

# SILVER

## Clinical outcomes

Department of Orthopaedics  
University Hospital, Muenster, Germany  
Head: Prof. Dr. med. G. Gosheger



## HMRS



## MUTARS®- Münster



The Journal of Arthroplasty Vol. 23 No. 6 2008

### The Influence of the Alloy of Megaprosthesis on Infection Rate

Georg Gosheger, MD,\* Christian Goetze, MD,\* Jendrik Hardes, MD,\* Uwe Josten, MD,†  
Wolfram Winkelmann, MD,\* and Christof von Steig, MD‡

Submitted January 18, 2005; accepted June 16, 2007.  
No benefits of funds were received in support of the study.  
Reprint requests: Georg Gosheger, MD, Department of Orthopaedics, University of Münster, Albert-Schweitzer 33, 48149 Münster, Germany.

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

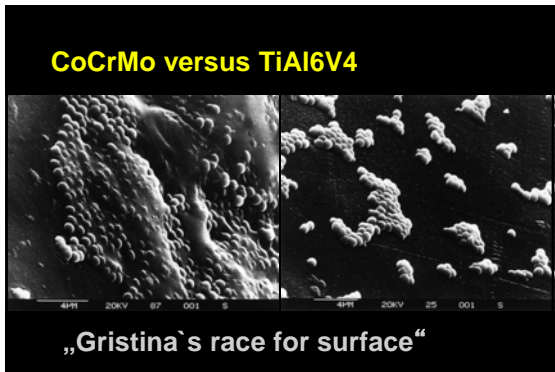
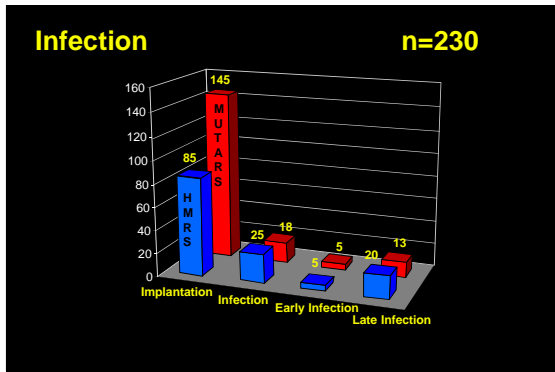
---

---

---

---

---




---

---

---

---

---

---

---

---



---

---

---

---

---

---

---

---



---

---

---

---

---

---

---

---

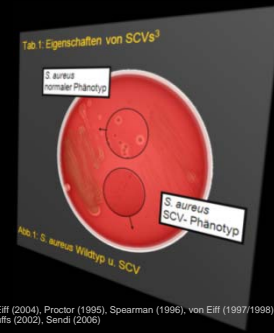
## Gentamycin-coating of EPR



- Resistance
- only short efficacy
- coating belongs to drug rules of EU

## Gentamycin

### Small Colony Variant



## Copper

# MORBUS WILSON



---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

## Copper



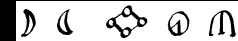
## Hashimoto-Thyreoiditis



## Antiinfective effect of silver

Paracelsus (16th cent.)

septic wounds



---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---





### Reduction of Periprosthetic Infection With Silver-Coated Megaprosthesis in Patients With Bone Sarcoma

BENDIK HARDES, MD,<sup>1,2</sup> CHRISTOF VON HILF, MD,<sup>2</sup> ARNE STREIFELBERGER, MD,<sup>3</sup> MAURICE BAUM, MD,<sup>1</sup> TIMOTHUS BLUDY, MD,<sup>2</sup> MARCEL P. HENRICHS, MD,<sup>2</sup> GREGOR HALSCHILD, MD,<sup>2</sup> and HELMUT AHRENS, MD<sup>2</sup>  
<sup>1</sup>Department of Orthopedics and Tumor Orthopedics, Maxima University Hospital, Maxima, Germany  
<sup>2</sup>Institute of Medical Radiobiology, Maxima University Hospital, Maxima, Germany

**Background and Objectives:** The placement of megaprosthesis in patients with bone sarcoma is associated with high rates of infection, despite prophylactic antibiotic administration. In individual cases, secondary amputation is unavoidable in the effort to cure infection.

**Methods:** The infection rate in 51 patients with sarcoma (proximal femur, n = 22; proximal tibia, n = 29), who underwent placement of a silver-coated megaprosthesis was assessed prospectively over a 5-year period, along with the treatment administered for infection. The infection rate was compared with the data for 78 patients in whom an uncoated titanium megaprosthesis (proximal femur, n = 51; proximal tibia, n = 27) was implanted.

**Results:** The infection rate was substantially reduced from 17.6% in the titanium to 5.9% in the silver group. Whereas 38.5% of patients in the titanium group ultimately had to undergo amputation when periprosthetic infection developed, these mutilating surgical procedures were not necessary in the study group.

**Conclusions:** The use of silver-coated prostheses reduced the infection rate in the medium term. In addition, less aggressive treatment of infection was possible in the group with silver-coated prostheses. Further studies with longer-term follow-up periods and larger numbers of patients are warranted in order to confirm these encouraging results.

*J Surg Oncol*, 2010;101:389–395. © 2010 Wiley-Liss, Inc.

**Key Words:** prosthesis-related infections; bone sarcoma; silver; implantation

## Efficacy Titanium vs Silver Proximal Femur Replacement

Group P > 0.05, infection rate p < 0.05

	age	Chemo	Radiatio	Rekon. length	OP time	Extra-articular
Titanium (n=33) 18.2%	36	58%	24%	209 mm	276 min.	12%
Silver (n=17) 5.9%	36	71%	24%	186 mm	230 min.	6%

## Efficacy Titanium vs Silver Proximal Tibia replacement

Group P > 0.05, Infection rate p < 0.05

	age	Chemo	Radiatio	Recon. length	OP time	Extra-articular
Titanium (n=41) 17,1%	22	88%	5%	149 mm	263 min.	12%
Silver (n=23) 4,3%	31	86%	9%	150 mm	226 min.	5%

Herzich et al. World Journal of Surgical Oncology 2014, 12:130  
<http://www.wjgo.com/content/12/1/130>

WORLD JOURNAL OF SURGICAL ONCOLOGY

RESEARCH Open Access

**Modular tumor endoprosthesis in surgical palliation of long-bone metastases: a reduction in tumor burden and a durable reconstruction**

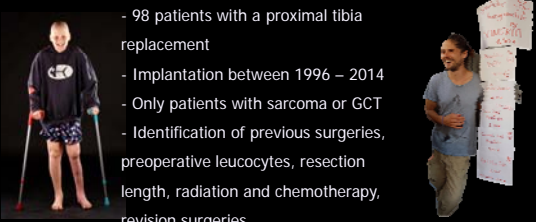
Marcel-Philipp Herzich<sup>1</sup>, Juliane Krebs<sup>1</sup>, Georg Goehrer<sup>2</sup>, Arne Streitberger<sup>3</sup>, Markus Nitzrott<sup>4</sup>, Tim Sauer<sup>5</sup>, Steffen Hoyer<sup>6</sup>, Gurpal Singh<sup>1,7</sup> and Jendrik Harde<sup>1\*</sup>

**Silver-coated prostheses**      **Uncoated prostheses**

**Infection rate 3,9%**      **Infection rate 12,9%**

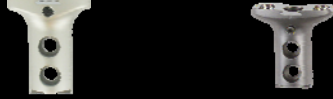
**Proximal tibia replacement 2016**

- 98 patients with a proximal tibia replacement
- Implantation between 1996 – 2014
- Only patients with sarcoma or GCT
- Identification of previous surgeries, preoperative leucocytes, resection length, radiation and chemotherapy, revision surgeries



**Proximal tibia replacement 2016**

**Silver (n=56)**      **Titanium (n=42)**




---

---

---

---

---

---

---

---



---

---

---

---

---

---

---

---



---

---

---

---

---

---

---

---



## Incidence of infection



Primary infection rate	16.7%	8.9%
Overall infection rate	19.0%	12.5%
Overall infection rate (in patients dead of disease)	22.2%	0%

## Treatment of infection



Amputation	37.5%	14.3%
Two-stage change	50.0%	14.3%
One-stage change	0%	28.6%
Antibiotics	0%	14.3%



**47 Ag Silver**  
W7 808-01

# PorAg-LINK





**S Stannum Implants**

Highly porous titanium system



**MUTARS**

PROVEN MODULARITY

---

---

---

---

---

---

---

---



---

---

---

---

---

---

---

---



---

---

---

---

---

---

---


---

**EURAMOS**

MAP plus maintenance pegylated interferon  $\alpha$ -2b (MAP/In) versus MAP alone in patients with resectable high-grade osteosarcoma and good histological response to preoperative MAP:

**First results of the EURAMOS-1 Good Response randomization**

S. Bielack, S Smeland, JS Whelan, N Marina, JM Hook, G Jovic, M Krailo, T Butterfass-Bahloul, T Kühne, M Eriksson, L Teot, H Gelderblom, L Kager, K Sundby Hall, R Gorlick, RL Randall, PCW Hogendoorn, G Calaminus, MR Sydes, M Bernstein on behalf of the EURAMOS investigators



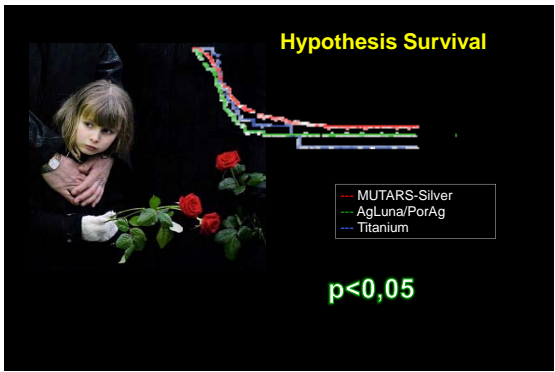
**EURAMOS**

Silver coating – better survival in 514 patients

**First results of the EURAMOS-1 Good Response randomization**

S. Bielack, S Smeland, JS Whelan, N Marina, JM Hook, G Jovic, M Krailo, T Butterfass-Bahloul, T Kühne, M Eriksson, L Teot, H Gelderblom, L Kager, K Sundby Hall, R Gorlick, RL Randall, PCW Hogendoorn, G Calaminus, MR Sydes, M Bernstein on behalf of the EURAMOS investigators






---

---

---

---

---

---

---

---



---

---

---

---

---

---

---

---



---

---

---

---

---

---

---

---

# Summary



- Good antimicrobial activity (>35 ppb)
- No relevant resistant bacteria
- No toxicity for Humans (<300 ppb)

Survival Analysis ????????

# Hypothesis Survival



---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---