

# Sonication: better, faster, stronger

T.S.Kramer

LADR GmbH MVZ Neuruppin, Germany

correspondence: t.kramer@ladr.de



**background** Orthopedic device associated infections (ODAI) and periprosthetic joint infections (PJI) are a rare, but devastating complication. Diagnostic approaches and definition of PJI vary. Most commonly tissue biopsies and synovial fluid sampling are recommended for identification pathogens causing ODAI and PJI. However sensitivity and specificity of those technique have been shown to be highly dependent on preanalytical factors like time and conditions of transportation, location of sampling, as well as analytical approaches and duration of incubation for up to 14d. Sonication of explanted orthopedic devices has been shown to be more than only an alternative in the diagnosis of PJI.

	before introduction of blood culture	after introduction of blood culture
prevalence of positive samples/ 100 samples	46,88	51,85
prevalence of positive joint samples/ 100 samples	44,25	50,36
prevalence of positive fracture samples/ 100 samples	50,00	88,24

**Table 1.** Prevalence of positive samples

**results** We evaluated 700 orthopedic samples sent for sonication, of which resulted in growth of one (n=355) or several (n=14) relevant pathogens. Coagulase negative staphylococci were isolated in 162 cases, *Staphylococcus aureus* was isolated in 67 cases, *Propionibacterium* spp. In 23 cases, *Streptococcus* spp. in 14 cases, Gram negative in 33 cases, *Enterococcus* spp. also in 14 cases and *Candida* spp. In 3 cases. The necessary time of incubation was further decreased to 1.8 days (range: 0-5) days after introduction of additional incubation of sonicate fluid in blood-culture bottles. All positive samples showed growth before the 8<sup>th</sup> day of incubation.

**methods** Retrospective cohort analysis of orthopedic samples sent for sonication from 29 surgical center between 06/2014-03/2017. Until 07/2015 samples were treated according to Trampuz et al. 2007. 100µl were plated on Columbia-, MacConkey-, Chocolate- and Schaedler agar each as well as brain-heart broth (BioMerieux, Marcy étoile) , incubated aerobically and anaerobically for up to 14days. In 07/2015 an additional enrichment of 10ml per aerobic and anaerobic blood culture bottles (Biomerieux, Marcy étoile) was introduced. The bottles were also incubated up to 14days and plated immediately if growth was detected. The p-values were calculated in graph pad with the Fisher's exact test

patient characteristics	before introduction of blood culture		after introduction of blood culture		p
	=n	(%)	=n	(%)	
samples	160		540		
age median (range)	72,00	(22-88)	73,61	(26-96)	
female	85	(53,13)	272	(50,37)	.589
joint	113	(70,63)	421	(77,96)	.073
fracture fixation	2	(1,25)	17	(3,15)	.395
<b>symptoms</b>					
fever	10	(6,25)	23	(4,26)	.19
prolonged woundhealing	18	(11,25)	70	(12,96)	1
fistula	14	(8,75)	38	(7,04)	.286
pus	20	(12,5)	56	(10,37)	.229
swelling	28	(17,5)	81	(15,00)	.144
loosening (radiological)	37	(23,13)	167	(30,93)	.192
loosening (functional)	34	(21,25)	125	(23,15)	1
immunosupression	5	(3,125)	2	(0,37)	.006
pain	8	(5)	26	(4,81)	.67
other	13	(8,13)	36	(6,67)	.355
<b>reason of primary implantation</b>					
degenerative	59	(36,88)	189	(35,00)	.169
arthritis	3	(1,88)	6	(1,11)	.408
fracture	11	(6,88)	33	(6,11)	.567
curent antibiotics	24	(15)	30	(5,56)	.0003

results	before introduction of blood culture		after introduction of blood culture		p
	=n	(%)	=n	(%)	
pathogen detection	75	46,875	280	51,85	0,281
positive under ABX treatment	13	8,125	22	4,07	<.0001
polymicrobial	2	1,25	12	2,22	0,747

type of infection					
early	9	5,625	43	7,96	0,593
late chronic	9	5,625	27	5,00	0,531
late acute	31	19,375	141	26,11	0,2571
joint prosthesis/pe	50	31,25	212	39,26	0,289
fracture fixation device	1	0,625	15	2,78	0,299

pathogens					
ConS	32	41,56	130	44,22	
<i>Staphylococcus aureus</i>	14	18,18	53	18,03	
<i>Streptococcus</i> spp.	6	7,79	8	2,72	
<i>Enterococcus</i> spp.	3	3,90	11	3,74	
Gram negative	10	12,99	23	7,82	
<i>Propionibacterium</i> spp.	5	6,49	18	6,12	
<i>Candida</i> spp.	1	1,30	2	0,68	

detection					
>100 cfu/ml	21	27,27	44	8,15	
>50 cfu/ml	23	29,87	26	4,81	
<50 cfu/ml	7	9,09	39	7,22	
BHI/blood culture	23	29,87	153	28,33	

**Table 3.** Clinical and bacteriological results

**conclusion** Sonication of explanted orthopedic devices and culturing of the sonicate fluid provides a fast reliable tool for diagnosing pathogens of PJI/ODAI without the need for prolonged incubation for up to 14days. The additional incubation of the sonicate in automated blood-culturing systems further improves the limit of detection and the time to growth.

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