medical Centre, Maastricht, The Netherlands</p>	R-F6.1
18.30 - 19.15	<b>General Assembly</b>	
20.30	<b>Gala Dinner at Bar &amp; Restaurant Silo 4</b>	

# SCIENTIFIC PROGRAMME

SATURDAY, 22 SEPTEMBER 2012

9.00 - 10.20

## Nailing for forearm and hand fractures

S1

Chairmen: K. Aktuglu , H.-J. Bail, G. Saka, V. Dubrov

### The treatment of adult isolated radius/Ulna diaphysis fractures with intramedullary radius A/Ulna A nail. L-S1.1

G. Saka, T. Kurtulmus, N. Saglam, M. Ugurlar, U. Ozturk, U. Bakir, C. Ozer, F. Akpinar.

Department of Orthopaedics, Umraniye Training and Research Hospital, Istanbul, Turkey

### Operative treatment of the greater and lesser arc wrist injuries. L-S1.2

R. Pavic<sup>1</sup>, P. Margetic<sup>2</sup>, M. Malovic<sup>1</sup>.

1 Department of Hand Surgery, University Clinic of Traumatologie, Zagreb, Croatia, 2 Department of Radiology, University Clinic of Traumatologie Zagreb, Croatia

### Intramedullary fixation of intra-articular distal radius fractures – first results for the Targon DR L-S1.3

S.S.I. Falk, N. Mielsch, M. Wendt, T. Mittlmeier, P. Gierer, G. Gradl.

Department for Trauma and Reconstructive Surgery, University of Rostock, Rostock, Germany

### Angle-stable plate or angle-stable locked nail fixation in distal radius fractures. An experimental examination and phase in clinical study. L-S1.4

W. Friedl<sup>1</sup>, M. Rinner<sup>2</sup>, M. Simnacher<sup>2</sup>, C. Mathieu<sup>2</sup>.

1 Klinikum Aschaffenburg, Aschaffenburg, Germany, 2 Smith&Nephew, Switzerland

9.30 - 9.40

## Discussion

### Long-term functional and radiological results of distal radius fractures after treatment with the Locking Compression Plate. R-S1.1

S. Tsitsilonis, D. Machó, K.-D. Schaser, N. P. Haas, F. Wichlas.

Clinic for Trauma and Reconstructive Surgery, Centre for Musculoskeletal Surgery, Charité - University Medicine Berlin, Berlin, Germany

### Long-term outcome of operative treatment of olecranon fractures with the use of the Locking Compression Plate: clinical results and quality of life 4 years postoperatively. R-S1.2

F.-M. Hahn, S. Tsitsilonis, K.-D. Schaser, N. P. Haas, F. Wichlas.

Clinic for Trauma and Reconstructive Surgery, Centre for Musculoskeletal Surgery, Charité - University Medicine, Berlin, Germany

### Prospective evaluation of complex olecranon fractures. Osteosynthesis with the XS nail. R-S1.3

W. Friedl<sup>1</sup>, J. Gehr<sup>2</sup>.

1 Klinikum Aschaffenburg, Aschaffenburg, Germany, 2 University of Würzburg, Würzburg, Germany

### Distal radius fractures: volar vs. dorsal plating. R-S1.4

D. Machó, S. Tsitsilonis, K.-D. Schaser, N. P. Haas, F. Wichlas.

Clinic for trauma and reconstructive surgery, Centre for Musculoskeletal Surgery, Charité - University Medicine Berlin, Berlin Germany

10.00 - 10.20

## Key-note lecture: Nailing for forearm and hand fractures

G. Saka, V. Dubrov

10.20 - 10.50

## Coffee Break

# SCIENTIFIC PROGRAMME

10.50 - 11.50	<b>Experimental Forum</b> Chairmen: B. Müller-Hilke, A. N. Chelnokov	S2
	<b>Micro-CT and osteodensitometry in osteoporotic bone: Who is right?</b> P. Herlyn <sup>1</sup> , <u>N. Cornelius</u> <sup>1</sup> , D. Haffner <sup>2</sup> , C. Kasch <sup>3</sup> , T. Mittlmeier <sup>1</sup> , D.-C. Fischer <sup>4</sup> . 1 Department of Traumatology and Reconstructive Surgery, University of Rostock, Rostock, Germany, 2 Clinic for Paediatric Kidney, Liver and Metabolic Diseases, Hannover Medical School, Hannover, Germany, 3 Department of Orthopaedics, University of Rostock, Rostock, Germany, 4 Department of Paediatrics, University of Rostock, Rostock, Germany	R-S2.1
	<b>CRPS: Early decompression treatment in a rat model.</b> <u>A. Schiebold</u> <sup>1</sup> , G. Gradl <sup>1</sup> , T. Mittlmeier <sup>1</sup> , B. Vollmar <sup>2</sup> , P. Herlyn <sup>1</sup> . 1 Department for Trauma and Reconstructive Surgery, University of Rostock, Rostock, Germany, 2 Institute for Experimental Surgery, University of Rostock, Rostock, Germany	R-S2.2
	<b>CRPS: The role of minimal nerve injury in a rat model.</b> <u>Z. Wang</u> <sup>1</sup> , G. Gradl <sup>2</sup> , T. Mittlmeier <sup>2</sup> , B. Vollmar <sup>1</sup> , P. Herlyn <sup>2</sup> . 1 Institute for Experimental Surgery, University of Rostock, Rostock, Germany, 2 Department of Traumatology and Reconstructive Surgery, University of Rostock, Rostock, Germany	R-S2.3
	<b>The effect of immunonutrition (Glutamine, Alanine) on fracture healing.</b> A. Kucukalp, <u>K. Durak</u> <sup>1</sup> , G. Sonmez <sup>2</sup> , S. Bayyurt <sup>1</sup> , M. S. Bilgen <sup>1</sup> . 1 Department of Orthopaedics and Traumatology, Uludag University Faculty of Medicine, Bursa, Turkey, 2 Department of Pathology, Uludag University Faculty of Medicine, Bursa, Turkey	R-S2.4
	<b>Antithrombin reduces inflammation and microcirculatory perfusion failure in closed soft tissue injury and endotoxemia.</b> <u>P. Gierer</u> <sup>1</sup> , F. Laue <sup>1</sup> , R. Rotter <sup>1</sup> , G. Gradl <sup>1</sup> , T. Mittlmeier <sup>1</sup> , B. Vollmar <sup>2</sup> . 1 Department of Trauma & Reconstructive Surgery, University of Rostock, Rostock, Germany, 2 Institute for Experimental Surgery, University of Rostock, Rostock, Germany	R-S2.5
	<b>Type II diabetes mellitus does not degrade skeletal muscle regeneration following severe soft tissue trauma in rat.</b> <u>R. Rotter</u> <sup>1</sup> , B. Schopp <sup>1</sup> , I. Stratos <sup>1</sup> , P. Gierer <sup>1</sup> , B. Vollmar <sup>2</sup> , T. Mittlmeier <sup>1</sup> . 1 Department of Trauma and Reconstructive Surgery, University Rostock, Rostock, Germany, 2 Institute for Experimental Surgery, University Rostock, Rostock, Germany	R-S2.6
	<b>Inhibition of caspase mediated apoptosis restores muscle function after crush injury in rat skeletal muscle.</b> <u>I. Stratos</u> <sup>1</sup> , Z. Li <sup>1</sup> , R. Rotter <sup>2</sup> , P. Herlyn <sup>2</sup> , T. Mittlmeier <sup>2</sup> , B. Vollmar <sup>2</sup> . 1 Institute of Experimental Surgery, University of Rostock, Rostock, Germany, 2 Department for Trauma and Reconstructive Surgery, University of Rostock, Rostock, Germany	R-S2.7
11.20 - 11.30	<b>Discussion</b>	
11.30 - 11.50	<b>Key-note lecture: Nailing in experimental settings</b> G. Gradl, A. Lenich	
11.50 - 12.00	<b>Break</b>	

# SCIENTIFIC PROGRAMME



12.00 - 12.50	<b>Varia</b> Chairmen: M. Kloub, P. Gierer	S3
	<b>Intramedullary stabilization of dislocated midclavicular fractures with Rockwood Pin.</b> L. Pohl, <u>K. AlMachout</u> , D. Kunzmann, F. Hoffmann. Traumatology, Klinikum Frankfurt (Oder), Frankfurt (Oder), Germany	L-S3.1
	<b>The angular-stable transiliac lumbopelvic fixation in unstable sacral and pelvic fractures.</b> <u>G. Müller</u> , J. Madert, K.-H. Frosch. Centre for Surgery and Traumatology, Asklepiosclinic St. Georg – Hamburg, Hamburg, Germany	L-S3.3
	<b>Retrospective analysis of the oncosurgical management of bone metastases of the upper extremity.</b> <u>P. Schwabe</u> , I. Melcher, C. Teichler, S. Maerdian, N. Haas, K. Schaser. Centre for Musculoskeletal Surgery, Charité - University Medicine Berlin, Berlin, Germany	L-S3.4
	<b>Treatment of sternum fractures.</b> <u>L. Lindemann-Sperfeld</u> <sup>1</sup> , M. Steinert <sup>2</sup> . 1 Department for Trauma and Reconstructive Surgery, Krankenhaus Martha-Maria Halle-Dörlau, Akademisches Lehrkrankenhaus der Martin-Luther-Universität Halle-Wittenberg, Dörlau, Germany. 2 Department for Thoracic Surgery, Akademisches Lehrkrankenhaus der Martin-Luther-Universität Halle-Wittenberg, Dörlau, Germany.	L-S3.5
12.30 - 12.40	<b>Discussion</b>	
	<b>Influence of the pathogen spectrum after traumatic amputations and type III C open fractures on the initial antibiotic therapy.</b> <u>M. Giesecke</u> <sup>1</sup> , C. Kleber <sup>1</sup> , C. A. Becker <sup>1</sup> , R. A. Schiller <sup>2</sup> , N. P. Haas <sup>1</sup> , K. D. Schaser <sup>1</sup> . 1 Centre for Musculoskeletal Surgery, Charité - Universitätsmedizin, Berlin, Germany, 2 Department of Microbiology, Charité - Universitätsmedizin, Berlin, Germany	R-S3.1
12.50 - 13.00	<b>Break</b>	
13.00 - 13.20	<b>Award Ceremony and closing remarks</b>	
13:20 - 14:20	<b>Packed Lunches</b>	



## THURSDAY, 20 SEPTEMBER 2012

9.20–10.50

### T1. Nailing around the foot

Chairs: H. Zwipp, P. Simon

#### L-T1.1

#### Locking nailing for displaced articular fractures of the calcaneus: an innovative procedure with the Calcanail®

P. Simon<sup>1</sup>, M. Goldzak<sup>2</sup>. <sup>1</sup>Chirurgie orthopédique et traumatologique, Centre hospitalier St. Joseph St. Luc, Lyon, France; <sup>2</sup>Clinique de l'Union, St. Jean, France

**Introduction:** The best treatment for displaced intra-articular fractures of the calcaneus remains controversial. Open reduction and internal fixation with a lateral plate has been established as the gold standard for twenty years: however rates of 15 to 40% of wound healing problems have been reported. Percutaneous reduction and fixation by isolated screws has been proposed but remains surgery for experts.

Other approaches, tools for achieving reduction such as inflating balloons, specific calcaneal nails have been proposed but none of these solutions are fully satisfactory. This is why we developed a special posterior approach in a safe area for wound healing and a special device (Calcanail) to maintain in a good position depressed articular fragments after reduction.

**Material and Methods:** The series is a prospective series from Toulouse and Lyon trauma units. The implant is available since august 2011. So we performed 15 cases in 13 patients, two of them presented bilateral fractures. We analyzed

- Preoperative CT scan with reformation, type of fracture
- Postoperatively clinical results according to AOFAS scoring system.
- Radiological results based on 3 months postoperative CT scan
- complications

**Results:** Full weight bearing was obtained within 2 or 3 months. The range of movement of the subtalar joint was preserved in all cases. Mean AOFAS score was 87/100.

Boehler angle passed from 0° preoperatively to 28.6° postoperatively. The thalamic index passed from 0.6 to 0.8.

**Discussion:** The mini-invasive posterior approach, the innovative reduction technique and the implant we proposed today reduce significantly surgical trauma and complication risk. Due to this posterior approach peroneal tendons are protected, impingement avoided and subtalar mobility preserved.

As a conclusion, this innovative implant provides decisive advantages:

1. the creation of a working channel which provides also a significant bone autograft
2. the intrafocal reduction of displaced articular surface whatever the surface was intact or broken in the middle
3. the insertion of a locking nail which maintains the reduced articular surface at the right height
4. the possibility to change from an ORIF to a reconstruction arthrodesis with the same approach and instrumentation in case of severely damaged posterior facet.

Our preliminary results are to be confirmed with a largest series and longer follow up.

#### L-T1.2

#### Calcaneal fractures. Biomechanical comparative study comparing plating vs. Calcanail in cadaveric bones

M. Goldzak<sup>1</sup>, M. Chaussemier<sup>2</sup>, R. Chieragatti<sup>2</sup>. <sup>1</sup>Clinique de l'Union, Saint Jean, France; <sup>2</sup>Institut Supérieur de l'Aéronautique et de l'Espace, Toulouse, France

ORIF and plating is the gold standard for the calcaneal fractures management, skin breakdowns are a real concern with a high incidence 14 up to 40%. We propose to compare the biomechanical features of plates fixing a cadaveric fractured calcaneal bone with the mini invasive talo calcaneal cadaveric blocs with calcaneal fracture and repairs by constructs including 5 plates, triangulation classic plates with 3.5 mm cortical screws, calcaneal head blocking screws from the AO Synthès brand and 5 Calcanails FH brand were compared in a biomechanical study made in the INSAE lab of the Toulouse University. Axial and compression stiffness were assessed. We construct with Calcanail, a nailing device. Calcanail device demonstrate either equivalent stiffness than plates in all testing modes under 2000N. Up to 5000N calcanail device is reliable but the AO plate construct remains more efficient. However the compression decompression axial stress shown the same behaviour in cyclic charges of the constructs. The use of calcanail for calcaneal fractures management is reliable in the usual treatment with mini invasive reduction and fixation, the construct stiffness allows a partial weight bearing after 3 weeks with any risk of failure and provides a good stability of the fracture fixation. Plates with head blocking screws had a superior stiffness but the disadvantage of an open procedure reduce their contribution.

#### L-T1.3

#### Closed reduction and percutaneous screw fixation of comminuted calcaneal fractures

F. Ortner. Department of Traumatology, Landeskrankenhaus Wiener Neustadt, Vienna, Austria

**Introduction:** Soft tissue damage limits open reduction of calcaneal fractures. Literature shows a high grade of complications in cases of open reduction and fixation with plates.

**Method:** Distraction of the calcaneus with the special calcaneus distractor regarding to Prof. Fröhlich. Percutaneous reduction of the posterior facette of the subtalar joint, followed by percutaneous fixation with a cannulated small screw. Fixation of length and angulation of the hindfoot with two large screws. Both screws start from the tuber calcanei. One goes to the anterior process and the other to the sustentaculum tali. A short video shows the procedure of the surgery.

**Results:** 25–30 cases per year we treat in this way in our trauma department. Our results in pain, walking ability, form of the hindfoot, rate of subtalar arthrodesis are good up to 75%. This is comparable with the literature in treating calcaneus fractures open or closed. Big difference in results is wound healing. Wound

complication and wound infection in open reduction cases reaches 10–15%. Closed reduction in our hands shows minimal wound and soft tissue complication.

**Conclusion:** With closed reduction and fixation of the calcaneal fractures we reach an equal result in function but we can avoid infection and soft tissue complications.

#### L-T1.4

##### Calcaneal nail ( C-NAIL)

M. Pompach<sup>1</sup>, H. Zwipp<sup>2</sup>, M. Amlang<sup>2</sup>, L. Zilka<sup>3</sup>, M. Carda<sup>1</sup>.

<sup>1</sup>Pardubicka krajska nemocnice, Department of traumatology, Pardubice, Czech Republic; <sup>2</sup>Department of traumatology, Universitätsklinikum Carl Gustav Carus, Dresden, Germany; <sup>3</sup>MEDIN a.s., Nove Mesto Na Morave, Czech Republic

**Introduction:** The authors present the first clinical results in treatment of calcaneal fractures using a newly developed calcaneal nail (C-NAIL). In their presentation the authors describe the clinical study, the indication for the minimal-invasive operation and explain in detail the surgical procedure using this new method.

**Materials and Methods:** In 2011 4 patients with 5 calcaneal fractures were treated in the Department of Traumatology in Pardubice, Czech Republic. This clinical study with the C-NAIL, which was developed as a Czech–German project was used in teamwork for the first 5 patients, all men in average age of 49.2 years (38–64 years). The fractures were classified as Sanders-Type IIA (n=3), Sanders IIB (n=3), Sanders IIIAB (n=3). The underlying principle of the operation is the minimal-invasive fixation of a fractured calcaneus with an interlocking nail which is introduced by stab incision after initial anatomic reduction of the posterior facet. This joint reduction is performed by subtalar arthroscopy or through a lateral 3 cm long inframalleolar incision. After restoring the posterior subtalar joint and Böhler's angle, controlling the result with fluoroscopy especially with a Broden's projection the aiming wire for the nail is drilled below the attachment of the Achilles tendon towards the center of the calcaneocuboid joint. Controlling this K-wire fluoroscopically to be also in the middle axes of the calcaneus it is then overdrilled for introduction of the nail. With the help of the radiolucent arms of the aiming device first the sustentacular fragment is fixed towards the introduced C-Nail by inserting first a K-wire through the signed "sustentacular" guiding arm into the sustentaculum. The second sustentacular screw and then consequently the lateral and two superior screws using the signed "lateral" and "superior" guiding arms are brought in place.

**Results:** Eight weeks after operation all patients were controlled radiologically and with the AOFAS score. The scores achieved to 85–100 points.

**Conclusion:** As a preliminary conclusion we can say that the C-NAIL is a new minimal invasive system which allows high primary stability, early functional after treatment with improved hindfoot motion and which reduces probably the risk of infection by avoiding detachment of soft tissues which is in contrast necessary for an extended Seattle approach and internal plate fixation. Till end of May 28 patients with C-NAIL were operated.

#### L-T1.5

##### Intramedullary medial collum support for Charcot arthropathy – is that sufficient?

A. Eschler, B. Ulmar, T. Mittlmeier, G. Gradl. Department for Trauma and Reconstructive Surgery, University of Rostock, Rostock, Germany

**Introduction:** Charcot arthropathy is most often treated non operatively. However, progressive loss of bone architecture and subsequent soft tissue complications like ulcer on locations where pressure concentrates make operative interventions necessary. We report on a small group of patients with Charcot arthropathy and reconstruction of the collapsed medial column by an intramedullary device.

**Material and Methods:** A total of 8 patients (median age 62 y, range 47–79 y) where enrolled with severe Charcot deformation Eichenholtz II. The medial column was stabilized primarily with an intramedullary rod (midfoot fusion bolt, Synthes) in order to reconstruct foot osseous geometry. The bolt was inserted via the head of MTI and forwarded into the talus.

**Results:** Median operative time was 136 min. Additional stabilisation of the lateral column was necessary in 3 cases. Follow up time averaged 18 months. Five out of 8 patients where reoperated due to soft tissue problems during the first stay. Implant associated problems where seen in 4 out of 8 cases with predominantly loosening of the bolt and consecutive instability. Instability was treated by the addition of angular stable plates. 1 patient had to undergo limb amputation due to ongoing infection.

**Conclusions:** Medial column support in Charcot arthropathy by an intramedullary rod apparently does not provide sufficient stability. Additional fixation using angular stable plates may be necessary or the use of a bolt with an interlocking possibility.

#### L-T1.6

##### Ankle fractures in older patients: the use of augmented fixation techniques

N. Viens, G. Sutter, D. Mangiapani, S. Adams, R. Zura. Orthopedics Department, Duke, Durham, USA

**Introduction:** Ankle fractures are among the most common injuries sustained by older patients. Management of these fractures remains both controversial and challenging. Augmented fixation techniques, including locking plates, tibia-pro-fibula screws, bicortical medial malleolar screws, intramedullary implants, and bone void fillers, have been utilized to improve fixation when bone quality is poor. Clinical outcomes from a series of older patients treated surgically for unstable ankle fractures were reviewed in an attempt to determine if patient or injury specific factors can predict the need for and efficacy of augmented fixation techniques and postoperative complications.

**Materials and Methods:** A retrospective series of 58 consecutive patients age 60 years and older with 63 unstable ankle fractures treated surgically by a single surgeon over a five year period was reviewed. Forty-seven females (81.0%) and 11 males (19.0%) with a mean age of 72.6 (range, 60 to 88.4) years made up the sample. All patients had comorbidities and the mean BMI was 31.4 (range, 19.4 to 59.8) kg/m<sup>2</sup>.

**Results:** The most common injuries were OTA type 44-B2 (66.7%) or Lauge-Hansen supination-external rotation type-4 (76.2%) fractures. Forty-seven (74.6%) fractures were due to a low-energy mechanism. Nineteen (30.6%) injuries were fracture-dislocations and seven (11.1%) fractures were open. Plates were used during fixation in the majority of fractures (92.1%). Trans-syndesmotic screws were used in 19 (30.2%) fractures. Augmented techniques were used in 31 (50.0%) cases overall. External fixation was used in addition to internal fixation in 9 (14.3%) fractures. Ten (17.2%) patients experienced complications: six (10.3%) wound problems, four requiring surgery; 3 five (8.6%) hardware removals, which included two for deep infections and below knee amputations; one (1.7%) non-union. Males and patients with fracture dislocations were significantly more likely to experience complications (p < 0.05). Age and fracture type were not predictive of clinical outcomes or the need for augmented fixation techniques.

**Conclusion:** Open reduction and internal fixation of ankle fractures in older patients is an effective option for the majority of patients. Most patients will experience good outcomes and be able to return to their pre-injury level of function after fracture healing. Further investigations are required in order to find patient and injury factors that can assist preoperative planning for the need for augmented fixation techniques and predict outcomes.



**R-T1.1****Initial experience with the application of ankle arthrodesis nail**

N. Tzachev<sup>1</sup>, A. Baltov<sup>1</sup>, D. Lilyanov<sup>1</sup>, I. Gerov<sup>2</sup>, A. Iotov<sup>1</sup>.

<sup>1</sup>Department of Orthopaedic and Trauma, Military Hospital, Sofia, Bulgaria; <sup>2</sup>Department of Orthopaedic and Trauma, Tokuda Hospital, Sofia, Bulgaria

**Introduction:** In 1986 Jean Martin Charcot describes an unusual hypertrophic destruction of the ankle joint. As of today one third of all diabetics bare the risk of developing the Charcot neuropathic osteoarthropathy. The tibial compartment instability usually has 3 staged progressive collapse: arthrosis of the hind-foot, talar valgisation and medial instability (Myerson et al). The clinical evaluation includes evolution of the pain, soft tissues condition and the neurovascular status.

**Materials and Methods:** Between 2007–2011 (5 years period) we had operated 10 patients (4 male, 6 female), mean age of 57.5 years. Posttraumatic arthrosis was found in 6 cases, 2 had open fractures, 1 had previous screw arthrodesis and 1-diabetic arthropathy. The surgical technique used was as follows: supine position of the patient, transfibular approach, resection of the joint surfaces (distractor can be used as well), the medial malleolus has to be saved (not so only when medial shift exists), the foot must be positioned in 5° of dorsiflexion (neutral) and 5° of valgus (usually the anterior tibial border points towards the second toe).

**Results:** We have achieved arthrodesis in all cases. There were no non-unions, vascular or neurological compromise. We have observed the following mistakes: wrong proximal locking in 1 case and medial malleolus fracture in 1 case.

**Conclusion:** As a final outcome we have achieved pain-free ankle joint. Both the pantallar and tibio-talo-calcaneal arthrodesis have good results and better advantages, compared to the amputation. The IM nail secures the rigidity of the fixation when compared to the crossed screw placement. The postero-anterior positioning of the screws in the calcaneus after direct compression is applied, increases the torsional resistance by 40% (Mann MR, Parks BG, Pak SD, Miller SD). The complication and revision procedures rate is very low as well.

**R-T1.2****A new plate for the treatment of Lisfranc's fracture**

D. Seligson<sup>1</sup>, C. Bowlin, C. Vanlaningham. <sup>1</sup>Department of Orthopedics, University of Louisville Hospital, Louisville, USA

**Introduction:** Lisfranc's tarso-metatarsal fracture dislocation is a tear through the ligament binding the internal cuneiform to the base of the second metatarsal. Even minor injuries in this area are a cause of long-term foot pain, limping, and disability. Actually motion with load in the midfoot is complex and failure of conventional fixation with screws or wires occurs frequently. We have devised a new plate which fixes a plate on the dorsum of the medial column of the midfoot to a screw which runs from the medial surface of the internal cuneiform to the base of the second metatarsal – the 'home run' screw. The advantage of this method is that the locking screw keeps the dorsal portion of the plate in position during fracture healing. The implant is removed at six months. This paper presents our initial experience in six patients using this new angle-stable plating for Lisfranc's fracture.

**Materials and Methods:** This paper presents our initial experience in six patients using this new angle-stable plating for Lisfranc's fracture.

**Results:** All patients have had good to excellent results with long-term follow up.

**Conclusion:** This new plate is a viable treatment option for the treatment of Lisfranc's fracture.

11.20–12.35

**T2. Nailing in reconstructive surgery and non-unions**

Chairs: P. V. Giannoudis, A. Rücker, A. N. Chelnokov

**L-T2.1****Closed nailing in valgus intertrochanteric osteotomy**

A.N. Chelnokov, A. Shalin, A. Bogatkin. *Orthopaedic Trauma, Ural Scientific Institute of Traumatology and Orthopaedics, Ekaterinburg, Russia*

**Introduction:** Non-unions and malunions of the proximal femur can be difficult to manage. Typical pattern of the problem is varus deformity which prevents normal functioning of the affected hip joint and causes leg length discrepancy. Conventional treatment approach includes valgus intertrochanteric osteotomy with lateral wedge removal and plating. The surgery requires incision up to 20cm and may be accompanied with significant blood loss. Closed nailing could be less invasive but a technique for this purpose is not yet introduced. Therefore the aim of our study was development of the technique of closed intramedullary nailing in valgus intertrochanteric osteotomy.

**Materials and Methods:** 11 patients with femoral neck non-unions (3/11), trochanteric non-unions (2/11) and malunions of the proximal femur (6/11) were treated during 2010–2011. The suggested surgical technique included fixator-assisted nailing with the use of a joystick into the head-neck segment. The osteotomy was performed percutaneously. After open wedge correction the final position was fixed by either reconstruction (2/11) or proximal femoral nails (9/11).

**Results:** Varus deformity was corrected in all cases. Low invasiveness and minimal blood loss with high stability of fixation provided rapid functional recovery and short hospital stay. 8/11 patients reached full weight-bearing at 3 month postoperatively. In 10/11 cases union with restoration of length and proper alignment was reached. In 1/11 case total hip replacement was necessary because of avascular necrosis of the femoral head.

**Conclusion:** Mini-access without bone stripping combined with high stability of intramedullary fixation allows not to excise a lateral bone wedge and use open wedge correction. It renders unnecessary hyper-valgisation to gain leg length. Use of opening wedge correction and percutaneous techniques decreases invasiveness and shorten duration of the surgery. Percutaneous intertrochanteric osteotomy with closed fixator-assisted nailing appears to be promising addition to armamentarium of hip reconstructive surgery.

**L-T2.2****The acute correction of deformities of the tibia with tibial nail using the new Monobloc Distal Bolt Locking Screw (MDBLS)**

T. Kurtulmus, N. Saglam, G. Saka, S. Yeniocak, E. Demirel, F. Akpınar. *Department of Orthopedics and Traumatology, Umraniye Education and Research Hospital, Istanbul, Turkey*

**Introduction:** The main purpose of deformity correction in congenital or acquired deformities of the tibia is achieving normal mechanical and anatomical axis, providing painless and functional limb. The result of the newly designed tibia intramedullary nail presented here allows immediate movement after surgery through its stable distal locking with MDBLS system acute correction.

**Materials and Methods:** We present a retrospective review of 5 patients who underwent osteotomy with application of the Monobloc Distal Bolt Locking Screw tibial nail (TST). 5 patients (4 males, 1 female; mean age: of 35.4 range 17 to 57 years). The primary outcome was change in preoperative to postoperative distal and proximal tibial joint orientation angles. No additional fixation, all patients were able to move after surgery. The clinically results were evaluated in AOFAS and Knee Society Score.

**Results:** In all cases, correction was applied mechanical axis reached normal limits by acutely. Complete consolidation was

achieved in all osteotomized segments. Recurrence was not seen in patients. Average follow-up time was 15 months (range 12 to 20 months), healing was 8 weeks (range 9 to 16 weeks). No patients had non-union, deep infection or implant failure.

**Conclusion:** Tibial deformities are treated surgically with different implants. We used tibial nail for its distal locking screw which provides stable locking in all plans achieving maximum resistance against the axial loading, rotation, translation and angulations forces in osteotomy line. The newly designed tibial nail we applied tolerates immediate movement unlike the traditional locking intramedullary tibial nail.

#### L-T2.3a

##### **Long-term results with renailling for non-unions of the femoral shaft**

I. Gerov<sup>1</sup>, N. Tzachev<sup>2</sup>. <sup>1</sup>*Orthopaedic Surgery, Tokuda Hospital, Sofia, Bulgaria;* <sup>2</sup>*Orthopaedic Trauma, Military Hospital, Sofia, Bulgaria*

**Introduction:** The non-union of the femoral shaft is a surprisingly common complication, especially when segmental, comminuted or butterfly fragment fractures are treated. Bone grafting and/or exchange nailing after reaming is the most common procedure to apply. The aim of this study is to stress on the importance of proper surgical technique, precise choice of implant and adequate postoperative protocol.

**Material and Methods:** In 6 years period, 84 femoral shaft fractures were nailed, all unreamed, of which 9 (10.7%) were non-unions 6 months post-op. In 4 (4.7%) cases the implant failed and in 1 (1.5%) a metastasis compromised the synthesis. 6 (7.1%) cases had hypertrophic and 3 oligotrophic (3.6%) non-unions. All patients underwent second procedure with reaming and renailling. The oligotrophic ones had complementary autologous bone grafting. The mechanism of injury, open/closed initial fracture, pattern and location of the fracture, type of non-union, increase in nail diameter, dynamic/static locking of the nail: these were all taken into account in the final assessment (mean follow up 3.5 years, range 1–6 years).

**Results:** All 9 (100%) non-unions were healed in period of 3–5 months after the reoperation and full weight bearing was resumed as soon as the end of the 1 week. Radiographic evaluation of union was determined by the presence of healing on at least three of four cortices. No pain or instability were present either.

**Conclusion:** Exchange reamed nailing is the treatment of choice for most femoral diaphyseal non-unions. Exchange reamed IM nailing and additional bone grafting may comply well when failed implants are to be extracted. Full weight-bearing and active rehabilitation are possible at an early stage.

#### L-T2.3b

##### **1 year later. Follow-up of a previously reported case of polytraumatic young patient with femoral non-union**

I. Gerov, K. Alexieva, S. Stoyanov. *Orthopaedic Surgery, Tokuda Hospital, Sofia, Bulgaria*

**Introduction:** A young doctor sustained a road traffic accident nearly 2 years ago. Initially treated with IM nail for a segmental femoral fracture and forearm comminution, he presented with the nail curved, distal locking screws failed and subsequently with an implant fracture at the site of the hypertrophic non-union.

**Material and Methods:** Exchange – proximally dynamised primarily – nailing was performed after extraction of the metal and simultaneous autologous bone grafting with an iliac crest graft, through the non-union site where the distal fragment was extracted from. The canal was overrimmed and a nail, 3 mm larger than the original one was inserted. Exchange plating and bone grafting was performed for the nonunited ulna as well.

**Results:** Return to work was possible, 3 weeks after the surgery. At the regular radiographic follow-ups the femur seems to heal well and 6 months after the operation three out of four cortices suggest bone union. Unfortunately, the ulnar graft has failed and he

is awaiting another procedure for this problem. Full weight bearing is possible.

**Conclusion:** The exchange reamed nailing with simultaneous bone grafting provided good result in this patient. It can be a standard procedure whenever a failed implant has to be extracted and the non-union site opened.

#### L-T2.4

##### **The treatment of the long bone non-unions with intramedullary nail**

N. Saglam, T. Kurtulmus, G. Saka, E. Demirel, M. Imam, F. Akpınar. *Orthopedics and Traumatology, Umraniye Education and Research Hospital, Istanbul, Turkey*

**Introduction:** Open fracture, loss of bone, surgical technical mistakes, early mobilizing, infection and factors related to patients are main reasons of long-bone non-unions. Ensuring the healing of the anatomically and physiologically damaged bone can be troublesome process for both patients and surgeons.

**Materials and Methods:** Thirty-two patients (19 men, 13 women; mean age 42.8 years; range 15 to 86 years) were operated on for pseudarthrosis that were femur in 10, tibia in 8, humerus in 7, ulna in 5, radius in. All patients had previous surgical treatments, respectively. Preoperatively, none of the patients had infected non-union. Treatment included open reduction and intramedullary nailing combined with autogenous bone grafting. The mean follow-up was 31.1 months (range 12 to 60 months). None of the patients had cast fixation after surgery and all the patients started to do exercises actively.

**Results:** Union was achieved in all the patients after a mean of 21 weeks (range 12 to 32 weeks). Infection, non-union, malunion, implant failure, or nerve injury did not occur in any of the patients.

**Conclusion:** The non-unions developed after fracture surgery, not selecting the right implant, technical errors on implementing the implant are the factors caused by surgeons. Such factors as type of the fracture and the occurrence of it, anatomical location, additional diseases related to patient, compliance of the patient's treatment determines the success of fracture healing. Treatment with open reduction and intramedullary fixation combined with autogenous bone grafting is a safe and effective option in long bone pseudarthroses.

#### L-T2.5

##### **The long telegraph nail for humeral shaft fractures – how to avoid non-union**

C. Cuny, M'B. Irrazi, A. Berrichi, N. Ionescu, P.-Y. Le Coadou, P. Beau. *Department of Orthopedics, CHR Metz-Thionville, Metz, France*

**Introduction:** The long Telegraph Nail was developed for use in humeral shaft fractures. Proximal locking is ensured by two or three screws, locked in the nail. Distal anteroposterior locking can be either static or dynamic.

**Materials and Methods:** The study initially included 148 patients who were operated between September 1998 and February 2005. There were 86 women with an average age of 68 years and 62 men with an average age of 53 years. After excluding patients with pathological fractures and those who were lost to follow-up, we were able to analyse 104 patients to determine the rate of non-union. Patients were divided into three groups: no distal locking, static distal locking, and dynamic distal locking. The Constant score was measured in 56 patients to determine shoulder function after the procedure. The average follow-up time was three years.

**Results:** There were no cases of post-operative radial nerve palsy or infection. The overall non-union rate was 7.7%. Without distal locking, the non-union rate was 12.5%; with static distal locking, the rate was 12.5% also. There were no cases of non-union in patients treated with dynamic distal locking. The average weighted Constant score was 105%. There were no functional clinical consequences, especially in the rotator cuff.



**Conclusion:** The long Telegraph® nail is used for anterograde nailing of the humeral shaft with a simplified dynamic or static distal locking system. In this series, use of the dynamic distal locking system resulted in a lower non-union rate. When implanted correctly, the system does not appear to affect shoulder function.

#### R-T2.1

##### **The treatment of adult forearm non-unions with modified Nicoll's Technique and newly designed Ulna-A and Radius-A Nails**

N. Saglam, G. Saka, T. Kurtulmus, U. Bakir, B. Kibar, F. Akpınar.  
*Department of Orthopedics and Traumatology, Umraniye Education and Research Hospital, Istanbul, Turkey*

**Introduction:** Management of non-union with a gap following a fracture of the radius or ulna is a challenging problem. In this study the result of forearm non-union and delayed unions treated using tri-corticocancellous iliac bone graft (Modified Nicoll's Technique) and newly designed radius-ulna intramedullary nails are evaluated.

**Materials and Methods:** 7 patients with plate-screw osteosynthesis applied because of broken forearm, but non-union developed (5 ulna, 2 radius non-unions) were evaluated. In all cases the length of applied tricortical graft was below 2.5 cm. 4 male and 3 female patients with 37 average age (19–55). All the patients were allowed to mobilize immediately without additional fixation. The results were evaluated according to Grace-Eversmann and DASH scoring.

**Results:** Average follow-up time was 12 months (8–22), healing; 6 months (5–7). Patients were not observed with deep or superficial infection or radioulnar synostosis. According to Grace-Eversmann scoring system excellent and good results were obtained in all cases. Average DASH score was 6 points (5–8).

**Conclusion:** The goal of treatment in non-union is to achieve painless and functioning elbow, forearm and wrist movements. The advantages of Ulna-A and Radius-A nails are compatible with forearm anatomy, to allow the graft placed with full contact where resection applied, to show adequate resistance against axial, rotational and shear forces. This method is that allows immediate post-operative rehabilitation and not requiring additional fixation. The successful results of a limited number of the cases make these nails in the treatment of non-union a promising alternative to standard plate-screw osteosynthesis.

14.30–15.50

#### **T3. New Concepts**

*Chairs: T. Mittlmeier, M. Wich*

#### L-T3.1

##### **Development of the telegraph nail for proximal humeral fractures**

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**Introduction:** The Telegraph nail, intended for proximal humeral fractures, was modified to use 4 proximal screws and thus becomes the Telegraph 4 (T4). A preliminary prospective study was performed with 105 patients and a 3 year follow-up.

**Materials and Methods:** The four screws, locked in the nail, hold the tuberosities and the humeral head. In the series from March 2008 to December 2009, were 78 women (74%). The average age was 69 years. There were 30% two-part surgical neck fractures, 41% three-part surgical neck fractures, 12% valgus impacted articular fractures and 15% of significantly displaced articular fractures. In 53% of the cases, the nail was placed percutaneously.

**Results:** Sixty-four patients were seen again with an average follow-up of 38 months. The overall rough Constant score was 64%; the weighted score was 83%. The scores were good or excellent in the two-part or three-part extra-articular fractures and in the valgus

impacted articular fractures. They were poor in the significantly displaced articular fractures. Complications occurred in 14 patients, including 8 revisions. These comprised one Telegraph re-nailing, three cases requiring prosthesis and four cases for material removal. These complications mainly occurred in the significantly displaced articular fracture group (54% of cases).

**Conclusion:** The results were good and excellent for the two- and three-part surgical neck fractures and for the valgus impacted articular fractures. They were poor for the significantly displaced articular fractures. The results were not satisfactory with significantly displaced articular fractures, which may be best treated by prosthesis, especially in the elderly.

#### L-T3.2

##### **Morphological analysis of a novel poly-axial intramedullary nailing concept for the treatment of proximal humerus fractures**

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**Introduction:** The demographic change is a factor for poor bone quality accompanied with a constant increase of proximal humeral fractures thus making surgical treatment rather demanding. In this context, monoaxial angle-stable internal fixation systems, such as plates or nails have improved outcome substantially. However, the monoaxial screw-plate or -nail interface not always allows to place the screw in the optimal remaining bone. Hence, just like the polyaxial plates a new polyaxial locking mechanism was developed for an interlocking nail (PolyAxNail) by this research group. The aim of this study was to investigate whether this new concept shows any benefit to address the screws into the safe zone of remaining bone stock. Virtual implantation allowed a comparison to 3 conventional, monoaxial nail systems.

**Materials and Methods:** Based on CT-datasets (n=25), virtual four part fractures (Neer IV-4) were created using Amira (Visage Imaging GmbH, Berlin, Germany). The novel PolyAxNail and three standard intramedullary, monoaxial interlocking nails (Targon PH, Ascupal; T2 Stryker und TriGen, Smith&Nephew) were implanted virtually (3× n=25). The PolyAxNail screws were placed to address the optimal bone stock.

**Results:** Depending on the size of the humerus (Collum Anatomicum) the various nails showed different distances of the screw heads to the fracture lines. Difficulties placing the proximal screws could be observed at the localization of the lower lesser tubercle or/and at the sulcus intertubercularis.

**Conclusion:** For the first time we demonstrate quantitative data of the quality of screw positioning in virtual humeral head fracture osteosynthesis. This analysis is the basis for the improvement of the design of the PolyAxNail.

#### L-T3.3

##### **Press-on interlocking – a new concept of fracture near fixation leads to early callus mineralization. An experimental study**

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**Objective:** Current obstacles in intramedullary nailing of midshaft long bone fractures are distal free hand interlocking with concomitant radiation exposure to both the surgeon and the patient and rotational and shearing forces during weight bearing at the fracture site that alter bony healing. This study analyses a new interlocking technique that may reduce shearing forces at the fracture site.

**Material and Methods:** 12 adult German black muttons received a midshaft osteotomy resulting in a fracture gap of 0.7 mm. One

group was treated with a reamed tibia nailing system (a special manufacturing for the sheep with the dimensions of the nail: 8 × 200 mm, 11 mm top diameter, 8 mm lower diameter, MORE Medical Solutions, Germany). In the second group six sheep were also treated with the reamed tibia nailing system and additional interlocking screws close to the fracture. Screws did not cross the nail, but were pressed on top of the nail (press on interlocking). In order to create a firm screw seating cavities were placed on the nail surface matching exactly to the screw tip leading to a “golf ball” structure on the nail surface. 10 weeks after operation the sheep were sacrificed with Trapanal und KCl and the tibiae were explanted. The quality of fracture healing was determined by mikro-CT (Skyscan 1076 *in vivo* micro-CT, Skyscan, Kontich, Belgium).

**Results:** Fracture near press on interlocking lead to significantly more callus mineralization as shown by a higher bone mineral density as in conventional interlocking nailing ( $0.434 \text{ g/cm}^3 \pm 0.0836 \text{ g/cm}^3$  versus  $0.567 \text{ g/cm}^3 \pm 0.106 \text{ g/cm}^3$ ;  $p=0.043$ ).

**Conclusion:** Fracture near interlocking is capable to enhance callus mineralization in a sheep model of a tibia subcritical diaphyseal defect fracture.

#### L-T3.4

##### Evaluation of an innovative combined magnetic and manual targeting device for distal locking of intramedullary nails

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**Introduction:** Intramedullary interlocked nailing has become a standard procedure for the treatment of diaphyseal and some metaphyseal tibial fractures. Nevertheless, distal free-hand locking remains a crucial task, resulting in an additional radiation exposure to the patient and the surgical staff. In order to enable an accurate and simple positioning of the screws, a combined magnetic and manual targeting system has been developed by Sanatmetal®.

**Material and Methods:** In two runs, 30 probands (group 1: 10 students; group 2: 10 residents; group 3: 10 attendings) – none of them familiar with the device – tested the radiation-free system using 60 intact cadaver tibias. Each proband performed the surgical procedure twice in succession.

**Results:** Referring to the first attempts, 9.6, 7.2 and 7.1 minutes were the time periods required to insert the four distal screws, the relevant values for the second attempts were 8.6, 6.3 and 6.2 minutes, in both cases revealing a significant difference between groups 1 and 2 and groups 1 and 3. Furthermore, the mean values within each group indicated a significant decrease of the test duration. Out of 240 drillings, only one failure (group 1) occurred, representing an accuracy of 99.58%. Of the probands, 90% rated the Sanatmetal® targeting device better than the standard method and 77% attested a high user-friendliness at least.

**Conclusion:** Due to the satisfactory test results, the brief training, the steep learning curve and the radiation-free technique the Sanatmetal® targeting device has to be considered an appealing alternative for distal locking.

#### R-T3.1

##### Early clinical outcomes of a new and different designed detection method: Applying minimal invasiveness, allowing sliding compression and effective antirotator in adult collum femoris fractures

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**Introduction:** Femoris neck fractures are intracapsular localized and problematic, they disrupt the integrity of the hip joint; different methods of treatment are applicable. The purpose of internal fixation application is to make an operation following anatomical reduction, trauma of minimal soft tissue and the loss of spongyous

bone stable as well as sliding compression and allowing for early rehabilitation. However, complications such as delayed healing, not healing and high avascular necrosis are highly evident. In our study we evaluated the early stage results of the patients whom were applied minimal invasive sliding antirotator compressive hip screw (MIS A CHS) for internal fixation.

**Material and Methods:** 19 out of 21 patients came for their final check up diagnosed with adult collum femoris fracture operated with MIS A CHS applied were retrospectively evaluated. 10 male and 9 female patients with mean age of 52 (range 25 to 82 years).

**Results:** Average operation time was 60 minutes (range 35 to 85); fluoroscopy time was 35 seconds (range 15 to 65) and healing was 17 weeks (range 12 to 36).

**Conclusion:** In the treatment of femoral neck fractures with minimal invasive approach, less bleeding, less damage to bone and surrounding tissues occurred. This situation, together with providing suitable biological environment for healing also facilitated the rehabilitation of patients after surgery. MIS A CHS minimal invasive used for internal fixation, easy and rapid implementation, beside scarcity in bleeding, minimal use of fluoroscopy, both with a fixed angle and any angle desired are some important advantages including the wedge on the system, which allowed sliding compression on fracture line to prevent rotation of the head.

#### R-T3.2

##### Percutaneous and minimally invasive screw fixation of acetabular fractures with 3D-fluoroscopy-based navigation

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**Introduction:** Anatomic reduction and gap-free (<1–2 mm) reconstruction of the articular surface after acetabular fractures (Ac-Fx) are accepted predictors for a good function and slow progression of a posttraumatic osteoarthritis of the hip. The complex anatomy and the variety of different fracture patterns require dorsal/ventral/extended approaches or even surgical hip dislocations, which can lead to a considerable morbidity. The percutaneous reduction and stabilization of Ac-Fx with the use of three-dimensional (3D) fluoroscopy-based navigation is a minimally invasive procedure and has been mentioned in the literature only with few case series. The aim of this study was the retrospective analysis of minimally displaced and minimally invasively reduced Ac-Fx, which were treated with percutaneous navigated screw fixation.

**Materials and Methods:** Between 2005 and 2011 twelve patients with Ac-Fx were treated minimally invasive with 3D-fluoroscopy-navigated screw fixation and have been included in the study (m/f: 9/3; mean age: 60 years, range: 16–80). The mean postoperative hospital stay was 8.6 (4–17) days. The mean follow-up was 29 (1–72) months.

A 3D-fluoroscopy-based scan (Arcadis Orbic 3D®, Siemens) was performed intraoperatively after percutaneous reduction with Schanz-screws or mini-open exposure using the first ilioinguinal window and fixation of the Navigation Reference Base on the ipsilateral iliac crest. The data were transferred to the navigation system (VectorVision®, BrainLab) and navigated drilling of the screw holes and the implantation of the planned lag screws was performed percutaneously. The quality of the reduction and the screw positions were evaluated with intra- and postoperative CT-scans. The Harris Hip Score was used to evaluate the clinical outcome.

**Results:** A total of 26 periacetabular screws were placed (2.16 (1–5) screws/patient). The postoperative reduction in the radiographic controls was anatomical in all cases (<1–2 mm step). There were no secondary fragment dislocations or mal-/non-unions. All screws were extraarticular without displacement and correctly addressed the fracture morphology. There was no intraoperative conversion

to an open procedure or extension of the surgical approach. The Harris Hip Score showed very good results.

**Conclusion:** The 3D-fluoroscopy-based navigated, percutaneous screw fixation of Ac-Fx is a promising method with a very good radiographic and clinical outcome. In minimally dislocated and percutaneously reduceable Ac-Fx this procedure enables an efficient minimization of surgical-exposure-related complications without compromising the anatomic articular reconstruction. The navigation and the intraoperative CT-scan with multiplanary reconstructions allow for an accurate placement of screws and mean an enormous improvement of intraoperative orientation and real-time control of reduction and implant position. Yet, new advances in fluoroscopy-technology (scan image quality, scan volume) and prospective studies are necessary to further verify these results.

### R-T3.3

#### The use of intraarticular semi-extended technique for treatment of tibial fractures

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**Introduction:** Intramedullary nailing is an accepted technique for tibial fractures. Until now the widely known procedure is the standard approach in 90°-flexion of knee joint. The difficult use of this method in case of proximal fractures makes it less appealing. Additionally, anterior knee pain is the most common complication after intramedullary nailing in standard position. The purpose of this study was to evaluate whether using the semi extended nailing approach reduces the presence of anterior knee pain following intramedullary nailing of tibial fractures.

**Materials and Methods:** 26 patients with a tibial fracture requiring intramedullary nailing were treated by using the semi-extended-approach. During the follow-up (18 months) the patients used visual analog scales (VAS) to report their level of knee affliction. Oxford-Knee-Score (OKS) and Activities-of-daily-living (ADL) showed their impairment caused by that pain. Additionally a simple kneeling test is used to quantitate the anterior knee pain. Range-of-motion, results of typical clinical tests and radiographs were also recorded.

**Results:** None of our patients reported anterior knee pain at the final evaluation. VAS, OKS, ADL and functional tests revealed excellent results. All patients were able to kneel for more than 60 seconds without pain and a minimal weight displacement to their non-operated site. 2 cases of medial meniscal lesion were most likely degenerative.

**Conclusion:** Compared to the standard procedure, tibial nailing in semi-extended-position reduces the functional impairment and the presence of anterior knee pain. We concluded that this technique simplified intraoperative imaging, fracture reduction and intraoperative management, especially the treatment of fractures in the proximal third of the tibia.

### R-T3.4

#### The PolyAxNail; Development and evaluation of a novel poly-axial and angle-stable intramedullary nailing concept for the proximal humerus

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**Introduction:** The two competing methods in osteosynthesis of long hollow bones are plating and intramedullary nailing. Whereas the evolution from uni-axial to stable poly-axial plates has proven to meet the clinical need for intraoperative flexibility and stable osteosynthesis, this development has not yet taken place in the

nails. Not only because of the necessity of finding intraoperatively the exact entry point and choosing the applicable depth of implantation intramedullary nailing is a relatively demanding procedure that places high expectations on the surgeon. After placing the first locking screw, the position of all other locking screws is defined. This is decisive for the success of the operation.

**Materials and Methods:** Based on CT-datasets of humeri a prototype for a proximal humeral nail with proximal polyaxial interlocking screws and a targeting device had been manufactured, and implanted in sawbones and cadaver humeri.

**Results:** The authors could show that the polyaxiality and true angle stability of the proximal screws are feasible features to address the optimal bone structures. The targeting device allowed a precise handling of the screw directions.

**Conclusion:** With the herewith introduced novel poly-axial intramedullary nailing concept the authors believe to even widen the spectrum of indications. This concept combines the advantages of the poly-axial plates with the advantages of the intramedullary locking nails. Because of the better fragment adaption this new IM concept should lead to faster bone healing and less pseudarthrosis. Further investigations concerning biomechanical stability and clinical studies have to be performed.

16.20–18.10

### T4. Nailing of the tibia

*Chairs: P. Rommens, C. Josten, K.-H. Frosch*

#### L-T4.1

#### Long-term stability of angle-stable versus conventional locked intramedullary nails in a distal tibia fracture model

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**Introduction:** Intramedullary nailing of tibia fractures is an accepted treatment option that has its advantageous but is attended by problems like decreased biomechanical stability especially in distal and osteoporotic fractures. The aim of this study was to investigate the biomechanical characteristics of the angular stable locking system (ASLS) for intramedullary nails in the treatment of unstable distal tibia fractures using the new biodegradable sleeves.

**Materials and Methods:** 16 fresh, frozen porcine distal tibiae were assigned to either the conventional group (CL) using three conventional locked screws or the angular stable group (AS) with three angle-stable locked screws. The 8mm expert tibial nail (Synthes) was used. Biomechanical testing included non-destructive torsional ( $\pm 5$  Nm) and axial loading ( $\pm 50$  N) at week 0, 4, 6, 8 and 12. In the meantime the specimens underwent immersion in phosphate-buffered saline (PBS).

**Results:** The AS group showed a significant higher torsional stiffness at all time points (at least 60%) compared to the CL group ( $p < 3.001$ ). The neutral zone was at least 5 times higher in the CL group ( $p < 3.001$ ). The mean axial stiffness was maximum 10 % higher (week 6) in the angle-stable locked group compared to the conventional group. There was no significant change of the mechanical characteristics over the 12 weeks within each group ( $p > 3.05$ ).

**Conclusion:** The angle-stable locking system (ASLS) using a special screw and sleeve locking for intramedullary nails provides a significant higher initial and long-term stability. Especially in torsional loading the differences determined in this study may have clinical relevance.



**L-T4.2****Treatment of tibia fractures with unreamed and reamed intramedullary nailing in adults**

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**Introduction:** The purposes of this study were to review tibia fractures treated with unreamed and reamed nailing and to assess the clinical and radiographic results, complication rates.

**Materials and Methods:** 124 patients with a fracture of the tibia were examined. The patients were randomly divided into two groups. Seventy-three patients treated with unreaming technique (group A). 51 patients reaming technique (group B). 57 patients were closed, 16 in open fractures. Mean age of the group A and B were 39 (17 to 81) and 36 (19 to 81). Group A consisted of 46 males, 27 females while group B consisted of 20 females and 31 males. Considering fracture based on AO/OTA classification. Clinical and radiological results were evaluated according to criteria of Johner and Wrush.

**Results:** There was no statistically meaningful difference between groups A and B. The study demonstrated that degree of mean time of surgery, joint range of motion, mean time of union, full weight bearing time and return to normal activities in patients of the group A was significantly more than that of the group B.

**Conclusion:** The use of the MBDL (TST) unreamed intramedullary nail was associated with good clinical, and radiological outcomes in patients. These preliminary results support the use of MBDL (TST) implants as a new treatment option for the tibial fracture cases.

**L-T4.3****Nailing for pilon fractures in disadvantaged patients**

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**Introduction:** Considerable advances in the past decade have improved the results of the treatment of distal tibial pilon fractures. Today's basic management scheme for high energy patients is a two-step approach. Initially the fracture is spanned with an external fixateur from the leg to the foot with or without fibular fixation. After the immediate post traumatic soft tissue swelling has subsided osteosynthesis with either a medial, antero-lateral or posterior locking plate is performed and the patient is placed at least for a few weeks in a non-weight bearing splint. Load bearing is progressed through the weeks following. This program requires patient compliance. There is a place in the non-compliant patient or patient with immense comorbidities for calcaneo-tibial nail and immediate weight bearing for the treatment of this fracture.

**Materials and Methods:** We report on five cases where patient limb and function except for ankle joint motion was achieved with nailing from the heel as primary treatment for a tibial pilon fracture.

**Results:** Good functional results in all cases at long-term follow up.

**Conclusion:** This protocol is a viable treatment strategy for this population group.

**L-T4.4****Angle-stable versus conventional distal tibia nail locking screws – a biomechanical study on fatigue performance**

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**Introduction:** In situations of repetitive high implant stress, distal locking screw failure is observed, especially during delayed fracture healing or early full weight bearing. To evaluate the long-term

performance of distal intramedullary tibia nail locking screws, angle-stable locking screws were compared to conventional locking screws.

**Materials and Methods:** The overreamed distal third of human surrogate tibia bones was instrumented with a 10 mm diameter intramedullary tibia nail and locked in the mediolateral plane with either two angle-stable locking screws or two conventional locking screws (n=3 specimens per group). Quasi-static and cyclic axial loading with constantly increasing load was performed up to screw failure.

**Results:** Stiffness values of angle-stable locking screw constructs were significantly higher compared to conventional locking screw constructs (p=3.025). The longer fatigue life of angle-stable locking screw constructs is expressed in a significantly higher number of cycles to failure compared to conventional locking screw constructs (p=3.004).

**Conclusion:** The enhanced fatigue performance of angle-stable locking screws is advantageous in situations, where the nail acts as load carrier and repetitive high implant stress occurs.

**L-T4.5****Prevalence and risk factors of reinterventions following reamed intramedullary tibia nailing**

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**Introduction:** The main objective of this study is to identify the prevalence and to analyse the aetiology of re-interventions following stabilization of tibial shaft fractures with reamed intramedullary nailing.

**Materials and Methods:** Retrospective analysis of prospectively documented data of adult patients that underwent reamed intramedullary nailing for stabilization of tibial shaft fractures over a three year period. Exclusion criteria were immature patients, pathological fractures, and periarticular fracture patterns. Clinical and radiological data available in a computerized database included patient demographics, mechanism of injury, fracture classification, open or closed injury pattern, ISS, perioperative complications, timing, causes and number of re-interventions, smoking habits, medical co-morbidities and progress to radiological fracture union.

**Results:** 183 (129 male) patients (mean age 37, range 14–87) met the inclusion criteria. 34 (18.5%) patients underwent at least one re-intervention (range 1–4). Identified causes for re-intervention were: aseptic non-union (35.3%), infected non-union (8.8%), early revision of fixation due to loss of reduction and metalwork failure (14.7%), canal intramedullary sepsis with evident fracture healing (5.9%), correction of rotational deformities (8.8%) and removal of metal work due to soft tissue irritation-anterior knee pain (26.5%). 34 (18.5%) patients sustained an open fracture out of which 10 (29.41%) underwent a re-intervention. Incidence of fracture patterns 42-B, C was statistically of greater significance in the re-intervention (41%) compared to the non re-intervention group (25%) (p=0.03).

**Conclusion:** Fracture patterns B, C [OR 2.1 (0.9–4.7)], open fractures [OR 2.2 (0.9–5.1)] and infection [OR 3.5 (1.1–11.9)] were highly predictive of the need on re-interventions following reamed IM tibia nailing.

**R-T4.1****Treatment of tibia fractures with titanium elastic intramedullary nail in children**

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**Introduction:** Children diaphyseal fractures occur with high energy trauma and are generally instable fractures. In this study, we evaluated the result of patients that titanium elastic nail was used in their surgical treatment.

**Materials and Methods:** 13 patients (11 male, 2 female; mean age: 13 range 4 to 12 years). All children with tibial shaft fractures treated operatively who underwent fixation with TENs. Mean follow-up was 18.4 months (range 12–48 months). Results were evaluated according to the Flynn classification for flexible nail fixation.

**Results:** Union was achieved in all patients at a mean of 10 weeks (range 8–13 weeks). At final follow-up, mean angulation was 3 degrees (range 0°–8°) in the sagittal plane and 4 degrees in the coronal plane (range 0°–10°). Seven patients complained of irritation at the nail entry site; there were no leg length discrepancies or physeal arrests as a result of treatment. According to the Flynn classification, we had 9 excellent, 3 satisfactory, and one moderate result.

**Conclusion:** Most pediatric tibial shaft fractures may continue to be successfully managed via traditional casting methods, but certain cases certainly warrant surgical stabilization. Elastic stable intramedullary nail represents a minimally invasive approach to tibial shaft fracture fixation. Advantages over other fixation techniques include a lower infection rate, touch-down weight bearing advancing to weight bearing in tolerance with sufficient fracture healing.

#### R-T4.2

##### Infection in tibial fractures treated with I.N.

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**Introduction:** Intramedullary nailing has been established as the gold standard in management of long bone fractures, providing the best results in bone healing with small complication rates. Despite all these, infection is the most common postoperative complication. The purpose of this study was to present our experience both in diagnosis and management of this problem.

**Materials and Methods:** 11 patients (mean age 45, ranged 20–62 y.o.), with tibial fractures initially treated with I.M., developed infection. One of them had a closed fracture and 10 had an open fracture (2 Gustillo I, 3 Gustillo II and 6 Gustillo IIIA). The management of the patients included one or two stages surgical therapy, depending on their clinical condition, local limb condition, wound cultures and the resistance of the organism in antibiotics.

**Results:** All patients were treated according to the protocols and from the 11 patients, in 10 patients the infection has been resolved. One patient has developed chronic osteomyelitis and is still under treatment.

**Conclusion:** In conclusion we may say that debridement, targeted antibiotic therapy and stability of the fracture are goals of high importance in the management for our patients. The treatment of infection after intramedullary nailing is a difficult problem that requires management in one or two stages to get the best results.

#### R-T4.3

##### Tibial head fractures: results after angular stable plate osteosynthesis

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**Introduction:** The operative treatment of tibial head fractures is because of the complex anatomy, the high axial loading and the leverage effect, a complex one. Insufficient reduction of the joint line, persisting articular incongruity, the development of steps in the joint line as well as misalignment are clear predictors for the development of posttraumatic osteoarthritis. In elderly osteoporotic patients low energy traumata are most common whereas Moore fractures due to high energy traumata are mainly found in younger patients. There exists a wide range of approaches and operative techniques. Concerning the optimal implant in subject to the fracture type the concepts are controversial. Studies concerning

this question with the needed patients numbers and follow up are only limited available. The aim of this study was to analyse the results of patients after tibial head fracture treated with an angular stable plate (LCP).

**Materials and Methods:** In this retrospective study we could include 109 patients, which were treated in our center between 1999–2010. The fractures were analysed concerning fracture type (AO and Moore) and type of operative treatment. We documented the clinical outcome (ROM, KSS, Lysholm), the degree of posttraumatic osteoarthritis (WOMAC), pain (VAS) as well as the reduction result. The postop. X-rays were rated regarding the degree of osteoarthritis (Jäger and Wirth), secondary loss of reduction and joint line steps (>2 mm).

**Results:** N = 109 patients were included [m:w 1:1.05, average age: 54 years (19–87)]. We could find in our cohort in 2% A-, 56% B- and in 42% of the cases Type C-injuries. Moore-fractures were found in 0 (I), 10 (II), 4 (III), 4 (IV) und 16 (V) patients. The average follow-up was 61±34 (1–140) month.

Table: Results

	Type A	Type B	Type C
ROM	128±10	117±14	109±10
Approach: 74% lat, 21% med., 5% combined			
Lysholm	94±8	77±25	52±29
KSS	100	88±16	67±23
VAS	0	0.9±1.2	4±2.3
WOMAC Pain	0	4.8±7.6	13.3±10.8
WOMAC AllDaiy	4±4	6.9±10.4	26.8±20.3
Osteoarthritis Index (Jaeger/Wirth)	1.5±0.7	1.3±0.9	2.2±0.8
Secondary loss of reduction	0%	33%	58%

**Conclusion:** Tibial head fractures are, with 1% of all fractures, a rare entity. The operative treatment follows, according to fracture type and localisation (meta-/diaphysal, intra vs. extraarticular) and individual factors, a sophisticated algorithm. The operative treatment using angular stable implants, which can be used in a minimal invasive technique via medial, lateral or combined approaches, seems to be a reliable technique, which allows the early functional rehabilitations of the patient, even in osteoporotic bone. Following this concept, good clinical results (see also the scores), minimising the appearance of posttraumatic osteoarthritis even in severest fracture types, can be achieved. However optimizing the concept especially for AO type C and Moore Type V fractures would be preferable.

#### R-T4.4

##### A tibia nail for human identification – a local forensic case

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**Introduction:** Internal fracture fixation represents a current concept of fracture treatment. As the amount of applied implants increases, there may be a potential for implant based individual tracking in particular circumstances i.e. in human identification. In spring 2010 in a forest near Rostock human remains including a stainless nail within a formerly fractured tibia were detected. Could the implant help to determine the identity of the corpse?

**Material and Methods:** In a forensic analysis the remains (parts of skeleton) were considered to belong to a male medium grown subject, whose remains may have been exposed to outdoor conditions for some years to a few decades. The tibial nail was analysed and according to the product “identification” number possible hospitals for implant placement and logistic paths were searched for IM-nailing operations. Furthermore a match analysis of the regional police departments database of missing individuals of the last 15 years was undertaken according to the proposed criteria of the involved subject which however was unsuccessful.

A DNA match analysis could identify a since winter 2003 missing local individual.

**Results:** Now equipped with the actual patients identity out of academic interest a survey was carried out to save clinical documents such as discharge letters and operative reports. Surgical procedure documentation was secured, however x-ray films had already been abolished.

**Conclusion:** A tracking for a presumptive identity based on the implant product number itself was unsuccessful. For this particular purpose the current German health product legislation including European directives do not enforce sufficient orthopaedic implant labelling.

## EX-T2

### Special lecture: Who was Müller-Meernach

D. Seligson<sup>1</sup>, L. Douglas<sup>1</sup>, L. Negrin<sup>2</sup>. <sup>1</sup>*Department of Orthopedics, University of Louisville Hospital, Louisville, USA;* <sup>2</sup>*Unfallchirurgie, AKH, Wien, Austria*

**Introduction:** Although Gerhard Kuentscher is considered the father of intramedullary nailing, the technique was practiced by Oskar Mueller-Meernach, a public hospital doctor in Saalfeld beginning in 1926.

The history of this nearly forgotten trauma surgeon and the times in which he practised are important to the development of marrow nailing as a standard method.

**Materials and Methods:** literature review, personal accounts from descendants.

**Results:** Mueller-Meernach advanced the method of intramedullary bolting to nailing with the use of longer marrow nails than those that had been used up until his time. Further he used non corrosive metal rather than bone nails. His nails were the first ones to provide stabile intramedullary osteosynthesis.

**Conclusion:** Mueller-Meernach was an important pioneer for intramedullary osteosynthesis.



## FRIDAY, 21 SEPTEMBER 2012

9.00–10.15

### F1. Nailing of the humerus

Chairs: M. Savvidis, H.-W. Stedtfeld, R. Haase

#### L-F1.1

### Experimental examination of factors influencing the deformation cut out risk in locked nail osteosynthesis of proximal humerus fractures

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**Introduction:** Locked nail osteosynthesis allows a minimal invasive stabilisation of the very frequent proximal humerus fractures. However most patients are elderly with poor bone quality and the proximal humerus is biomechanically highly loaded. The factors influencing the cut out risk was examined in an alternating load test model.

**Material and Methods:** As standard model a PHN series with spiral blade and screw fixation. As test, Implanta – a device with the option of 4 locked screw fixation and additional possibility of a fork blade over the central screw – was tested under different locking alternatives. (HGN = Humerus Gliding Nail.)

A subcapital defect osteotomy for deformation testing (1000 Cycles between 50 and 150 N) and an osteotomy along the column anatomicum for cut out were tested with 1000 Cycles between 50 and 300 N load. In each group 5 sow bones were tested.

**Results:** the deformation in all groups increased from the first to the 1000th Cycle. The mean deformation was 1 mm for the HGN blade, 1.1 for the HGN screw and 1.55 mm for the PFN Group. The standard deviation was gug and the results not significant different. In the cut out test the rate of cut out was similar for the PHN and the HGN with a single screw, whereas the cut out for the HGN with 4 screws was reduced by 50% and the use of the blade additional with the central screw reduced the cut out risk by 66%. However standard deviation was very high.

**Conclusion:** for a reduced deformation and cut out risk the most important factor is the number of locking elements. The combination of locked screws with a fork blade with a higher implant bone contact surface improves the cut out rate but in the small series the differences are not significant.

#### L-F1.2

### Biomechanical evaluation of locking plate fixation of proximal humeral fractures augmented with calcium phosphate cement

G. Gradl<sup>1</sup>, M. Knobe<sup>1</sup>, M. Stoffel<sup>2</sup>, A. Prescher<sup>3</sup>, T. Dirrrichs<sup>4</sup>, H.-C. Pape<sup>1</sup>. <sup>1</sup>Department for Trauma Surgery, University Hospital Aachen, Aachen, Germany; <sup>2</sup>Institute of General Mechanics, University of Aachen, Aachen, Germany; <sup>3</sup>Institute of molecular and cellular anatomy, University Hospital Aachen, Aachen, Germany; <sup>4</sup>Department for Diagnostic and Interventional Radiology, University Hospital Aachen, Aachen, Germany

**Introduction:** Locking plate fixation of proximal humeral fractures is associated with the risk of glenohumeral joint screw penetration. The potential beneficial effects of calcium phosphate cement

augmentation on fixation stability have not been extensively studied in this indication. This study evaluated the influence of calcium phosphate cement augmentation on failure of fixation in a cadaveric fracture model.

**Materials and Methods:** A 5 mm wedge osteotomy was created in each of eleven paired fresh-frozen human cadaver humeri (age >65 years). Specimens were randomly assigned to receive either plate fixation (Group I) or cement augmentation and plate fixation (Group II). Constructs were tested for axial stiffness, load to failure and failure mode using a material testing machine.

**Results:** Cement augmented specimens resisted higher loads (1936±609 N) in comparison to non augmented specimens (1373±590 N) (p=0.01). In Group I, varus displacement and glenohumeral screw perforation occurred in all cases. Varus displacement occurred in two cases in Group II whereas glenohumeral screw perforation did not occur in any case. There was no significant difference in axial stiffness between groups.

**Conclusion:** Calcium phosphate cement augmented locking plates enhanced fixation stability in proximal humeral fractures and reduced glenohumeral screw perforation in this two part cadaveric model. The ultimate advantage of this method will have to be determined in vivo.

#### L-F1.3

### Operative treatment of humeral shaft fractures with an antegrade locking nail (Targon PH Long, Fa. Aesculap). A retrospective study – preliminary results

A. Dietze, A. Strübing, H.-W. Stedtfeld, T. Mittlmeier. Department for Trauma and Reconstructive Surgery, University of Rostock, Rostock, Germany

**Introduction:** Humeral shaft fractures are a rare fracture entity. The described treatment options range from conservative to various operative techniques including antegrade and retrograde intramedullary nailing. Sufficient surgical technique as well as postoperative shoulder mobilisation are key measures for good functional results. In our clinical outcome study we present results of an operative treatment option in humeral shaft fractures.

**Material and Methods:** From the beginning of 2009 until the end of 2010, from 28 patients (12 male, 16 female) with a humeral shaft fracture treated with a long Targon PH nail 21 were successfully contacted and enrolled in our study. Functional outcome was measured by Constant-Murley and Morray Score through a postal questionnaire and subsequent clinical examination in selected cases. Plane X-rays were recorded pre- and postoperatively for surgical technique evaluation. Complications were carefully noted. Postoperative physiotherapy was allowed without limitations in partial weight bearing for 6 weeks.

**Results:** The functional outcome was determined by August 2011. Average Constant-Murley Score was 52 points average (range 27–75) and Morray Score 56 points (range 15–80). One wound infection and one implant removal had to be treated. Perioperative x-ray documentation was available in all 21 enrolled patients. No clinical non-union or pseudarthrosis were found. In 7 cases radiological fracture union proof was available.



**Conclusion:** Antegrade nailing represents a suitable treatment option in humerus shaft fractures. Nail insertion through the glenohumeral joint with the associated adhesions and poor mobility remain the major challenge to present good functional outcome. A further completion of the here present preliminary result will add value to the study and improve its power.

#### L-F1.4

##### **Complications after interlocked intramedullary nailing of the humeral shaft fractures**

*A. Baltov, Department of Orthopaedics and Traumatology, Military Medical Academy, Sofia, Bulgaria*

**Introduction:** Intramedullary fixation is looking for its results in relation to the recently increasing number of patients with high-energetic fractures, polytrauma, osteoporosis and pathological fractures.

**Materials and Methods:** For a period of 10 years, 111 patients with HSF have passed a treatment and the respective follow-up after interlocking intramedullary nailing (ILIMN) with I and II generation nails, with antegrade approach for 105 (94.5%) and retrograde for 6 (5.5%) fractures. Reaming has been done with 51 (45.9%) patients.

**Results:** The registered intraoperative complications are 52 (46.85%) related to 40 (36.04%) patients, equal to 1.3 per patient. The most common are distraction 5 (4.5%), long proximal locking screw 9 (8.1%), diaphyseal fractures 7 (6.3%) and countersinking of the nail in the humeral head 8 (7.2%). The number of postoperative complications is 40 (36.04%) related to 19 (17.12%) patients. Technical mistakes, such as distraction, longer nail and additional fractures create serious problems with union and postoperative shoulder pain, which results in increased number of surgeries to 36 (32.46%). When ILIMN with I generation nails is used, the intraoperative complications related risk increases 1.58 times, and the postoperative complications related risk is 1.67 times higher compared to II generation nails. According to Constant-Murley score excellent and very good functional results are achieved with 93 (83.78%) patients; better results are achieved with II generation nails 65 (58.56%), while reaming does not influence the clinical results for both nail generations. Postoperative shoulder pain has been registered for 18 (16.2%) patients.

**Conclusion:** With IM nails specific mistakes and technical complications are registered, which are related only to IM nails. Strictly following the indications (high-energetic C Type fractures, polytrauma, pathological and impending fractures) ILIMN meets the gap between the functional bracing and the plating, as it achieves better results compared to both of them.

#### R-F1.1

##### **Proximal humeral fractures: Discrepancies between a predetermined clinical pathway and the actual clinical decision**

*J. Weber, J. Westphal, M. Schoen, Department of Trauma, Orthopaedic and Hand Surgery, Klinikum Südstadt, Rostock, Germany*

**Introduction:** Clinical pathways should facilitate clinical decision making, but sometimes modifications are necessary. We analyzed a consecutive series of proximal humeral fractures treated at our department to find out how often such modifications occurred and which reasons could be found.

**Materials and Methods:** In a retrospective cohort study all consecutive patients with a proximal humeral fracture who were admitted into our department from January 2010 to December 2011 were included. All x-rays and ct-scans of the injury were reevaluated by two experienced shoulder surgeons. The theoretically best therapeutic decision was compared with the actual decision. All cases with discrepancies between best and actual clinical decision were analyzed separately. Reasons were divided into two groups: primary false therapeutic decisions and different therapy due to patients-specific conditions.

**Results:** 167 patients with proximal humeral fractures were treated in the above mentioned time period. 109 underwent surgery and 58 were treated conservatively. The type of therapy was selected according to the analysed medical imaging. Therapeutic decisions followed our own clinical pathway in 86%. Of the remaining 14% only 4 cases of the primary fracture classification and the following treatment were retrospective false, in 19 cases the reasons for discrepancies were patient specific conditions associated.

**Conclusion:** Our data show that in a good trained team the predetermined clinical pathway can be followed. Most of the discrepancies were caused by patient-specific conditions. We did not observe major complications due to these variations in therapy.

#### R-F1.2

##### **Antegrade nailing in the distal third humeral fractures**

*A.N. Chelnokov, A. Bazhenov, Orthopaedic Trauma, Ural Scientific Institute of Traumatology and Orthopaedics, Ekaterinburg, Russia*

**Introduction:** Plating through posterior approach is conventional treatment option in distal third humeral fractures, and antegrade nailing has not been accepted in adults as a treatment modality in fractures near the elbow. Antegrade nailing of the humerus causes damage of rotator cuff and articular surface of the humeral head. Aim of this study was to develop a technique of antegrade elastic stable intramedullary nailing suitable for distal third humeral fractures.

**Materials and Methods:** Fixator-assisted nailing with a tapered elastic titanium nail inserted through the greater tubercle was performed in 37 patients with extraarticular distal humeral shaft and metaphyseal fractures. Implant position and fracture alignment were assessed postoperatively. Clinical and radiological assessment in 1, 2, 3, 6 and 12 month included measurement of shoulder and elbow range of motion, and functional outcome using Constant shoulder and SF-36 scores.

**Results:** Patients demonstrated rapid functional recovery. 34 patients were available for follow-up in six month. Union occurred in 33/34 fractures (97%), mean time to union was 10 weeks (range, 4 to 15 weeks). 33/34 patients had minimal or no pain and full range of motion without any sign of rotator cuff problem. After six month the mean Constant shoulder score was 88, the mean SF-36 physical functioning score was 92. Three patients had complications, which included one non-union (union reached after exchange nailing), and proximal migration of the nail in two cases: the nails were re-inserted and locked proximally with further uneventful healing.

**Conclusion:** The tapered elastic titanium nail provides high union rate and good functional recovery in distal third humeral fractures without damage of the articular surface of the humeral head or violating the rotator cuff. So the approach can be treatment of choice in these injuries.

#### R-F1.3

##### **An innovative technique for entry hole creation in retrograde humeral nailing**

*R. Biber<sup>1</sup>, H.-J. Bail<sup>1</sup>, B. Zirngibl<sup>1</sup>, H.-W. Stedtfeld<sup>2</sup>. <sup>1</sup>Department for Trauma and Orthopaedic Surgery, Klinikum Nürnberg, Nürnberg, Germany; <sup>2</sup>Department for Trauma and Reconstructive Surgery, University of Rostock, Rostock, Germany*

**Introduction:** Antegrade and retrograde nailing are widespread techniques for the treatment of humeral shaft fractures. Creating the nail entry hole is a crucial step hereby. The common free-hand techniques of creating the nail entry are associated with considerable rates of iatrogenic fractures in retrograde nailing.

**Material and Methods:** A specific device for creation a nail entry hole has been designed as part of the Targon H instruments and made commercially available by Aesculap (Tuttlingen, Germany). After a standard triceps-splitting approach the guide instrument is firmly applied to the bone by a screw, whose hole can be used later



for interlocking. Creation of the entry hole is then performed by a guided access reamer with an integrated stop.

We performed a retrospective evaluation of all Targon H implantations since 2000. Operation time, usage of the guide instrument and intraoperative problems were analyzed. Postoperative x-rays were checked for iatrogenic humeral fractures, and postoperative exercise regime was evaluated. Cases of infection and non-union were noted.

**Results:** We identified 87 cases (46 antegrade/41 retrograde). In all retrograde cases the guide instrument was used. No iatrogenic fractures were observed during operation or on postoperative x-rays. Active exercise was allowed postoperatively in every patient. Mean operative time was shorter for retrograde nailing (90 min vs. 108 min;  $p=3.012$ ). We saw two non-unions (2%) and no infections.

**Conclusion:** Usage of the guide instrument is a safe and reproducible way of creating an entry hole in retrograde humeral nailing. The risk of additional fractures seems to be minimized.

10.45–11.45

## F2. Fracture fixation for implant associated fractures and how to avoid complications

Chairs: H. Tarutis, L. Großterlinden

### L-F2.1

#### The Periprosthetic Fracture Plus: What they didn't teach you in Vancouver

L. Douglas, B. Hartley, D. Seligson. *Department of Orthopedics, University of Louisville Hospital, Louisville, USA*

**Introduction:** Conventional therapy for fracture of the femur in relation to a total hip or knee is placement of an intramedullary nail. Retrograde nailing provides a solution for stabilization of a fracture in relation to an implant because the nail can be inserted from the knee either through the femoral component or proximal in the shaft distal to a hip replacement. This fracture is called the 'periprosthetic fracture plus' because it presents unusual difficulties for reosteosynthesis. Periprosthetic fracture plus is the result of trying to nail an osteoporotic bone with a small caliber, rigid, closed section nail. This condition can be avoided by appreciating the situation and not letting this fracture happen.

**Materials and Methods:** Here we describe the case protocols and of four patients for whom medullary nailing proved disastrous and in whom the solution was repair of their new fractures with locking plates and screw cables.

**Results:** We have found nailing unsatisfactory in a series of patients with osteoporosis and implants.

**Conclusion:** This condition can be avoided by appreciating the situation and not letting this fracture happen.

### L-F2.2

#### Periprosthetic fractures after TKA: management and results

S. Märdian, P. Schwabe, M. Dahne, G. Matziolis, N. Haas, K.-D. Schaser. *Center for Musculoskeletal Surgery, Charité – University Medicine Berlin, Berlin, Germany*

**Introduction:** The number of implanted TKA in Germany rises in combination with longer survival of the implants, new implant concepts and rising activity level of the patients. Periprosthetic fractures after TKA are found in 0.2–2.5% (femur 0.3–2%, tibia 0.3–0.5%) of the cases. The incidence is higher after revision arthroplasty than after primary arthroplasty. In most cases the pathogenesis are low energy traumata or pathologic fractures due to implant loosening. It is still controversial in which cases a reconstruction and in which cases a revision arthroplasty should be done.

The aim of this study was to investigate the results of periprosthetic fractures after TKA considering the different indications of reconstruction with angular stable implants or revision arthroplasty.

**Materials and Methods:** We included all periprosthetic fractures which were operatively treated in our center in the years 2005–2010 in this retrospective study. The fractures were analyzed concerning the fracture type (Femur: Su, Tibia: Felix), cause of fracture (high/low energy), type of operative treatment. The postoperative complications, duration until bony healing, number of re-operations and the use of walking frames were recorded.

**Results:** We could recruit 31 patients [m:w 5/26, average age: 83 years [60–96]. 5 patients died, 2 patients were amputated due to infection, 4 patients were lost to follow up. Average amount of re-operation:  $0.5 \pm 1.4$  [0–6], pain: 55% none, 30% loading pain, 10% rest pain; bony healing:  $5.6 \pm 2.6$  month [3–12]; revision arthroplasty: 8; reconstruction: 23; 74.2% low energy trauma, 25.8% high energy trauma, pathologic fractures: 16.1%. The femur [n=30] and tibia fractures [n=3] were treated by reconstruction in 15 [75%] and 4 [66.7%] of the cases and with revision arthroplasty in 5 [25%] and 2 [33.3%] of the cases.

**Conclusion:** Periprosthetic fractures after TKA are a seldom but rising entity. The operative treatment follows different algorithms regarding the fracture type, the implant type (closed vs. open box), the anchorage type (cemented vs. Non cemented) and individual factors. In case of a stable TKA the angular stable plate osteosynthesis seems to be a reliable, minimal invasive technique, which allows a low level of damage to the knee joint surrounding soft tissue and the option of early rehabilitation even in osteoporotic bone. Implant loosening as well as implant failure after reconstruction need to be treated by a revision arthroplasty in order to restore the function to a similar level as before the fracture.

### L-F2.3

#### Fracture Fixation around intramedullary implants – a biomechanical study on different cerclage looping techniques

M. Lenz<sup>1</sup>, S.M. Perren<sup>1</sup>, B. Gueorguiev<sup>1</sup>, R.G. Richards<sup>1</sup>, G.O. Hofmann<sup>2</sup>, M. Windolf<sup>1</sup>. <sup>1</sup> AO Research Institute Davos, AO Foundation, Davos, Switzerland; <sup>2</sup>Department of Traumatology, Hand and Reconstructive Surgery, Friedrich-Schiller-University Jena, Jena, Germany

**Introduction:** Cerclages can be applied as reduction and fixation tools in combination with intramedullary implants. Looping techniques applied on wire and cable cerclages enhance its fixation capacity. Their stability and strength was biomechanically compared in a cyclic loading test.

**Materials and Methods:** Different configurations of cerclage cables ( $\emptyset 1.7$  mm, crimp closure) and solid cerclage wires ( $\emptyset 1.5$  mm, twist closure), forming 7 groups (n=3), fixed two cortical half shells of human femoral shaft mounted on a testing jig (one single cerclage looped once around the shells, one single cerclage looped twice, two cerclages each looped once, two braided wires, twisted around each other looped once). Cerclage pretension, load leading to onset of plastic construct deformation (LPD) and load at total failure were identified during sinusoidal cyclic loading with constantly increasing force (0.1 N/cycle), starting at 50 N peak load. Statistical differences between the groups were detected by univariate ANOVA with Tukey B post hoc correction.

**Results:** The LPD was significantly better for double looped cables ( $1334 \text{ N} \pm 319$ ), than single looped cables ( $646 \text{ N} \pm 108$ ), but comparable to two single looped cables ( $1191 \text{ N} \pm 334$ ). Double looped wires  $752 \text{ N} \pm 119$  performed significantly superior ( $p < 3.05$ ) to single looped wires ( $343 \text{ N} \pm 33$ ) and comparable to single looped cables. Braided wires exhibited early plastic deformation ( $119 \text{ N} \pm 55$ ).

**Conclusion:** The fixation stability under cyclic loading could be enhanced by the use of double looped cerclages, leading to a more reliable fracture fixation. Double looped wires performed comparable to a single looped cable. The use of braided wires could mechanically not be recommended.

**R-F2.1****Periprosthetic fracture after MIPO for femoral stress fracture at tracker of computer-navigated total knee replacement**

*K.S.R.K. Prasad, K.K. Karras, R. Kumar, A. Sharma. Prince Charles Hospital, Merthyr Tydfil, United Kingdom*

**Introduction:** Periprosthetic fracture after Minimally Invasive Plate Osteosynthesis (MIPO) of stress fracture involving the femoral pin site tract in computer assisted total knee arthroplasty is unique in orthopaedic literature. We are reporting this unique presentation, treated by a reconstruction nail (PFNA).

**Methods:** A 75-year old female, who had computer navigated right total knee replacement 6 weeks back, was admitted with increasing pain over distal thigh for 3 weeks without trauma or stumble. Prior to onset of pain, she achieved a range of movements of 0–105°. Perioperative radiographs did not suggest osteoporosis, pre-existent benign or malignant lesion, or fracture. Radiographs demonstrated transverse fracture of distal third of femur through pin site tract. We fixed the fracture with an 11-hole combi-hole locking plate by MIPO technique. Eight weeks later, she was readmitted with periprosthetic fracture through the screw hole at the tip of the MIPO Plate. She was treated by Reconstruction Nail (PFNA), removal of locking screws and refixation of intermediate segment with unicortical locking screws. Then she was protected with plaster cylinder for 4 weeks and hinged brace.

**Results:** She made uneventful recovery and was comfortably mobilising partial weightbearing in a hinged brace. At 12 weeks, fractures were uniting well. She was started on osteoporosis treatment, pending DEXA scan.

**Conclusions:** Reconstruction Nail (PFNA), refixation of intermediate segment with unicortical locking screws Constitutes a logical management option for the unique periprosthetic fracture after Minimally Invasive Plate Osteosynthesis (MIPO) of stress fracture involving femoral pin site tract in computer assisted total knee replacement.

**KN-F2****Intramedullary nailing for treatment of complications**

*H. Tarutis, M. Bendala, F. Remmler. Klinik für Unfallchirurgie und Orthopädie, Klinikum Spandau, Spandau, Germany*

**Introduction:** Operative treatment for fracture fixation has many advantages. But sometimes we have to treat the complications of ORIF-procedures.

**Materials and Methods:** Failures of different kinds of fracture fixation techniques were analysed and successful treated by intramedullary nailing.

**Results:** Techniques and results of intramedullary nailing are shown for handling of complications after operative treatment of long bone fractures.

**Conclusion:** Intramedullary nailing is useful for successful revision surgery in cases with complications after operative treatment of shaft fractures of long bones.

11.55–12.35

**F3. Nailing of the femur, session I femur shaft**

*Chairs: K. Aktuglu, P. Rommens, K.-K. Dittel*

**L-F3.1****The intramedullary nailing of adult femoral shaft fracture by the way of open reduction is a disadvantage or not?**

*H. Burc, T. Atay, D. Demirci, Y.B. Baykal, V. Kirdemir, H. Yorgancigil. Department of Orthopaedics and Traumatology, Suleyman Demirel University, Medical School, Isparta, Turkey*

**Introduction:** The purpose of this study is that to evaluate superiority and results of open technique in the treatment of femoral shaft fracture with interlocking intramedullary nailing. The prospective study designed to evaluate results of our technique.

In this study, the patients that were consulted to Orthopaedics and Traumatology Department of University Hospital that is third level of trauma center. We claim that open technique is not a disadvantage during union process over closed technique in treatment of femoral shaft fracture with interlocking nailing.

**Materials and Methods:** In this study, 44 patients that were consulted for adult femoral shaft fracture between January 2008 to July 2010 were included. Patients with open fractures, gun wounds, neurovascular injuries, and patients that did not have isolated femoral diaphysis fractures were excluded from study. Clinical and radiological results of the patients were checked periodically. The open interlocking intramedullary nailing were used in treatment.

**Results:** Complete union rate was 90.9% in 40 patients who were treated with open interlocking intramedullary nailing for adult femoral shaft fracture and non-union rate was 9.1% in 4 patients. Mean union time was 18.3 weeks (12–36 weeks). Evaluation of followed 44 patients according to Thoresen Criteria were excellent in 22 patients, good in 6 patients, bad in 4 patients.

**Conclusion:** We think that open technique is an acceptable technique, because all results of our study were similar to results of closed intramedullary nailing technique in literature and some advantages of open technique over closed technique.

**L-F3.2****Factors affecting the closed reduction of diaphyseal fractures of the femur**

*Y.A. Kati<sup>1</sup>, A.O. Yildirim<sup>2</sup>, O.F. Oken<sup>2</sup>, A. Ucaner<sup>2</sup>. <sup>1</sup>Department for Orthopaedics and Traumatology, Can State Hospital, Canakkale, Turkey; <sup>2</sup>Ankara Numune Training and Research Hospital, Ankara, Turkey*

**Introduction:** This level II prospective study investigates patient and fracture-related factors likely to affect closed reduction time in the surgical treatment of femur fractures, and the effect these factors have on closed reduction time.

**Materials and Methods:** 79 diaphyseal femur fractures of 75 patients were included in the present study. All fractures were treated with indirect closed reduction by manual traction using antegrade nailing and static locked reamed intramedullary nails. The three variables considered to influence the duration of closed reduction, i.e. the type of fracture, BMI, and the preoperative period (time from injury to surgery), were evaluated either separately or in a combination of two or three of the variables. Their influence on the closed reduction time was analyzed and evaluated.

**Results:** In this study according to the outcomes, a preoperative period  $\leq 24$  h had a significant effect in shortening the reduction time. The reduction time was not significantly affected by the type of fracture. The reduction time was prolonged in overweight patients, but the difference was not significant. When the three variables BMI, preoperative period and fracture types were evaluated together, the common effect of these three variables was not significant.

**Conclusion:** In conclusion, based on these results we think that closed reduction should certainly be aimed for in femur fractures in which intramedullary nailing is planned. Also, early surgical intervention appears to have a beneficial effect on the success of closed reduction.

**L-F3.3****The patellofemoral kinematics following locked intramedullary nailing treatment for femur shaft fracture**

*A.O. Yildirim<sup>1</sup>, E. Aksahin<sup>1</sup>, Y.A. Kati<sup>1</sup>, B. Sakman<sup>2</sup>, A. Ucaner<sup>1</sup>, A. Bicimoglu<sup>1</sup>. <sup>1</sup>Orthopaedics and Traumatology, Numune Education and Research Hospital, Ankara, Turkey; <sup>2</sup>Radiology Clinic, Numune Education and Research Hospital, Ankara, Turkey*

**Introduction:** The purpose of this study is to investigate the effect of rotational deformities on the patellofemoral alignment using magnetic resonance imaging method in patients whose femur fractures were treated with intramedullary locking nails.

**Materials and Methods:** The dynamic patellofemoral magnetic resonance imaging results of 33 patients (5 female and 28 male) were reviewed. All the patients were given Kujalo patellofemoral clinical evaluation scores at the latest follow-up. Those having less than 10 degrees of rotational deformity were classified as Group A, those with more than a 10 degree internal rotation deformity as Group B in either direction as Group C more than a 10 degree external rotation deformity. Then these three groups were compared regarding patellofemoral parameters and clinical scores.

**Results:** Group A had 14 (42.4%) patients, Group B had 12 (36.4%) patients and in Group C there were also 7 (21.2%) patients. The mean patella score in Group A ( $90.6 \pm 6.1$ ) was significantly higher when compared with Group B ( $87.6 \pm 9.9$ ) ( $p < 0.05$ ) and Group C ( $74 \pm 7.02$ ) ( $p < 3.05$ ). In Group C patients, medial patellar tilt was detected when compared with the intact side. There were no significant differences in any parameters in any section in either Group A or Group B.

**Conclusion:** Our results revealed that more than 10 degrees external rotation deformity could cause deterioration in the patellofemoral scores. Anatomic reduction of the fracture site should be performed as soon as possible and external rotational deformities should especially be avoided with the aim of preventing patellofemoral misalignment.

#### L-F3.4

##### Treatment of femoral shaft fractures with interlocking intramedullary nailing in adults

N. Saglam, T. Kurtulmus, G. Saka, M. Imam, M. Abughalwa, F. Akpinar. *Department of Orthopedics and Traumatology, Umraniye Education and Research Hospital, Istanbul, Turkey*

**Introduction:** We evaluated with manual traction for the reduction and nailing of femoral shaft fractures in patients who the quality of the reduction, operative time, complications and functional results.

**Materials and Methods:** Interlocking intramedullary nailing was performed in 103 femoral shaft fractures (68 men, 35 women; mean age 45.5 years; range 17 to 96 years). Of the fractures, 50 were in the right femur, 53 were in the left femur, and 1 was bilateral. There were 88 closed and 15 open femoral fractures. The results were evaluated according to the Thoresen criteria. Final evaluations included 103 fractures whose follow-ups (mean 30.3 months; range 18 to 60 months) were completed.

**Results:** The mean time to union was 18.5 weeks (range 12 to 46 weeks). 8 patients had a varus angulation, and 3 patients a valgus angulation of 7 degrees; 2 patients had a posterior angulation of 8 degrees, one patient had an internal rotation of 12 degrees, 6 patients developed a shortening of 2 cm. Knee flexion was 90–100 degrees and extension loss was 20–25 degrees in 2 patients. Knee flexion was 90 degrees in 5 patients, and 105 degrees in 2 patients. According to the Thoresen criteria, 84.2 % of patients had excellent or good results.

**Conclusion:** The high success rate obtained with interlocking intramedullary nailing makes with manual traction in supine position it an appropriate method in the treatment of femoral shaft fractures in adults.

14.30–15.50

#### F4. Nailing of the femur, session II proximal femur

*Chairs: M. Brax, M. Kloub, J.P.A.M. Verbruggen*

#### L-F4.1

##### Clinical and functional outcomes of internal fixation with intertrochanteric antegrade nail in older patients with proximal extracapsular femoral fractures: a case series

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**Introduction:** The intertrochanteric Trigen Intertan<sup>®</sup> nail (Smith&Nephew, Memphis, TN) is a fixation device for proximal extracapsular femoral fractures (EFF).

**Aim:** to evaluate clinical and functional outcomes in patients with EFF treated with Intertan nail.

**Materials and Methods:** Functional outcomes were reviewed for all patients consecutively admitted to our Emergency Department with EFF from June 2008 through June 2011. Fractures were classified according to the Jensen classification. The American Association of Anaesthetists (ASA) score was assessed properly actively. The Barthel index (BI) was used to assess the level of physical function before fracture and over 6 months of follow-up.

**Results:** 135 patients were included (mean age: 82.9 years; 81.5% females). 41 patients had stable fractures (24 type 1 and 17 type 2), while 104 presented with unstable fractures (29 type 3, 40 type 4 and 35 type 5). 31% were ASA II and 66% ASA III. The average operative time was 35 minutes. Intraoperative fracture occurred in 1 case. Two patients died within 10 days postoperatively, and 9 in within 6 months. Weight-bearing was allowed between the third and tenth postoperative. No loss of reduction, non-union or failure of devices were observed. At 6 months after surgery, functional status was similar to the pre-fracture level.

**Conclusion:** Trochanteric nailing with Intertan<sup>®</sup> produces highly satisfactory functional results in patients with EFF, with complications. Full functional recovery is obtained on average 6 months after surgery. This nail may be particularly useful in comorbid patients in whom more invasive procedures are contraindicated and early mobilization is needed.

#### L-F4.2a

##### Internal fixation of intracapsular hip fractures with a new dynamic locking plate Targon FN<sup>®</sup>

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**Introduction:** Our study aim to analyse the results after one year of a new implant Targon FN (AESCULAP), who combine sliding hip screw and parallel cannulated screws. It's a new material specially designed for internal fixation of intracapsular hip fractures, allowing compression of the fracture and rotational stability around the femoral neck.

**Material and Methods:** This study is a retrospective one with population of one hospital. There is 51 patients operated between February 2008 and October 2010. The patients are from 31 to 94 years old at the fracture time, on average 67.5 years. The average following is 13.52 months. 33 (65%) fractures are undisplaced and 18 (35%) are displaced. The revision is made by using the Martin J. Parker's (UK) method; using the clinical Parker score, the Charnley pain score and a radiological following.

**Results:** At one year, 45 (88%) patients have the same clinical Parker Score that before fracture. Only two patients (3%) have an unsatisfactory Charnley pain score. We don't observe any non-union or avascular necrosis for undisplaced fractures. On the other hand, for displaced fractures, we found one (5.6%) non-union and three (16.7%) avascular necrosis.



Concerning undisplaced fractures, literature shows us rate of non-union of 6% and 4% for avascular necrosis. Our results are really better. A first study made by Martin J. Parker (UK), about the same implant, reveals rate of 3% for both. About the displaced fractures, it's classically described rate of 33% for non-union and 16% for avascular necrosis. In this case, our results are better only for non-union. For Martin J. Parker, it's respectively 15% and 7%.

**Conclusion:** The very good results show in our study allow extending the indication of this material until 75 years old, for displaced fractures. There is no age limit using this technique for undisplaced fractures.

#### L-F4.2b

##### **Open stabilization of acute acromioclavicular joint dislocation with a suture endobutton fixation: functional and radiological evaluation of 21 patients**

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**Introduction:** Acromioclavicular dislocation is a pathology that can lead to chronic pain and fonctionnal discomfort and affect especially sportive population. The aim of this study is to evaluate a technique of stabilization of the acromioclavicular joint using Arthrex (Naples, Florida) endobutton implanted between the clavicle and the coracoid process.

**Material and Methods:** Twenty one patients, average age 38 years [14;57], were operated for acute acromioclavicular dislocation. An open surgery was performed. The Tightrope device was put in place to create a nonrigid anatomic fixation, to reduce the luxation and to repair the delto-trapezius fascia. Functional scores with Quick DASH and Simple Shoulder Test were conducted and radiological measurements describing clavicle position were evaluated: acromioclavicular and coracoclavicular distances before and after the surgical procedure and comparison with the healthy shoulder. A Student test was used for statistical evaluation.

**Results:** The mean follow up was 18.1 months [7;34], 17 patients had a type III injury from Rockwood classification and 4 patients had a type IV. The mean Quick DASH score reached 6.8 [0;40.9], the mean SST score was 11.1 [7;12], a significative difference ( $p < 3.05$ ) was observed for pre and post-operative radiologic measurements. The mean lengthening after 3 months was 2.9 mm [SD 1.4] for acromioclavicular distance and 3.3 mm [SD 3.3] for coracoclavicular distance. At last follow-up, the radiological difference between pathologic and healthy shoulders was no significant ( $p < 3.05$ ).

**Conclusion:** The Tightrope system is an effective procedure to control the frontal displacement of the acromioclavicular dislocation. A limited lengthening of the device is observed in the first months which then becomes stable. The functional outcomes were always good or excellent. This open technique requires sharply exact tunnels and allows a reparation of the delto-trapezius fascia. A longer follow up is expected and more studies should evaluate the efficiency of the device in the frontal displacement or in chronic dislocation.

#### L-F4.3

##### **"Japanese finger" type – rare pertrochanteric fractures**

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**Introduction:** "Japanese finger" type is a special type of pertrochanteric fractures. These types of fractures are caused by high energy trauma of young people. It is characterized by undamaged trochanter minor and interpozium of m. iliopsoas in the postero-medial zone of the fracture's line. This type of fracture is a stable type and it is recommended for extramedullary osteosynthesis. Close reduction is difficult; in most of the cases it is

impossible. In that case minimal open reduction technique or open reduction is done. Our choice of osteosynthesis device depends on that – cefalomedullary nail (CMN) or Dynamic Hip Screw (DHS).

**Materials and Methods:** Retrospective evaluation of 25 patients with average age of 45 years who were treated for a 12 year period. These were: women – 9, men – 16. Home incidents with 6 patients, 12 after crash accident and 7 after high falling trauma. We had 6 patients with politrauma. We used third generation cefalomedullary nails with 16 patients (Fi nail) in the cases of close or partially open reposition. In 9 cases with open reduction we use 135° DHS place.

**Results:** We did not have incidents with pulmonal embolia, infection and deep vein thrombosis. We counted difference in the mean operative time: it was 54 min. in the cases with CMN and 68 min. in the cases with DHS; the mean time of "X" ray exposition was 2, 4 min. with nail and 1, 2 min. with place; the mean blood loss was 200 ml. with cefalomedullary nail and 400 ml. with DHS. The average consolidation time was 12 weeks in both groups.

**Conclusion:** Cefalomedullary nails as osteosynthesis device offer excellent stabilization and the biological advantages of intramedullary nailing. That is why we prefer it in the cases of close or partially open reduction. When an open reduction is needed because of the existing operative access we use 135° DHS with two or three holes.

#### L-F4.4

##### **Retrospective analysis of total hip arthroplasty for displaced, intracapsular neck of femur fractures, in a tertiary referral centre**

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**Introduction:** Recent UK NICE guidelines suggest that Total Hip Arthroplasty (THA) be offered to all patients with a displaced intracapsular neck of femur fracture who: are able to walk independently; not cognitively impaired and are medically fit for the anaesthesia and procedure. This is likely to have significant logistical implications for individual departments.

**Materials and Methods:** Data from the National Hip Fracture Database was analysed retrospectively between January 2009 and April 2012. The aim was to determine if patients with displaced intracapsular neck of femur fractures admitted to a single tertiary referral orthopaedic trauma unit received a THA if they met NICE criteria. Case notes were then reviewed to obtain outcome and complication rates after surgery.

**Results:** Six hundred and thirty-eight patients were admitted with a displaced intracapsular neck of femur fracture over the described time period. Eighty-nine patients met the NICE criteria to receive a THA (mean age 76 years, M:F = 23:66); however, 27 patients had a THA. The other patients received either a cemented Thompson or bipolar hemiarthroplasty. Within the THA cohort there were no complications. Within the hemiarthroplasty cohort there was 2 mortalities, 2 implant related infections, 2 dislocations and 2 required revision to a THA.

**Conclusion:** There is evidence to suggest better outcomes in this cohort of patients, in terms pain and function. There is a clear scope for optimisation and improvement of infrastructure to develop time and resources to cope with the increased demand for THA for displaced intracapsular neck of femur fractures, in order to closely adhere to the NICE guidelines.

**R-F4.1****The Trigen® intertan nail (Smith&Nephew Co.) for treatment of proximal femoral fractures**

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**Introduction:** As the population of the elderly increases, osteoporotic fractures of the proximal femur have become a serious problem. Currently available nailing-systems are technically demanding due to their complexity and the persistent rotational instability of the head-neck fragment. We examine retrospectively the use of an innovative proximal femoral nail (Trigen® Intertan, Smith&Nephew Co.) with a trapeze-shaped design for a better rotational stability. Furthermore it offers an integrated interlocking screw option for linear active interfragmentary compression.

**Materials and Methods:** Within 1 year 100 patients were treated with the Intertan. Three senior surgeons, all experienced in closed nailing techniques, performed all operations. Fracture patterns were classified by AO. For osteosynthesis short and long Intertan was used to manage femoral neck (12), intertrochanteric (69) and subtrochanteric (19) fractures. The postoperative assessment included: operation and fluoroscopy time, postoperative blood loss, needed blood transfusion, stay in hospital, mortality, rate of complication and required operative revision. Surviving patients were followed up clinically and radiologically for at least 6 months.

**Results:** In total we recorded 9 specific complications: postoperative seroma (3), avascular necrosis of the femoral head (3), progression of coxarthrosis (2) and non-union (1). The average patient age was 78.9 years ( $f=80.8$ ;  $m=78.9$ ). Of the 100 patients 9% required revision surgery. Neither cut out nor implant failure was reported. The mortality within 6 months was 11%.

**Conclusion:** We regard the Intertan-Nail as an effective method to treat proximal femoral fractures and also femoral neck fractures in younger patients. However, attention is paid to the correct indication and performance of surgical procedure.

**R-F4.2****Proximal femoral nailing with continuous manual traction**

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**Introduction:** In this study the result of quality of reduction, operation time, complications and functional results of patients applied with proximal femoral nail with the help of continuous manual traction without traction table in supine position were evaluated.

**Materials and Methods:** 245 patients (159 female, 86 male; mean age: 75.3 years; range: 24 to 97 years) who were treated proximal femoral nails for intertrochanteric fractures. Fractures were caused by a simple fall in 221 patients, falls from height in 12 and traffic accident in 12. 118 patients had Type 31-A1, 47 patients had Type 31-A2 and 73 patients had Type 31-A3 fractures according to the AO/OTA classification. Results were evaluated clinically and radiologically. Mean follow-up period was 27.2 (range: 12 to 72) months.

**Results:** Reduction was achieved in 82.6% of patients. Mean surgery duration was 72.2 (range: 45 to 120) minutes. Complete union was achieved in 223 patients at a mean of 20 (range: 17 to 23) weeks. Postoperative mean collodiaphyseal angle was 118.5 (range: 105 to 130) degrees. Harris hip score were excellent 15, very good in 41, good in 53, bad in 45. One year mortality rate was 26.55%. Reoperated were in 22 patients with hemiarthroplasty.

**Conclusion:** Complications such as pudendal nerve neuropraxia, erectile dysfunction and skin necrosis due to compression have been reported when traction table is used to maintain reduction in intertrochanteric fractures. These types of iatrogenic problems are avoidable with manual traction. In addition, pre-operative

preparation of patients is short and total operation time is reduced. Dependency on muscle strength of manual traction assistant, intraoperative reduction should be checked frequently.

**R-F4.3****Neck of femur fractures in patients aged over 85 years – are they a unique subset?**

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**Introduction:** The U.K. population is ageing with the largest increase expected to occur in people over 85 years (85+).

**Materials and Methods:** We have examined the hypothesis that neck of femur (NOF) fractures in the 85+ group exhibit demonstrable key outcome measurement differences after surgery when compared to a standard neck of femur population. A prospective observational study of the demographics, clinical features and outcome for two groups of patients (65–84 and 85+ years of age at presentation) was collected for a single trauma unit over a 3 year period.

**Results:** The female/male ratio was greater in the over 85+ group. We have found significantly higher incidences of comorbidity, delay in discharge, and lesser likelihood of return to pre-fracture domicile. 30-day and 1 year mortality rates were also higher when compared to the 65–84 age group. This was despite a dedicated orthogeriatric service and no difference in time to surgery between the two groups.

**Conclusion:** 85+ patients presenting with NOF represent a unique highrisk patient group. Despite adherence to published key principles of care this group is at higher risk and as such merits focused clinical attention

**R-F4.4****The effectiveness of a distal target device in the use of long gamma nail**

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**Introduction:** The aim of this study is to present the effectiveness of a distal target device in the use of long gamma-nail.

**Materials and Methods:** 18 patients with equal number of fractures treated surgically with long gamma-nail between 2010 and 2012, were reviewed. Mean patient age was 75 years whereas 10 of them were females. The cause was pathological fracture due to metastatic tumor in peritrochanteric area in 4 patients, subtrochanteric fracture in 8 and, inter-subtrochanteric in 6 patients.

**Results:** In an averaged follow up of 68 months 4 patients with metastatic tumor died within the first 2 postoperative years. All fractures except for one united within an average of 4.3 months (range 3–6 months). We did not observe any major or minor complications such as superficial or deep infections, malunion, delay union, or adjacent joints restriction of motion. There was observed one non-union with breakage of nail and distal screw revised successfully with a new long gamma nail of a larger diameter.

**Conclusion:** We consider that long gamma-nail is an acceptable method of treatment for difficult fractures of subtrochanteric area with good functional results and low rate of complications. The new distal target device is highly effective with a success reaching 100%.

16.20–17.40

### F5. Session III hints, pitfalls and complication management in proximal femur nailing

Chairs: R. Zura, W. Friedl, G. Gradl

#### L-F5.1

#### Complications and techniques of proximal femoral fractures with the Targon® PF

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**Introduction:** In the treatment of proximal femoral fractures by means of osteosynthesis, it is important to select a competent implant system, while performing surgeries with adequate manoeuvring. We have treated 522 proximal femoral fractures with an intramedullary nail. This is to report our examinations of complications encountered with the implant system and our surgical techniques.

**Materials and Methods:** Between July, 2005 and March, 2012, 522 patients with proximal femoral fractures were treated with use of Targon® PF nail. Postoperatively, complications developed in 9 cases (1.7%), which included secondary traumatic fractures in 2 cases, infection in 1 case, cut-out of the lag screw in 5 cases and back-out in 1 case. Of these complications, we focused on the cut-out and back-out cases (1.1%), and assessed them clinically and radiographically. For the preoperatively un-reduced fractures on the traction table, we use instruments that we specially designed for intra-operative reduction.

**Results:** According to AO classification, there were 3 cases in A2–2, 2 in A2–3 and 1 in B2. 33.3% of Support Screws were placed in an optimal position, which is the inferior area in the anteroposterior view and the central area in the lateral view. The average amount of telescoping of lag screw was 14.7 mm.

**Conclusion:** All the 6 cases encountered with complications were unstable fractures. Use of reduction instruments was very supportive to perform a minimally invasive surgery. Combination of a potential implant system and intra-operative reduction instruments for unstable fractures yield to have achieved good reduction, and consequently, development of complication was remarkably diminished (1.1%).

#### L-F5.2

#### Failure of proximal femur fractures after intramedullary stabilisation with Gamma 3 nail, a retrospective analysis

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Abstract not available at time of publication.

#### L-F5.3

#### Femoral neck collapse after internal fixation of intracapsular hip fractures

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**Introduction:** Excessive collapse of the femoral neck after internal fixation of an intracapsular hip fracture has been thought to lead to residual pain or impaired hip function. This theory remains to be proved in clinical practice. The new Targon FN hip screw has been designed for the internal fixation of intracapsular hip fractures to allow for limited collapse to occur along the line of the femoral neck with multiple telescoping lag screws, whilst resisting varus deformity occurring at the fracture site. This enables femoral neck collapse to be measured on follow-up radiographs.

**Materials and Methods:** 240 patients with an intracapsular hip fracture were treated by internal fixation with the Targon FN screw and plate fixation. Collapse of the femoral neck at the fracture site was calculated by measuring the amount of slide that occurred in the sliding femoral neck screws.

**Results:** The mean amount of femoral neck collapse was 8.6 mm. Femoral neck collapse was significantly increased in those fractures which went onto fracture non-union (mean collapse 13.3 mm), but not for those that later developed avascular necrosis (mean collapse 9.6 mm). For those fractures that healed the mean collapse after the fracture healed was 5.8 mm for undisplaced fractures and 9.3 mm for displaced fractures (p value for difference 0.001). For the fractures that had healed excessive collapse at the fracture site this was associated with a statistically significant increase in residual pain in the hip and greater impairment of mobility at one year from injury. There was no significant difference in the amount of collapse related to sex or age of the patient.

**Conclusion:** Collapse of the femoral neck after an intracapsular hip fracture has a detrimental effect on outcome. Future research looking at ways to prevent this collapse is indicated.

#### L-F5.4

#### Z-effect after intramedullary nailing systems for trochanteric femur fractures

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**Introduction:** The aim of this study was to investigate the incidence of Z-effect after intramedullary nailing and risk factors contributing to this effect. We hypothesized that long nails provides more neck strength due to a longer lever and are therefore less likely to develop a misbalance of a higher head compressive strength than neck compressive strength.

**Materials and Methods:** In a retrospective cohort study all patients treated operatively with a two lag screw intramedullary nailing device for trochanteric hip fracture in 2006 and 2007 were included. We analyzed patient charts regarding patient and operation characteristics. Furthermore we conducted radiologic measurements in the 2-year follow-up period to investigate the quality of the fracture fixation and risk factors for developing Z-effect. The re-operation risk after intramedullary nailing with two lag screws was investigated with multivariate regression analysis.

**Results:** The incidence of Z-effect was 13% of which 46% was clinically relevant. We found no support for our hypothesis that long nails would provide more stability and are less likely to develop a Z-effect. Re-operation was performed in 17% of cases of which 28% was due to a Z-effect. Instable fracture type was a predictor for re-operation as well as migration of the superior and inferior lag screw. Other patient and radiological measures did not reach significance.

**Conclusion:** The incidence of Z-effect in this study was 13% of which less than half was clinically relevant. In general, migration of the lag screws is common and a risk for re-operation as well as instable fracture types.

#### L-F5.5

#### Lateral cortical notching in specific cases of delayed unions or non-unions after intertrochanteric and reversed fractures

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**Introduction:** Stabilization of both intertrochanteric and reversed trochanteric fractures is commonly performed by proximal femoral nailing. However biomechanics significantly differ between these two fracture types.

**Material and Methods:** In this study we analyzed the occurrence of delayed union or non-union after inter- or reversed trochanteric fractures in eight patients (seven females and one male).

**Results:** Mean age was 73.3 years (range: 63–82). The interval between initial operation and first intervention ranged between 4.3 months and 15.0 months (mean: 8.4 months). Failure of bone healing may cause permanent strain on the implant leading to nail breakage, which we observed in three of these eight cases.



**Conclusion:** Dynamization is part of the general treatment concept for delayed union and non-union after intramedullary fracture fixation. Normally it is performed by removal of interlocking screws or by occupying a 'dynamic' interlocking hole. We can show however that some types of inter- and reversed trochanteric fractures develop a characteristic kind of non-union at the level of the lesser trochanter. This condition causes pain while walking and includes the risk of implant failure due to material fatigue. In these cases dynamization may be blocked by the cortex of the distal fragment directly contacting the prominent lag screw or its sleeve. We describe a procedure we call "lateral notching", which is needed in order to make distal conventional dynamization effective and to allow for bone healing.

#### R-F5.1

##### Is proximal femoral nailing a good procedure for teaching in orthogeriatrics?

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**Introduction:** Proximal femoral nailing is a common operation in orthogeriatrics and a highly standardized procedure. For teaching purposes, this operation is often performed by residents and supervised by attending physicians. The objective of this study is to investigate if teaching this operation influences the surgical in-house complication rate.

**Material and Methods:** Patients who received a proximal femoral Targon PF nail (Aesculap AG, Tuttlingen, Germany) for trochanteric fractures were included in a cohort at our urban academic teaching hospital between 1998 and 2010. To evaluate potential effects of patient age, we separately analyzed several age groups. Complications including wound infection, hematoma, intraoperative malreduction or implant malpositioning causing revision, pain, cut-out and readmission due to nonunion were recorded.

**Result:** Our collective consists of 1,515 patients (m/f: 410/1,106). The mean age was 78.7 years (range: 19–103 years). The overall complication rate was 7.9%. In 857 cases operated by attending physicians, the complication rate was 6.9%. However the 659 operations performed by residents, we found a higher complication rate of 9.3%. Further investigating this difference by chi-squared test, we found no significance ( $p=3.09$ ). Whilst analyzing the complication rates for the different age groups, we did not find a statistically significant difference except in the age group between 71 and 80 years, for which the odds ratio indicated a 2.6-fold increased complication risk for operations performed by residents ( $p=0.01$ ). Further analysis revealed that this increased complication rate was mainly due to increased number of cut-out.

**Conclusion:** We conclude that proximal femoral nailing is an operation suitable for teaching purposes. However, patients between 71 and 80 years of age seem to be at an increased risk for cut-out if operated by a resident.

#### R-F5.2

##### Rotation instability and micromovements are independent prognostic factors for the failure rate of dislocated medial femur neck fractures

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**Introduction:** The hypothesis of this study is that the instability of fracture fixation which allows micro movements is an important independent factor responsible for the high failure rate of the osteosynthesis in medial femur neck fractures independent from osteoporosis, disturbed blood supply and high biomechanical load. With a I beam profile implant rotation and movement stability, bone compression and minimised cut out risk are achieved.

**Material and Methods:** from 1982–1992 93 patients with dislocated medial femur neck fractures (Garden III and IV) were treated with 3 to 4 screw fixation (49% re-examined after 10 years). In a second group 83 patients with the same fracture types treated from 1999 to 2005 with the Gliding nail (GN) which is an intramedullary implant with a gliding femur neck component with a rotation stable I beam profile. All patients were re-examined in 2006.

**Results:** In the screw group 58% of the re-examined and 29% of the whole group had a secondary hip joint prosthesis operation. In the GN treated patients only 10.4% had failed and received a secondary hip prosthesis.

The severe offset loss in the screw groups due to micro movements with bone resorption was not seen in the GN group so that the device is used now also in cases with pseudarthrosis after screw fixation.

**Conclusions:** The rate of complications after medial femur neck fractures is only in part dependent from the disruption of blood circulation. The minimised cut out risk, the avoided micro movements and rotation stability of the GN allows a relevant reduction of the local complication rate and secondary prosthesis implantation rate. Cut out and pseudarthrosis are reduced dramatically. The data is supported by our experimental tests regarding the cut out risk.

#### KN-F5

##### Cutting out. A main problem in the management of trochanteric fractures. Experimental and clinical examination

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**Introduction:** The proximal femur is the highest loaded part of the skeleton because of its angulated for which requires balancing of the body weight by the abductor muscles. On the other side the bone density is reduced in elderly patients so that these fractures occur mainly in elderly people. Therefore the cut out of the femur head and neck component is the most severe complication in the management of these fractures. Because of the femur neck ante version and more dorsal localisation of the trochanter minor defect in A2 unstable fractures also a tendency of rotation of the head and neck will occur and so more impaction of unstable fractures will occur in intramedullary but even more in extramedullary osteosynthesis if this is not blocked by the device used for osteosynthesis. Stronger impaction also reduces the offset and the lever arm of the abductor muscles which should be avoided.

**Experimental examination: Material and Methods:** To avoid cut out but also other complications a proximal femur nail with a I beam profile of the femur neck component was constructed: the gliding nail (GN) and small GN (SGNS). The nail insertion is possible dynamic and static in femur neck as well in femur shaft direction. **Results:** an I beam plate (16 × 10 mm) used in the Gliding nail, a single screw (12 mm) fixation of the Gamma Nail and a double screw fixation (11 and 6 mm) used in the Proximal Femur Nail were tested. For testing 9 sow bone femura and 3 pair of corps femura were used. A2 type of osteotomy and tests of 1000 cycles alternating load at 1000 N and 1500 N in the sow bones and 6000 cycles up to 3.500 N were performed. **Results:** in the sow bones the I beam profile plate shows a total deformation of 1 mm after 1000 N and 2 mm after 1500 N test. For the 12 mm screw the corresponding values were 2.5 mm and 5.6 mm. The double screw fixation showed a total cut out at 1000 N in one femur and at 1500 N in both others. In the corpse femura the differences were similar.

**Clinical examination – Trochanteric fractures: Material and Methods:** In a five year period 03.1996–03.2001 501 patients all patients with trochanteric and subtrochanteric fractures were evaluated. Re-examination was performed at least 6 months after therapy. All patients with no additional injury of the same leg were allowed full weight bearing immediately (98%). 70% were female, mean age 76.2 years, median 80 years. 82% had risk factors, 11.2%

were in a nursing home. 95% were treated in the first 36 hours by 23 surgeons. *Results:* early local complications occurred in 2.5%. Only wound revisions for haematoma (11 cases with 5 times positive bacteriology) occurred but the general rate of complications was 28.5% especially urinary and pulmonary infections. Hospital mortality was 3.9%. Whereas the mortality in patients without risk factors the mortality was 2.4% when 4 risk factors were present mortality was 90%. Osteoporosis and Diabetes had no influence as risk factor. Late local complications were 3.3%. In 1.9% blade dislocation but in no case cut out was observed. In all cases joint preserving reosteosynthesis was possible. Central impaction of the blade was minimal with 0.24 mm, varus displacement 0.7 degree, the mean fracture impaction was only 2.2 mm due to the rotation stability of the blade so that the neck could not rotate to dorsal located bone defect. The 3 months mortality was 14.9%, 15.3% were in a nursing home.

**Clinical examination – Medial femur neck fractures:** *Material and Method:* From 06.1999 we started to use the SGNS fixation also for joint preserving therapy in all not dislocated and all dislocated medial femur neck fractures and in under 60 year old patients all fractures. 131 patients were treated to Dec. 2005. *Results:* In 7 patients (9.6%) head necrosis and secondary joint replacement was necessary and in other 6 patients (8.2%) implant removal or change of the blade because of tractus irritation was necessary. The risk of head necrosis and secondary joint replacement in our series was higher in elderly patients with not dislocated fractures than in younger patients with dislocated fractures. *Discussion:* The cut through of the I beam profile plate is reduced by 2/3 compared to single screw fixation and 3/4 as compared to the PFN double screw fixation. The cross section profile is very important to reduce the cut out risk of devices for proximal femur fracture fixation. The double plane support of the I beam increases the support surface and minimises the cut out risk. The rotation stability can be also relevant for the difference found. The worse results of the double as compared to the single screw fixation can be due to the very cranial position of the proximal small diameter screw and the probably not identical loading of the 2 screws because of the movement of the screws in the gliding holes of the nail/fixation device. *Conclusion:* the results show that the event of a trochanteric fracture is still a serious risk but local complications especially cut out of the implant and severe impaction of the fracture can be avoided by using the GN.

17.50–18.30

## F6. Perioperative management

Chairs: D. Seligson, W. Lehmann

### L-F6.1

#### Death by trauma 2010: mortality and trauma mechanisms in Berlin, Germany

C. Kleber<sup>1</sup>, M. Giesecke<sup>1</sup>, C.T. Buschmann<sup>2</sup>, M. Tsokos<sup>2</sup>, N.P. Haas<sup>1</sup>.  
<sup>1</sup>Center for Musculoskeletal Surgery, Charité-Universitätsmedizin, Berlin, Germany; <sup>2</sup>Institute for Legal Medicine and Forensic Science, Charité-Universitätsmedizin, Berlin, Germany

**Introduction:** Trauma is the third common cause of death in the western industrialized countries, and continuous innovations in emergency trauma care managed to lower the trauma mortality in Germany considerably over the past decades. Data from the German Trauma Registry (DGU) showed a constant decrease in trauma mortality for patients dying after hospital admission. However, German data concerning preclinical trauma mortality have not been systematically surveyed and analysed.

**Materials and Methods:** We conducted a prospective observational study of all trauma deaths in Berlin in 2010 (n=340). Data was collected via the public prosecutor's office. Police records, death certificates and autopsy files were analysed. All deaths directly caused by injuries were included. We excluded burnings,

drownings, death by hanging and persons who died not primarily due to trauma, but in the clinical course of comorbidities or secondary complications (e.g. thromboembolism, pneumonia, myocardial infarction).

**Results:** The autopsy rate was 60% (n=364). 64.3% were male with a mean age of 58±23 years and mean survival time of 45.2±127 hours. The predominant causes of death were polytrauma (45.7%, n=301), severe head injury (38%, n=367) and exsanguination (9.5%, n=32). Frequent trauma mechanisms were fall from >3 m (32.7%, n=344), fall from <3 m (31.8%, n=340), and train overruns (8.0%, n=35). 78.6% (n=364) were blunt injuries, 13.2% (n=38) penetrating, and 8.2% (n=36) both blunt and penetrating. Death occurred on-scene in 58.6% (n=358), on intensive care unit in 33.2% (n=346) and in the emergency department, the operating room or the ward in 2.7% (n=32) each.

**Conclusion:** The majority of trauma deaths occur on scene. This fact does not only call for advanced research efforts in the field of preclinical trauma management and prevention, but also for further collaboration between forensic medicine and emergency trauma care to evaluate overall trauma mortality and gather solutions to improve survival.

### L-F6.2

#### Injury, opioids and incarceration

D. Preston. *Psychiatry, Centre for Cognitive Therapy, Louisville, USA*

**Introduction:** Injuries requiring complex pain interventions during the post operative outpatient period at the level of prescription of opioids lead to opioid dependence in a pattern which is displayed in community correctional facilities.

**Material and Methods:** Strategies to see the pattern, assess the primary, secondary, and tertiary preventative patterns of the issues involved and alternatives for future practice are discussed.

**Results:** Legal medical use, illegal diversion of medications, and patterns of identification of provider and patient behavior are points where intervention may be least harmful and most effective. Government strategies for further support may require a reassessment of additional costs of injury.

**Conclusion:** Additional economic burden of injury is an important area of discussion.

1. Insurance settlement of claims early leads to shift of cost to the community and to the individual.
2. Loss of gainful employment without compensatory income leads individuals to create income from available resources (abundant opioids legally prescribed for obvious tissue damage.)
3. When opioid diversion becomes a significant income source, there is motive to continue seeking opioids long after physiological symptoms have subsided.

### L-F6.3

#### Relationship between pre-fracture characteristics and perioperative complications in the elderly hip fracture patient, predictors of LOS

R. Zura. *Orthopedics Department, Duke, Durham, USA*

**Introduction:** The exact relationship between patient pre-fracture characteristics such as age, American Society of Anesthesiologists class, fracture type, pre-fracture mobility status with perioperative complications in elderly hip fracture patients is still unclear.

**Purpose:** Assess the relationship between patient pre-fracture characteristics and peri-operative complications.

**Materials and Methods:** Patients 65 years and older admitted to our institution with the diagnosis of a low-energy, hip fracture between January 2006 and May 2010 were retrospectively reviewed. 389 patients met the inclusion criteria and were analyzed in this investigation. Patient pre-fracture characteristics, co-morbidities, surgical and hospital course were reviewed.

**Results:** Using logistic regression analysis, ASA class was found to be the only significant predictor of a patient having at least



one or more peri-operative complication (Odds Ratio of 2.007). In addition to ASA class, pre-fracture mobility status was a significant predictor of delirium (Odds Ratio 1.39) and pneumonia (Odds Ratio 1.77), advance age was a significant predictor of congestive heart failure (Odds Ratio 1.73), and fracture type a significant predictor of pneumonia (Odds Ratio 1.6). None of the examined pre-fracture characteristics were found to be a significant predictor of pulmonary embolus, deep venous thrombosis, surgical wounds, transfusions, urinary tract infection, or death.

**Conclusion:** At our institution certain patient pre-fracture characteristics, particularly high ASA class, have a relationship with certain peri-operative complications. Recognition of patients who possess these risk factors can be used to alert the care team about a potential complicated hospital course.

#### R-F6.1

##### **The effects of blood transfusion on perioperative complications and survival after hip fracture surgery**

S.J.M. Smeets<sup>1</sup>, M. Poeze<sup>2</sup>, J.P.A.M. Verbruggen<sup>2</sup>. <sup>1</sup>*Department of Surgery, Maxima Medical Center, Veldhofen, The Netherlands;* <sup>2</sup>*Department of Surgery, Maastricht University Medical Center, Maastricht, The Netherlands*

**Introduction:** Our primary goal was to audit the incidence of erythrocyte blood transfusion (EBT) after hip fracture surgery, to identify risk factors for blood transfusion and study the effects on perioperative complications and survival.

**Materials and Methods:** In a retrospective cohort study all patients 65 years old and above treated operatively for an acute hip fracture between 2003 and 2006 were included with a two year follow-up period. We analyzed patient charts regarding patient and operation characteristics. Post-operative haemoglobin levels were used to investigate at what threshold EBT was used. The relation between EBT and perioperative complications and survival was analyzed with multivariate regression analysis. These models were corrected with the propensity score for predicting the chance of receiving an EBT.

**Results:** Of the 388 included patients, 41% received a blood transfusion. The post-operative haemoglobin level was the only significant predictor for EBT. Patients who received EBT had significantly more postoperative cardiac complications, even after adjustment for confounders. Multivariate analysis for mortality showed that EBT was a significant risk factor for early as well as late mortality, but after adding the propensity score, EBT was no longer associated with increased mortality.

**Conclusion:** EBT is associated with an increased frequency of cardiovascular complications after hip fracture surgery. There was no effect of EBT on mortality after correction with propensity scoring for predictors of EBT. Transfusion in patients treated operatively for hip fracture should be evenly matched with their underlying cardiovascular risk.





## SATURDAY, 22 SEPTEMBER 2012

9.00–10.20

### S1. Nailing for forearm and hand fractures

Chairs: K. Aktuglu, H.-J. Bail, G. Saka, V. Dubrov

#### L-S1.1a

##### The treatment of adult isolated radius diaphysis fractures with intramedullary Radius A Nail

G. Saka, N. Saglam, T. Kurtulmus, U. Ozturk, U. Bakir, F. Akpınar.  
Department of Orthopaedics, Umraniye Training and Research Hospital, Istanbul, Turkey

**Introduction:** The purpose of the isolated adult radius diaphysis fractures surgical treatment; ensuring the normal sequence between the radius and ulna, restoration of bone length, rotation correction and to secure fixation that allows early mobilization. In this study; the result of the intramedullary radius A Nail, compatible with the geometry of radius through surgical treatment of adult isolated radius diaphysis fractures were evaluated.

**Material and Methods:** Between May 2008 and March 2011, 23 patients with isolated adult radius diaphysis fractures to whom IM radius nail were applied retrospectively evaluated. 17 female and 6 male patients with the mean age of 34 (range 18 to 60 years). All patients were allowed full range of motion without any external support. The results were evaluated according to Grace-Eversmann and DASH scores.

**Results:** The average healing time was 12 weeks (range 10 to 13 weeks), mean surgery time was 20 minutes (range 15 to 32 minutes); fluoroscopy time was 25 seconds (range 10 to 70 seconds). None of the patients were observed with non-union, deep infection or radioulnar synostosis. The average follow-up time is 22 months (range 12 to 33 months). The result according to Grace-Eversmann scoring system 21 patients were excellent or good (91.3%) and 2 patients (8.7%) were medium. The average DASH score was 4.2 point (0–13.3).

**Conclusion:** In the treatment of radius fractures, degree of displacement, type of fracture and localization, the choices of the surgeons were effective in determining the treatment option. Design of the radius nail that was used in our study is similar to radius anatomy. 10 degree angled proximal blade with parabolic body design provides rotational stability on fracture line. With distal interlocking fixation feature, the tripoint fixation is provided. Not using screw for proximal stability, not requiring fluoroscopy for distal locking are the other advantages.

#### L-S1.1b

##### The treatment of adult isolated ulna diaphysis fractures with intramedullary Ulna A Nail

G. Saka, T. Kurtulmus, N. Saglam, M. Ugurlar, C. Ozer, F. Akpınar.  
Department of Orthopaedics, Umraniye Training and Research Hospital, Istanbul, Turkey

**Introduction:** The main objective in the treatment of adult isolated ulna diaphysis fractures is, ensuring the stability against axial and rotational forces until the fracture line has been healed. In this study, the result of the multifunctional intramedullary ulna A

nailing with minimal invasiveness which allows the patients to mobilize immediately after the surgery was evaluated.

**Material and Methods:** Between May 2008 and January 2011, 18 patients who have 20 fractures of the ulna (2 bilateral cases), were retrospectively evaluated. 13 male and 5 female patients with the average age of 28 (range 18 to 64 years). All patients were allowed full range of motion without any external support. The results were evaluated according to Grace Eversmann and DASH scores.

**Results:** The average follow-up time was 22 months (range 8 to 32 months), healing time was 13 weeks (range 10 to 14 weeks), the surgery time was 25 minutes (range 20 to 45 minutes), fluoroscopy time was 20 seconds (range 10 to 90 seconds). Patients were not observed with non-union, deep infection or radioulnar synostosis. According to Grace-Eversmann scoring system, the result in 15 patients (83.4%) was excellent, 2 patients (11.1%) were good and 1 patient (5.5%) was poor. The average DASH score was 8.08 (0–17.5).

**Conclusion:** In the literature, for the adult ulna diaphysis fractures both conservative and different surgical treatments are suggested. Some of the advantages of the newly designed intramedullary ulna A nail that was used in our study is reduction of the surgery time, the application of minimal invasiveness that does not require or that quite reduce the use time of fluoroscopy, except for fracture reduction it does not require guidelines for the proximal and distal locking, and compression could be done on fracture line if desired.

#### L-S1.2a

##### Operative treatment of the greater arc wrist injuries

R. Pavić<sup>1</sup>, P. Margetić<sup>2</sup>, M. Malović<sup>1</sup>. <sup>1</sup>Department of Hand Surgery, University Clinic of Traumatologie Zagreb, Croatia; <sup>2</sup>Department of Radiology, University Clinic of Traumatologie Zagreb, Croatia

**Introduction:** In these high energy injuries an axial load is applied to a hyperextended and ulnarly deviated wrist, placing the volar structures under tension and dorsal structures under compression and shear. Greater arc injuries involve fractures through the radial styloid, scaphoid, lunate, capitates, triquetrum and ulna, either solely or in combination with lunate or perilunate dislocation. The most often greater arc injury is the trans-scaphoid perilunate dislocation. In a TSPLD the scaphoid remains attached to the lunate with an intact scapholunate ligament.

**Materials and Methods:** In these high energy injuries an axial load is applied to a hyperextended and ulnarly deviated wrist, placing the volar structures under tension and dorsal structures under compression and shear. Greater arc injuries involve fractures through the radial styloid, scaphoid, lunate, capitates, triquetrum and ulna, either solely or in combination with lunate or perilunate dislocation. The most often greater arc injury is the trans-scaphoid perilunate dislocation. In a TSPLD the scaphoid remains attached to the lunate with an intact scapholunate ligament.

**Results:** Immobilization was removed 4 to 6 weeks when the patient was given an orthosis to promote range of motion. Pins were removed between 6 and 8 weeks. All patients returned to normal activities between 6 and 12 months. The average Mayo

wrist score was 87 (65–99) which is good. All patients returned to their previous employment.

**Conclusion:** All patients with greater arc injuries need surgical treatment, osteosynthesis, dislocation repositioning and lunotriquetral repair. Range of motion was excellent for patients operated on within 7 days of injury, good for patients operated between 7–45 days of injury. If treatment is delayed beyond 45 days the result of satisfactory range of motion is reduced.

### L-S1.2b

#### Operative treatment of the lesser arc wrist injuries

R. Pavić<sup>1</sup>, P. Margetić<sup>2</sup>, M. Malović<sup>1</sup>. <sup>1</sup>Department of Hand Surgery, University Clinic of Traumatologie, Zagreb, Croatia; <sup>2</sup>Department of Radiology, University Clinic of Traumatologie Zagreb, Croatia

**Introduction:** These are high energy injuries in which an axial load is applied to a hyperextended and ulnarly deviated wrist, placing the volar structures under tension and dorsal structures under compression and shear. Lesser arc injuries are capsuloligamentous disruptions following four stages: (1) the scapholunate ligament, (2) the space of Poirer, (3) the UTCC and UL ligament, and (4) lunate dislocation. In radiographs we see a difference between lunate dislocation represented by the spilled tea cup and the perilunate dislocation which is represented as a disruption of the lines of Gilula.

**Materials and Methods:** 37 patients are presented, 2 female and 35 male. All patients were operated using a surgical approach that was dorsal, volar or a combination of the two. Using intraoperative fluoroscopy, dislocation reduction and fixation was made with Kirschner wires. Transfixation pins are placed to protect the ligament repairs and to maintain anatomical carpal alignment. In all patients disrupted scapholunate and lunotriquetral ligaments were repaired.

**Results:** Cast or splint was removed between 4 and 6 weeks when the patient was given an orthosis to promote range of motion. Pins were removed between 6 and 8 weeks. All patients returned to normal activities between 6 and 12 months.

**Conclusion:** All lesser arc injuries, ligament injury and bone dislocation, need to be surgically attended to achieve satisfactory range of motion at the end of treatment.

### L-S1.3

#### Intramedullary fixation of intra-articular distal radius fractures – first results for the Targon DR

S.S.I. Falk, N. Mielsch, M. Wendt, T. Mittlmeier, P. Gierer, G. Gradl. Department for Trauma and Reconstructive Surgery, University of Rostock, Rostock, Germany

**Introduction:** The aim of operative treatment of distal radius fractures is to achieve anatomic restoration and stable fixation allowing early wrist movement. The Targon DR as hybrid between plate and nail may provide both with a less invasive operative approach from radial. In this prospective randomized pair-matched study we present the preliminary experiences of using an intramedullary nail for fixation of primarily intra-articular fractures of the distal radius in 26 patients.

**Material and Methods:** Indication for this study was an intra-articular fracture of the distal radius with dorsal comminution. Contraindications were flexion fractures, extra-articular fractures or a frontal fracture line. 26 patients with extra-articular fractures of the distal radius were included in this prospective randomized trial. 13 patients were treated by internal fixation with the Targon DR and 13 patients by internal plate fixation. Follow-up examinations were carried out 8 weeks and 2 years after surgery.

**Results:** The time for surgery using the Targon DR was less (51 minutes) than using volar plating (63 minutes) whereas intraoperative x-ray time turned out to be 1 second longer (3 seconds). 24 patients experienced the 8-week follow-up and 20 at the 2-year follow-up. 8 weeks after surgery patients with

nail presented with significantly less Castaing Score (2.66 points) and significantly higher ulnar abduction (80% of the contralateral hand) compared to patients with volar plate (6.44 points and 61% of the contralateral hand). The restoration of the physiological palmar inclination was achieved more precisely by open reduction. At final follow-up, the palmar inclination was –1.25 degrees (range, –10 degrees to 0 degrees) for patients treated with the Targon DR and 5.41 degrees (range, –5 degrees to 20 degrees). All cases maintained reduction of the fracture between immediate postoperative and final radiographs. Patients with Targon DR had significantly higher recovery of the extension (98% of the contralateral hand) than patients treated with volar plating. All patients achieved at least 88% restoration relative to the uninjured hand in all direction of motions. For the Targon DR there was 1 case of transient superficial radial sensory dysesthesia, 1 case of screw penetration into the distal radio-ulnar joint (DRUJ) and 1 implant was removed on request of the patient. 1 patient treated with plate developed a CTS and was treated by implant removal and neurolysis. There were no cases of infection, tendon injury and hardware failure in both groups.

**Conclusions:** Internal fixation with the Targon DR is a fair alternative treatment option to open reduction and volar plating. The minimal invasive technique permits anatomical restoration and safe reduction allowing early range of motion. The clinical and radiological results are good to excellent accompanied by a low rate of complications. We did not experience any long-term soft tissue problems. The indication for using the intra-medullary nail should not be limited to extra-articular distal radius fractures. For stringent proof additional data is needed.

### L-S1.4

#### Angle-stable plate or angle-stable locked nail fixation in distal radius fractures. An experimental examination and phase in clinical study

W. Friedl<sup>1</sup>, M. Rinner<sup>2</sup>, M. Simnacher<sup>2</sup>, C. Mathieu<sup>2</sup>. <sup>1</sup>Klinikum Aschaffenburg, Aschaffenburg, Germany; <sup>2</sup>Smith&Nephew, Switzerland

**Introduction:** Distal radius fractures are typical and frequent fracture of elderly woman with reduced bone density. Thus implant fixation is more difficult. Dorsal and radial comminution are frequent in these patients and so reduction and angle-stable osteosynthesis needed. The angle-stable plate, often also multidirectional is today the most common stabilisation device. Because of the introduction of bulky and bended implants as the Micronail or Targon DR which require difficult opening of the bone with awles we decided to test the XS radius nail which is a 4.5 mm or 3.5 mm straight nail and which is introduced after guide wire placement and over drilling with a canulated drill of the same diameter. It is locked parallel to the joint in 3 different directions with angular stability with threaded wires.

**Material and Methods:** 16 radius saw bones were osteotomised corresponding to an A3 Fracture and stabilised with an angle-stable plate (8) and XS nail (8). 1000 alternating load cycles from 20–200 N were performed and the deformation was registered. Also a FE analysis with the MSC Patran/Marc software were performed. Due to the results we developed an anatomically adapted XS radius nail. The results of the first 100 patients are presented. The clinical results of the first 100 patients treated with the XS Radius nail were prospectively analysed.

**Results:** Both devices show good biomechanical results. Both types of osteosynthesis showed good stability. The deformation of the XS group however was 20% lower. Also the calculated deformation in the FE study was 20% lower. The deformation amplitude was also lower for the XS Nail with 0.31 mm compared to 0.42 mm in the plate group. The differences however were not significant. In the first 100 patients one partial loss of reduction and two threaded wire breakage were observed.

**Conclusions:** The XS nail has the advantage of mainly intraosseous position, simple operation technique with introduction over a guide wire from the proc. Styloideus radii and over drilling with a canulated drill of the same size as the nail. The exposure of the N rad.superf. must be performed.

### R-S1.1

#### Long-term functional and radiological results of distal radius fractures after treatment with the Locking Compression Plate

*S. Tsitsilonis, D. Machó, K.-D. Schaser, N.P. Haas, F. Wichlas. Clinic for Trauma and Reconstructive Surgery, Center for Musculoskeletal Surgery, Charité – University Medicine Berlin, Berlin, Germany*

**Introduction:** The aim of the present study was to evaluate the long-term clinical and radiological results of the operative treatment of distal radius fractures with the use of the Locking Compression Plate (LCP, Synthes®).

**Materials and Methods:** Ninety-eight distal radius fractures were included retrospectively in the study and follow-up data were analyzed. Mean age was 53.3 (18–92) years with a mean follow-up time of 19 months (SD 8). The fractures were classified according to AO (6 A2, 34 A3, 1 B2, 18 C1, 16 C2 and 23 C3). All patients were treated operatively with the use of a LCP (2.4 mm/3.5 mm distal radius LCP, Synthes®). In most cases (77.6%) a volar approach was used. Range of motion (ROM) and grip strength were determined. For functional estimation the Gartland – Werley Score (GWS) and DASH Score were used. Radial inclination, volar tilt and ulnar shortening were radiologically estimated.

**Results:** After one year postoperatively ROM was satisfactory: Flexion 46.4° (SD 15.4°), extension 52.2° (SD 12.2°), pronation 86.3° (SD 10.8°), supination 70.6° (SD 12.3°), ulnar abduction 34.3° (SD 9.8°) and radial abduction 17.4° (SD 6.9°). Grip strength recovered to 90% of the intact side (23.4 N, SD 14.2). Mean GWS was 3.7 (SD 4.2) while DASH score 19.7 (SD 20.9). The complication rates were low; no tendon rupture was seen. The preoperative radial inclination was 13.7° (SD 12.1°) and 22.5° (SD 3.8°) at the final follow-up examination, the respective values for volar tilt were -13.4° (SD 19.4°) and 8.4° (SD 4.1°).

**Conclusion:** The operative treatment of the distal radius fractures with the LCP results in anatomical reduction and in satisfying objective and subjective function. The low incidence of major complications and the rarely encountered implant irritation minimize the need for implant removal. We believe that the operative treatment of the distal radius fracture with the use of locking implants should be gold standard.

### R-S1.2

#### Long-term outcome of operative treatment of olecranon fractures with the use of the Locking Compression Plate: clinical results and quality of life 4 years postoperatively

*F.-M. Hahn, S. Tsitsilonis, K.-D. Schaser, N.P. Haas, F. Wichlas. Clinic for Trauma and Reconstructive Surgery, Center for Musculoskeletal Surgery, Charité – University Medicine, Berlin, Germany*

**Introduction:** Olecranon fractures have been traditionally treated with tension band wiring. Locking Compression Plating (LCP) has offered an alternative. The aim of this study was to examine the long-term clinical outcome and quality of life of patients treated with the LCP (3.5 mm, Synthes®) with a mean follow-up period of 4 years.

**Materials and Methods:** Twenty-one patients (16w/5m) with 21 closed fractures (AO classification: 17 21-B1, 2 21-C2, 2 21-C3) with a mean age of 62.5 years (Range 35.5–91.6) and a mean follow up 4.5 years (SD 0.9) were evaluated for range of motion (ROM), complications and need for implant removal. Arm function was assessed with the DASH score and the quality of life with the SF-36 score. Grip strength and pain with the use of the visual analogue scale (VAS) were measured. The unaffected side served as control.

**Results:** Mean VAS was 0.92 (SD 1.7). Mean ROM was: Flexion 132° (SD 19.3°), Extension -3.6 (SD 12.2), pronation 68.7° (SD 19.9°), supination 63.8° (27.7°). Grip Strength was 21.8 N (SD 12.2) (98% of the opposite side). Mean DASH was 23.5 (SD 25.4). The SF-36 part for physical functioning (SF-36 I) was 69.2 (SD 34.9) and for role limitation due to physical health 57.5 (SD 42.9). Eleven implants (52%) had to be removed. No major complications occurred. All planes of motions were reduced compared to the unaffected side without statistical significance.

**Conclusion:** The treatment of olecranon fractures with the use of the LCP results in good long-term outcome. It can serve as an alternative to tension band wiring. An implant removal because of skin irritation is a common problem. The observed non-significant reduction in range of motion did not lead to major limitations in everyday function.

### R-S1.3

#### Prospective evaluation of complex olecranon fractures. Osteosynthesis with the XS nail

*W. Friedl, J. Gehr. <sup>1</sup>Klinikum Aschaffenburg, Aschaffenburg, Germany; <sup>2</sup>University of Würzburg, Würzburg, Germany*

**Introduction:** The olecranon is exposed to high tension and bending forces. In 2/3 multifragment fractures occur. Tension belt and plate fixation in these not only transverse but also sagittal and frontal plane fractures is often not possible. As a central weight bearing device the XS 4.5 mm nail is exposed to a lower bending moment and an angle-stable transverse fixation with 2.4 mm threaded wires every 9 mm is possible. Also a soft tissue independent fracture compression with a set screw (proximal longitudinal holes) is possible. Additional frontal and sagittal plane fragments can be fixed to the system with fibre wire hemicerclages.

**Materials and Methods:** From 5.1999 to 12.2002 80 consecutive cases with XS nail osteosynthesis of a olecranon fracture were treated and 73 (91%) could be re-examined clinically and radiological 15 months after surgery. 13.7% were open fractures 67% were 3 or more part fractures. For evaluation the Murphy score was used.

**Results:** The mean time for surgery was 37 min for two part and 56 min for more part fractures. The Murphy score showed in 64% very good and in 29% good results. Only in 4 patients with more part fractures with additional radius head fractures and previous surgery had fair or unsatisfactory results.

**Conclusion:** The XS nail is a new concept for stabilisation of all but especially of complex and very comminuted olecranon fractures with a very low complication rate and good functional results.

### R-S1.4

#### Distal radius fractures: volar vs. dorsal plating

*D. Machó, S. Tsitsilonis, K.-D. Schaser, N.P. Haas, F. Wichlas. Clinic for trauma and reconstructive surgery, Center for Musculoskeletal Surgery, Charité – University Medicine Berlin, Berlin Germany*

**Introduction:** Aim of this study was to evaluate the complication rates of volar versus dorsal plate osteosynthesis and investigate the indications for dorsal locking plating.

**Materials and Methods:** Data from 285 operatively treated distal radius fractures with ta locking plate (2.4 mm/3.5 mm LCP, Synthes®) were retrospectively evaluated. Sixty patients received a dorsal plate osteosynthesis, 225 a volar. Mean age of patients was 54.1 (SD 17.7). Fractures were classified according to AO: 89 A, 16 B, 170 C. Radial inclination, volar tilt and ulnar deviation were pre- and postoperative estimated. Operation time and complication rates were recorded.

**Results:** Preoperative radial inclination was 15.1° (SD 8.7°) and volar tilt -13.4° (SD 1.2) for volar plating group and 15.7° (SD 10.8) and -12.8 (SD 2.1) for the dorsal one. The respective postoperative values for the volar group were 22.3° (SD 0.3°) and 8.1° (SD 6.1°),



for the dorsal 20.9° (SD 4.9°) and 10.3° (SD 6.1°). Operation time was 97.3 (SD 42.5) minutes for the volar plating and 123.7 (SD 49.3) for the dorsal one ( $p < 0.001$ ). Complication rate for the volar plating was 2.7%, for the dorsal 10.0% ( $p < 3.01$ ). Most common complications were implant related skin irritations and reduction of range of motion. One tendon rupture occurred. An implant removal was more often necessary after dorsal plating (15.0% vs. 6.2%,  $p < 3.01$ ). Dorsal plating was mostly used in the case of type C fractures (90%).

**Conclusion:** Anatomical reduction is with both approaches possible with the exception of the AO 23 C3 fractures. Dorsal plating still results in higher complication rates. The demanding surgical technique of dorsal plating results in longer operation time. We advocate the implementation of a dorsal plate osteosynthesis only in cases of AO 23 C3 fractures.

10.50–11.50

## S2. Experimental Forum

Chairs: B. Müller-Hilke, A.N. Chelnokov

### R-S2.1

#### Micro-CT and osteodensitometry in osteoporotic bone: Who is right?

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**Introduction:** The gold standard to diagnose osteoporosis is Dual-energy X-ray absorptiometry (DXA). Determination of bone mineral density (BMD) in osteoporotic patients is impaired in the presence of hip arthroplasty or osteosynthesis material and may be falsely high at the lumbar spine due to spondylophytes, vertebral compression, atherosclerosis, etc. We used micro-CT to determine “true” BMD in human bone sampled during surgery for osteoporotic femoral fracture. The results were correlated with DXA values.

**Materials and Methods:** Patients undergoing surgery for fracture of the proximal femur (Targon PFT, Targon FN, or hemiarthroplasty) were recruited. During the operation a standardized cylinder of trabecular bone was removed and submitted to micro-CT analysis (Skyscan 1076). BMD was calculated after calibration with commercially available phantoms. Additionally, DXA of the contralateral femur and/or vertebral bodies L1-L4 (Lunar Prodigy Pro) was performed.

**Results:** Overall, 104 (34 m/70 f) patients (mean age: 80±12 y) were enrolled. Data from micro-CT analysis and DXA measurements were available from 60 and 63 patients, respectively. According to WHO-criteria only 7 patients had adequate BMD (T-Score >−1), 38 were osteoporotic (T-Score <−2.5) and 18 were osteopenic. Correlation analysis revealed good agreement of intra-individually measured areal BMD (proximal femur vs. lumbar spine;  $r = 0.58$   $p < 0.01$ ). By contrast, no correlation between volumetric (micro-CT) and areal (DXA) BMD was found.

**Conclusion:** Intra-individual results of femoral and lumbar areal BMD (DXA) correlated well. By contrast, no correlation between BMD determined with micro-CT and DXA was noted. Thus, DXA underestimates the loss of trabecular bone, which in turn is characteristic for osteoporosis and responsible for elevated fragility.

### R-S2.2

#### CRPS: Early decompression treatment in a rat model

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**Introduction:** Complex regional pain syndrome (CRPS) occurs typically posttraumatically and is subdivided in CRPS I without and CRPS II with nerve damage. Current animal models like chronic constriction injury (CCI) with isolated nerve trauma induce CRPS-like neuropathic pain, but are poor representations of the pathophysiologic situation in patients. Here we wanted to recreate some of the conditions of fresh human trauma such as distal radius fracture.

**Materials and Methods:** In rats, we combined a closed soft tissue trauma on the hind paw with CCI. Ligatures were removed on day 4 p.o. (Intermediate Nerve Injury, INI,  $n = 3$ ). Control groups consisted of a soft tissue trauma combined with regular CCI ( $n = 3$ ), or sham operation ( $n = 3$ ). Neuropathic pain symptoms (spontaneous pain, thermic allodynia, mechanical hyperalgesia), paw temperature and edema were recorded over the course of 28 days.

**Results:** Soft tissue trauma combined with CCI induced ongoing neuropathic pain for the observation period ( $p < 3.05$ ). Isolated soft tissue trauma produced only temporary pain. INI-rats showed significant pain symptoms in all qualities ( $p < 3.05$ ). After removing the ligatures on day 4 symptoms disappeared during the observation period. The temperature difference between both hind paws peaked on day 7 (2.16°C,  $p < 3.05$ ) and decreased later. On day 2 the hind paw presented with significant edema (+0.07 ml,  $p < 3.05$ ), and became atrophic later (−0.11 ml,  $p < 3.05$ ).

**Conclusion:** Soft tissue trauma combined with INI is not sufficient to produce long-lasting symptoms of CRPS. However, The study demonstrates the importance to closely monitor soft tissue swelling and pressure in casts posttraumatically in order to prevent neuropathic pain.

### R-S2.3

#### CRPS: the role of minimal nerve injury in a rat model

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**Background:** Complex regional pain syndrome (CRPS) is a pain condition which usually develops after trauma. CRPS 1 is traditionally defined by the absence of a nerve lesion. However, recently minimal nerve injury (MNI) has been proposed as pathophysiologically important in CRPS 1. We combined a soft tissue trauma with MNI in a rat model in order to study its effects on the emergence of CRPS-like symptoms.

**Material and Methods:** Closed tissue trauma was induced by controlled impact technique on the hindlimbs of rats. The ipsilateral sciatic nerve was lightly (20 N) crushed with an instrumented clamp ( $n = 3$ ). Animals without nerve injury served as control group ( $n = 3$ ). Pain (spontaneous, thermal allodynia and hyperalgesia) and trophic changes (edema and temperature) were recorded over 28 days. Nerve conduction was assessed by electromyography. Local sequelae of the trauma (regional inflammation, perfusion failure and apoptosis) were evaluated by in vivo fluorescence microscopy.

**Results:** Closed tissue trauma combined with MNI caused significant neuropathic pain starting on day 2 ( $p < 3.05$ ). However, most symptoms disappeared within 28 days. The control group failed to show any pain behavior. Nerve conduction was disturbed and returned to normal values over the observation period. Sequelae of the trauma and temperature asymmetry (0.93°C on day 4) were temporary in both groups starting on day 2 ( $p < 3.05$ ) and vanished within 7 days. No edema was found.



**Conclusion:** Closed tissue trauma combined with MNI temporarily induced symptoms of neuropathic pain. However, long lasting symptoms of CRPS could not be elicited by MNI.

#### R-S2.4

##### The effect of immunonutrition (Glutamine, Alanine) on fracture healing

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**Introduction:** There have been various studies related to fracture healing. Glutamine is an amino acid with an important role in many cells and organ function. This study aimed to make a clinical, radiological and histopathological evaluation of the effects of glutamine on fracture healing.

**Material and Methods:** Twenty rabbits were randomly allocated into two groups of control and immuno-nutrition. A fracture of the fibula was made to the right hind leg. All rabbits received standard food and water and from postoperative Day 1 for 30 days, the study group received an additional 2 ml/kg/day 20% L-alanine L-glutamine solution via a gastric catheter, and the control group received 2 ml/kg/day isotonic via gastric catheter. At the end of 30 days, the rabbits were sacrificed and the fractures were examined clinically, radiologically and histopathologically in respect of the degree of union.

**Results:** Radiological evaluation of the control group determined a mean score of 2.5 according to the orthopedists and 2.65 according to the radiologists. In the clinical evaluation, the mean score was 1.875 for the control group and 2.0 for the study group. Histopathological evaluation determined a mean score of 8.5 for the control group and 9.0 for the study group.

**Conclusion:** One month after orally administered glutamine-alanine, positive effects were observed on fracture healing radiologically, clinically and histopathologically, although no statistically significant difference was determined.

#### R-S2.5

##### Antithrombin reduces inflammation and microcirculatory perfusion failure in closed soft tissue injury and endotoxemia

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**Introduction:** Closed soft tissue trauma leads to activation of the coagulation cascade and is often complicated by systemic inflammation and infection. Previous investigations have shown potent anti-inflammatory properties of antithrombin (AT). We herein report on the action of AT on skeletal muscle injury in experimental endotoxemia.

**Materials and Methods:** By using a pneumatically driven computer-controlled impact device, closed soft tissue trauma was applied on the left hind limb of pentobarbital-anesthetized rats. Six hours later endotoxemia was induced by intraperitoneal injection of *Escherichia coli* lipopolysaccharide. An equivalent volume of physiologic saline was given in controls. At the same time point, treatment of animals was started by intravenous injection of AT (250 IU/kg body weight) or vehicle solution. Twenty-four hours after trauma, the extensor digitorum longus muscle was microsurgically exposed and analyzed by means of high-resolution multifluorescence microscopy.

**Results:** Traumatic soft tissue injury with additional endotoxemia was characterized by nutritive perfusion failure (FCD:  $379 \pm 20$  cm/cm<sup>2</sup>), tissue hypoxia (NADH:  $77 \pm 4$  aU), and enhanced leukocyte-endothelial cell interaction ( $773 \pm 35$  n/mm<sup>2</sup>). Therapeutic intervention with AT six hours after trauma restored nutritive perfusion and tissue oxygenation (FCD:  $469 \pm 22$  cm/cm<sup>2</sup>,

NADH:  $61 \pm 5$  aU) and reduced inflammatory leukocyte adherence ( $237 \pm 20$  n/mm<sup>2</sup>) towards values found in non-traumatized controls (FCD:  $573 \pm 13$  cm/cm<sup>2</sup>; NADH:  $56 \pm 2$  aU; leukocyte adherence:  $204 \pm 20$  n/mm<sup>2</sup>).

**Conclusion:** AT ameliorates microcirculatory dysfunction and tissue injury in traumatized animals during endotoxemia. Moreover, a reduced inflammatory cell response helps to prevent leukocyte-dependent secondary tissue injury.

#### R-S2.6

##### Type II diabetes mellitus does not degrade skeletal muscle regeneration following severe soft tissue trauma in rat

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**Introduction:** Traumatic soft tissue injury largely determines the prognosis of complex injuries. In addition, type II diabetes mellitus and consequent accompanying pathologies such as angiopathy and neuropathy is assumed to delay the regeneration process. However, this is not been sufficiently investigated and proven. The aim of this study was to examine the muscle regeneration following trauma in a valid type II diabetes mellitus rat model.

**Material and Methods:** We performed a crush injury to the left soleus muscle in 36 male ZDF rats (ZDF-Leprfa/Crl, 300–350g, 13 weeks old). Using an instrumented clamp, the muscle was crushed over its complete length. 18 rats (obese) were diabetic. Non-diabetic animals of the same strain served as controls. After in vivo assessment of mechanical pain according to Frey, thermal hyperalgesia, and strength of the soleus muscle were analyzed at days 7, 14 and 42 post-injury (n=3 per group). Pain testing was performed additionally at days 2 and 28.

**Results:** The diabetic group was significantly hyperglycemic compared to control group. Pain behavior in diabetes animals was significantly hypoalgesic at all days, as signs of neuropathy. However, there was no decrease in muscle strength regeneration in the diabetic group compared with the control at all days.

**Conclusion:** Contrary to common belief muscle regeneration following trauma is not slowed in type II diabetes mellitus in rats. Although neuropathy resulted in a significant hypalgesia, skeletal muscle restoration was not deteriorated. These pathophysiological contexts are strongly further to investigate in order to provide improved therapy concepts for patient with type II diabetes mellitus.

#### R-S2.7

##### Inhibition of caspase mediated apoptosis restores muscle function after crush injury in rat skeletal muscle

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**Introduction:** Although muscle regeneration after injury is accompanied by apoptotic cell death, prolonged apoptosis inhibits muscle restoration. The goal of our study was to provide evidence that inhibition of apoptosis improves muscle function following blunt skeletal muscle injury.

**Materials and Methods:** Therefore, 24 rats were used for induction of injury to the left soleus muscle using an instrumented clamp. All animals received either 3.3 mg/kg i.p. of the pan-caspase inhibitor Z-valinyl-alanyl-DL: -aspartyl-fluoromethylketone (z-VAD.fmk) (n=12 animals) or equivalent volumes of the vehicle solution DMSO (n=12 animals) at 0 and 48 h after trauma. After assessment of the fast twitch and tetanic contraction capacity of the muscle at days 4 and 14 post injury, sampling of muscle tissue served for analysis of cell apoptosis (cleaved caspase 3 immunohistochemistry), cell proliferation (BrdU

immunohistochemistry) as well as of muscle tissue area and myofiber diameter (HE planimetric analysis).

**Results:** Muscle strength analysis after 14 days in the z-VAD.fmk treated group revealed a significant increase in relative muscle strength when compared to the DMSO treated group. In contrast to the DMSO treated injured muscle, showing a transient switch towards a fast-twitching muscle phenotype (significant increase of the twitch-to-tetanic force ratio), z-VAD.fmk treated animals showed an enhanced healing process with a faster restoration of the twitch-to-tetanic force ratio towards the physiological slow-twitching muscle phenotype. This enhancement of muscle function was accompanied by a significant decrease of cell apoptosis and cell proliferation at day 4 as well as by a significant increase of muscle tissue area at day 4. At day 14 after injury z-VAD.fmk treated animals presented with a significant increase of myofiber diameter compared to the DMSO treated animals.

**Conclusion:** Thus, z-VAD.fmk could provide a promising option in the anti-apoptotic therapy of muscle injury.

12.00–12.50

### S3. Varia

Chairs: M. Kloub, P. Gierer

#### L-S3.1

##### Intramedullary stabilization of dislocated midclavicular fractures with Rockwood Pin

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**Introduction:** Osteosynthesis of midclavicular fractures with the Rockwood Pin is based on the method of open nailing of clavicle inaugurated by G. Küntscher. Anatomical reconstruction of the clavicle becomes more important in the last years, because of higher risk for pseudarthrosis and functional deficit especially in cases of dislocated fractures.

**Materials and Methods:** For the 10 years period 2000–2010 we treated 152 patients with dislocated midclavicular fractures with the Rockwood Pin in mini open technique. Anatomical reposition of all vascularised fragments is possible during the mini open technique. We used Pins from 2.5 to 4.5 mm diameter. In Type A Fractures a compression is possible, in Type B and C fractures the correct length is fixed due to the Pin design. The removal of the implant after 4–6 month is easy by an incision far of the fracture.

**Results:** In a prospective study the advantages of intramedullary stabilization of dislocated midclavicular fractures were examined. Follow up examination was realised at time of Pin removal using the constant score. In all cases a primary functional stability was reached. Non-union we saw in 2 cases, local skin infections over the end of the Pin in 9 cases and partial plexus paresis in 1 case.

**Conclusion:** Rockwood Pin is a good method for intramedullary stabilisation of dislocated midclavicular fractures (Type A, B and C in OTA classification). It allows minimal invasive approach and anatomical reposition and shows good functional and cosmetic results.

#### L-S3.3

##### The angular-stable transiliac lumbopelvic fixation in unstable sacral and pelvic fractures

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**Introduction:** The angular stable lumbopelvic fixation of the pelvis gained importance over the last years not only due to demographic changes. Especially in trauma in the Elderly the incidence of sacral insufficiency fractures is increasing over the last years. However the literature available about this technique is still quite weak. We therefore reviewed all patients in our clinic that underwent

lumbopelvic fixation to detect the strengths, weaknesses and dangers of this technique.

**Materials and Methods:** We retrospectively reviewed all patients that underwent lumbopelvic fixation between 2003 and 2011 due to sacral insufficiency fractures, traumatic lumbopelvic dislocation and instable pelvic fractures, that could not be mobilised in consequence of accompanying Injuries of the extremities. The evaluation included injury pattern, screw placement, general and specific complications, fracture consolidation, secondary dislocation in plain x-ray, local soft tissue conditions, pain as well as the modified Majeed Score.

**Results:** 91 patients received a lumbopelvic fixation in the given period. Up to this point 66 of them have been conclusively reviewed. The average age was 50 years. 24% were above 70 years of age. 23 patients were classified as polytrauma. 19 patients had B-, 40 C-Injuries, 5 sacral dislocation and 2 Tumors. The mean operating time was 120 min. The consolidation rate was 94%. Plain X-ray showed 2 material displacements that required revision surgery and 5 showed loosening of an iliac screw. In one instance secondary dislocation was observed. There were 11 patients with asymptomatic affection of the sacroiliac Joint by an iliac screw. A postoperative wound infection developed in 2 patients. There were no cases of material associated decubital ulcers. 58% reported to be able to palpate the material manually. 4% reported about pain in supine position, 7% while sitting.

**Conclusion:** The transiliac lumbopelvic fixation is a safe technique providing a high biomechanical stability and therefore permitting early weight bearing mobilization with little soft tissue compromise. Precise intraoperative screw placement is the key point of this technique.

#### L-S3.4

##### Retrospective analysis of the oncosurgical management of bone metastases of the upper extremity

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**Introduction:** Because of permanent advances in oncologic therapies and the extended life expectancies the incidence of bone metastases with consecutive pathological fractures (Fx) is constantly rising. The healing potential of pathological Fx is limited, especially under neoadjuvant radiochemotherapy. The stabilisation of apparent and impending pathological Fx is mandatory concerning an acceptable and pain free quality of life and is an integral part of a palliative therapy concept in addition to an adjuvant therapy. Aim of this retrospective study was to investigate the different treatment strategies on the upper extremity with a differentiated focus on the outcome.

**Materials and Methods:** Between 2003–2009 66 patients (mean age 63.9y (17–89), m/f: 23/23 with 69 bone metastases had been treated in our center and were retrospectively analysed with information from the medical record, clinical follow up visits and by contacting relatives and involved oncologists.

**Results:** The primary tumor biology of the metastases were renal cell- (29.4%), mamma- (16.1%), lung-carcinoma (11.8%) and plasmocytoma (16.1%). In 95% the humerus was affected (54.2% diaphysis, 32.2% dia- and metaphysis, 13.5% metaphysis). The vast majority of the cases were multiply metastasised. In 59 cases (85.5%) a pathologic fracture was imminent by the time of the diagnosis. In 10 cases (14.5%) operative stabilisation was performed for an impending fracture. In 14/64 (22%) cases the impending/apparent pathological fracture was the first manifestation of a malign tumor.

28/41 patients were treated with an intramedullary nail (5 compound osteosyntheses) / angular stable plate osteosynthesis (36 compound osteosyntheses). 63% did not receive a neoadjuvant treatment, 7.4% received neoadjuvant chemo- and

4.4% radiotherapy. 25% of the patients did not undergo adjuvant treatment, 19.1% and 8.8% received radio- and chemotherapy. In 4 patients the osteosynthesis failed (1 nail, 3 plates, all without cement and neoadjuvant therapy, 2× postop radiation). The mean time until failure was 13.3±13 months and was therefore higher than the overall survival rate (9.7±9.0 months).

**Conclusion:** The oncosurgical treatment of metastases of the upper extremity generally shows good results concerning the failure rate (6%). A pre- and postoperative therapy, as well as cement are favourable concerning the failure rate, pre- and postoperative therapy with radiation was favourable concerning the overall survival rate. Impending pathological fractures (only 10 patients) are probably developing problems late in the disease due to the lower axial load compared to the lower extremity. This could explain the high rate of apparent pathological fractures. The prophylactic stabilisation did not alter the prognosis.

### L-S3.5

#### Treatment of sternum fractures

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**Introduction:** The treatment of sternum fractures and instabilities after infections requires close interdisciplinary collaboration between trauma, thoracic and heart surgeons.

For the past two years we have been implanting the Synthes sternum stabilising system in patients with sternum fractures or instabilities of the sternum due to other causes.

This system contains anatomically angular stable plates for the sternum as well as for the connection between the sternum and the ribs. The advantage of this method is the highly stable angular fixed plate in combination with a minimally invasive approach. Therefore, this system can be employed both for stabilising multiple rib fractures associated with breathing difficulties and also in infected areas.

This method is also eligible for patients with poor bone quality as a result of diabetes mellitus, osteoporosis or other comorbidities. Also patients with multiple traumas and a flail chest can profit from this method because it is possible to extubate earlier as the breathing mechanism is stabilised more rapidly. Thus the positioning of the patient is less complicated which is important because these patients often suffer with pulmonary difficulties.

**Material and Methods:** Until now 28 patients have been treated surgically with angular stable plates for the sternum or the adjoining ribs. In 7 patients we needed to perform surgery to treat multifragmentary fractures of the sternum. Due to the instability of the sternum after an infection, secondary to heart surgery, it was necessary to treat 19 of the patients. 2 patients received angular stable plates after an emergency sternotomy.

**Result:** Except for one patient who did not recover from a cardiological primary disease and 2 patients who died from osteomyelitis, all patients recovered without complications.

Especially patients who suffered from multiple traumas showed rapid recovery from the pulmonary injuries and other injuries caused by multiple traumas.

**Conclusion:** On summary of our results, this method may help trauma surgeons with the treatment of multiple trauma patients, especially when suffering from instable thoracic injuries, as well as heart surgeons who can profit from both the low rate of complications and the innovative implant and surgical instruments.

### R-S3.1

#### Influence of the pathogen spectrum after traumatic amputations and type IIIC open fractures on the initial antibiotic therapy

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**Introduction:** Traumatic major amputations and type 3C open fractures still remain a surgical and critical care challenge because of infection, multiple organ failure and serious handicaps for the patients. In addition to the radical surgical debridement the initial calculated antibiotic therapy is crucial for the outcome. Therefore, the epidemiology of pathogens associated with these injuries is a necessity guiding the decision which antibiotic agents are chosen.

**Materials and Methods:** Beside complete microbiological findings (wound cultures, resistance testings), the administered antibiotic therapy, the duration of the hospitalization and the number and type of performed operations were analyzed. The statistical evaluation was performed with PASW Statistics 19.0 (Mann-Whitney test and significant differences were considered  $p < 0.05$ ).

**Results:** 17.6% of the patients were female ( $n=9$ , age 37.5 years ±13.4). 62% of the patients were polytraumatized (ISS>15), 52.9% had suffered a severe polytrauma (ISS>25) with an overall mean ISS of 24.7±13 and PTS 34.8±20.6. The predominantly injured body regions were the lower leg ( $n=30$ ; 58.8%), upper leg ( $n=7$ ; 13.7%) and arm ( $n=3$ ; 11.8%). No statistical significant differences between type 3C open fractures and major traumatic amputations referring to injury severity, hospitalization (39.1±22.4, range 7–103 days), ICU-days (11.9±14.2, range 0–78 days), survival, infection rate, type of infection, number and type of needed surgical interventions was found. Wound cultures were positive in 70.6% ( $n=36$ ) total. Pseudomonas was found in 27.5% ( $n=34$ ), 37.3% ( $n=39$ ) had positive proof of combined wound contamination (>1 species in same culture). All 51 patients received initial antibiotic coverage, which was found not supply full coverage in 45.1% ( $n=33$ ) according to resistance testings. Insufficient calculated antibiotic therapy was significantly associated with proof of pseudomonas ( $p > 3.01$ ).

**Conclusion:** This study revealed an up to date pathogen spectrum in Major traumatic amputations, and 3C open fractures, with a unique pathogen spectrum and increased incidence of Gram-negative pathogens and combined infections. This serves as a reliable foundation for a justifiable change in the initial calculated antibiotic therapy with further extension towards gram-negative coverage, especially against pseudomonas. Unwanted side effects and resistancy shifts have to be respected. In addition to the radical surgical debridement and thorough wound irrigation, an extended antibiotic coverage may lower infection rates and therefore improve outcome after severe open soft tissue injuries.







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