



Retrospective Evaluation of the Incidence of Early Periprosthetic Infection with Silver-Treated Custom Endoprostheses in High Risk Patients: Case Control Study

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Introduction

Deep periprosthetic infection is one of the most challenging complications to treat after endoprosthetic replacement. Most published series reported lifetime periprosthetic infection rates of 5-13%¹⁻⁶.

The most effective treatment for deep infection is two-stage revision with success rates of 70-75%. In a series of 1264 patients who had undergone endoprosthetic replacements, 38 patients (3%) had subsequent amputation for uncontrollable periprosthetic infection¹.

Reducing infection has become the number one priority in limb salvage surgery. Because colonization of the prosthesis is a prelude to clinical infection, one important approach is to attach an antimicrobial substance to the surface of the prosthesis. The Agluna[®] silver surface treatment is used for this purpose on endoprostheses by Stanmore Implants and is the subject of this study.

This mid-term study is the first case-control study to be undertaken to review the performance of silver treatment of endoprostheses.

Objective

The objective of this case-controlled, single centre study was to compare the incidence of early periprosthetic infection in high risk patients who have undergone endoprosthetic reconstruction using the Agluna silver-treated custom endoprostheses from Stanmore Implants, with a control group who received non Agluna-treated endoprostheses from Stanmore Implants.

Inclusion / Exclusion criteria

A list of all patients who received Agluna-treated endoprostheses at the ROH was obtained (n= 126).

Cases with any of the following criteria were excluded from the study:

- Less than 18 years of age at the time of insertion of implant
- Less than 6 months follow-up
- Surgery outside the study window

Case-Matching

The control cases were selected using the search engine of a retrospective database of the oncology service of the ROH, which contains data on all patients treated at the department (n= 31,188). The case matching was undertaken for each of the 85 patients based primarily on:

- The anatomical location of the implant
- The type of surgery (primary, one-stage revision or two-stage revision)

A list of all suitable matches was then reviewed in a chronological order according to the surgery date. The first possible control case on the list (after excluding those cases who did not meet the study inclusion criteria) was selected accordingly.

The data collected during the postoperative period, and at 3, 6, 9 and 12-month post-operative visits was analysed.

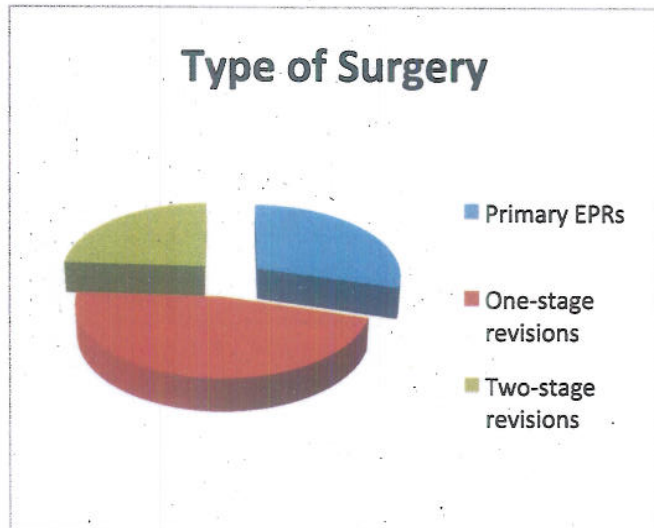
A periprosthetic infection was diagnosed by the fulfilment of three of the five criteria which follow⁷:

- CRP > 10 mg/dl
- ESR > 30 mm/hr
- Positive joint aspiration culture
- Purulent intraoperative tissue appearance
- Positive intraoperative culture

Results

- 170 patients: 106 ♂, 64 ♀
- 85 silver treated implants / 85 controls
- Mean age 42.2 yrs (range, 18.4-90.4 yrs) at time of implant insertion
- 50 primary endoprostheses
- 79 one-stage revisions
- 41 two-stage revisions

Anatomical Location	Number in study
Distal Femur	63
Proximal Tibia	36
Proximal Femur	19
Hemipelvis	16
Total Femur	6
Proximal Humerus	6
Distal Humerus	2
Distal Radius	2
Intercalary	12
Combined femoral/tibial	8



Postoperative infection rates p<0.01:

- Silver treated implants 11.8%, n = 10/85
- Control implant 22.4%, n = 19/85

Proximal tibia:

- Agluna group infection rate 11.1% (2/18)
- Control group infection rate 22.2% (4/18)

Distal femur:

- Agluna group infection rate 9.7% (3/31)
- Control group infection rate 18.8% (6/32)

The infection rate is halved with the use of Agluna treated implants around the knee joint.

Anatomical location	Total number of cases	Silver Group						Control Group					
		Primary		Single stage revision		Two stage revision		Primary		Single stage revision		Two stage revision	
		Infected/total	% infected	Infected/total	% infected	Infected/total	% infected	Infected/total	% infected	Infected/total	% infected	Infected/total	% infected
Distal femur	63	0/3	0%	2/20	10%	1/8	13%	0/3	0%	2/19	11%	4/10	40%
Proximal tibia	36	1/9	11%	0/4	0%	1/5	20%	0/9	0%	1/3	33%	3/6	50%
Proximal femur	19	-	-	0/9	0%	0/1	0%	-	-	1/9	11%	-	-
Hemipelvis	16	4/7	57%	-	-	0/1	0%	4/7	57%	0/1	0%	-	-
Proximal humerus	6	-	-	0/1	0%	0/2	0%	-	-	0/1	0%	0/2	0%
Other locations	30	0/7	0%	0/5	0%	1/3	33%	1/5	20%	1/7	14%	2/3	67%
Total	170	5/26	19%	2/39	5%	3/20	15%	5/24	21%	5/40	13%	9/21	43%



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If the prosthesis does get infected it then seems easier to treat with a silver coating:

- Success rates with DAIR (Debridement, antibiotics and implant retention) $p < 0.01$:
 - Silver treated implants 70%, $n = 7/10$
 - Control implants 31.6%, $n = 6/19$
- Persistent periprosthetic infection necessitating device removal, amputation or chronic antibiotics suppression $p < 0.01$:
 - Silver treated implants 3.5%, $n = 3/85$
 - Control implants 15.3%, $n = 13/85$
- Postoperative infection in patients with intraoperative positive cultures $p < 0.01$:
 - Silver treated implants 13.3%, $n = 2/15$
 - Control implants 40%, $n = 6/15$
- Success rates with two-stage revisions $p < 0.01$:
 - Silver treated implants 85%
 - Control implants 57.1%

Results from patients who were found to have positive cultures during their second stage surgery:

	Silver-Treated Implants			Control Implants		
	No postop infection	Infection resolved	Infection not resolved	No postop infection	Infection resolved	Infection not resolved
Coagulase -ve staph (8)	75%	12.5%	12.5%	25%	-	75%
Staph aureus	-	100%	-	-	-	-
Strept viridans	-	-	-	-	-	100%
Pseudomonas	-	100%	-	-	-	-
Enterobacter sp.	-	-	100%	-	-	-

Conclusions

The mid-term results of Agluna-treated endoprostheses are associated with lower rates of early periprosthetic infection.

These silver-treated implants are particularly useful in two-stage revisions for periprosthetic infection and in those patients with incidental positive cultures at the time of implant insertion.

The DAIR procedure appears to be more successful with Agluna treated implants.



Bibliography:

1. Jeys LM, Grimer RJ, Carter SR, Tillman RM. Periprosthetic infection in patients treated for an orthopedic oncological condition. *J Bone Joint Surg Am.* 2005;87:842–9.
2. Gosheger G, Gebert C, Ahren H, Streitbuerger A, Winkelmann W, Harges J. Endoprosthetic reconstruction in 250 patients with sarcoma. *Clin Orthop Relat Res.* 2006;450:164–71.
3. Sim IW, Tse LF, Ek ET, Powell GJ, Choong PF. Salvaging the limb salvage: management of complications following endoprosthetic reconstruction for tumors around the knee. *Eur J Surg Oncol.* 2007;33:796–802.
4. Shehadeh A, Nouveau J, Malawer M, Henshaw R. Late complications and survival of endoprosthetic reconstruction after resection of bone tumors. *Clin Orthop Relat Res.* 2010 Nov;468(11):2885-95.
5. Shin DS, Weber KL, Chao EY, An KN, Sim FH. Reoperation for failed prosthetic replacement used for limb salvage. *Clin Orthop Relat Res.* 1999;358:53–63.
6. Zeegen EN, Aponte-Tinao LA, Hornicek FJ, Gebhardt MC, Mankin HJ. Survivorship analysis of 141 modular metallic endoprostheses at early followup. *Clin Orthop Relat Res.* 2004;420:239-50.7.
7. Parvizi J, Ghanem E, Menashe S, Barrack RL, Bauer TW. Periprosthetic infection: what are the diagnostic challenges? *J Bone Joint Surg Am.* 2006 Dec;88 Suppl 4:138-47.
8. Byren I, Bejon P, Atkins BL, Angus B, Masters S, McLardy-Smith P, et al. One hundred and twelve infected arthroplasties treated with “DAIR” (debridement, antibiotics and implant retention): antibiotic duration and outcome. *J Antimicrob Chemother.* 2009 Jun;63(6):1264–71.