Quote Of The Year

When you are dead, you do not know that you are dead.

All the pain is felt by others.

The same thing happens when you are stupid.

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How to Maximize Results in Surgery

Richard G. Buch, M.D.

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Is it the patient? What can they influence??

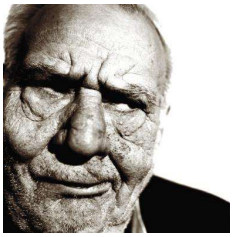
- Obesity (BMI > 40)
- Malnutrition
- Diabetes
- Smoking
- ETOH
- Poor Compliance

Is it the patient? What can't they influence??

- Age
- Bad Soft Tissue
- Bad Perfusion
- Previous Operations
- Recurrent Infections
- Allergies
- Reduced Immune Response
- Tumor
- Adjuvant Therapy

Is it the patient – what cannot be influenced?

- Age
- Bad soft tissue
- Bad perfusion
- Many previous surgeries
- Recurrent infections
- Allergies
- Reduced immune response
- Tumor
- Adjuvant therapy



Is it the patient – what can be influenced?

- Obesity (BMI < 40 = 170cm, 115 kg)
- Malnutrition
- Diabetes
- Smoking
- Alcohol
- Poor Compliance

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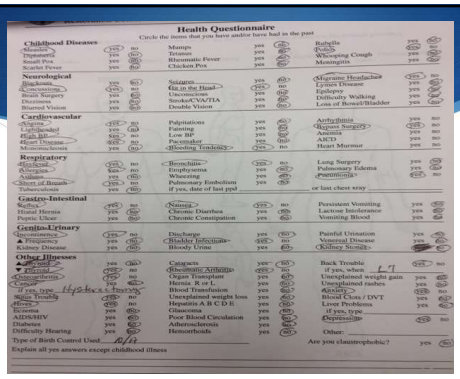

Health Questionmaire

Circle the items that you have and/or have had in the past

Childhood Diseases							
Measles	yes	no	Mumps	yes	no	Rubella	yes no
Chickenpox	yes	no	Tetanus	yes	no	Polio	yes no
Small Pox	yes	no	Rheumatic Fever	yes	no	Whooping Cough	yes no
Scarlet Fever	yes	no	Chicken Pox	yes	no	Meningitis	yes no
Neurological							
Blackouts	yes	no	Seizures	yes	no	Migraine Headaches	yes no
Concussions	yes	no	Hit in the Head	yes	no	Lymes Disease	yes no
Brain Surgery	yes	no	Unconscious	yes	no	Epilepsy	yes no
Dizziness	yes	no	Stroke/CVA/TIA	yes	no	Difficulty Walking	yes no
Blurred Vision	yes	no	Double Vision	yes	no	Loss of Bowel/Bladder	yes no
Cardiovascular							
Angina	yes	no	Palpitations	yes	no	Arrhythmia	yes no
Lightheaded	yes	no	Fainting	yes	no	Bypass Surgery	yes no
High BP	yes	no	Low BP	yes	no	Angina	yes no
Heart Disease	yes	no	Pacemaker	yes	no	ACD	yes no
Murmurs/Screen	yes	no	Bleeding Tendency	yes	no	Heart Murmur	yes no
Respiratory							
Blocked	yes	no	Bronchitis	yes	no	Lung Surgery	yes no
Allergies	yes	no	Emphysema	yes	no	Pulmonary Edema	yes no
Asthma	yes	no	Wheezing	yes	no	Pneumonia	yes no
Short of Breath	yes	no	Pulmonary Embolism	yes	no		
Tuberculosis	yes	no	If yes, date of last ppd			or last chest xray	
Gastro-Intestinal							
Reflux	yes	no	Nausea	yes	no	Persistent Vomiting	yes no
Hiatal Hernia	yes	no	Chronic Diarrhea	yes	no	Lactose Intolerance	yes no
Peptic Ulcer	yes	no	Chronic Constipation	yes	no	Vomiting Blood	yes no
Genito-Urinary							
Incontinence	yes	no	Discharge	yes	no	Painful Urination	yes no
▲ Frequency	yes	no	Bladder Infections	yes	no	Venereal Disease	yes no
Kidney Disease	yes	no	Bloody Urine	yes	no	Kidney Stones	yes no
Other Illnesses							
Head Injury	yes	no	Cataracts	yes	no	Back Trouble	yes no
Thyroid	yes	no	Rheumatic Arthritis	yes	no	if yes, when	L4
Osteoporosis	yes	no	Organ Transplant	yes	no	Unexplained weight gain	yes no
Cancer	yes	no	Hernia R or L	yes	no	Unexplained rashes	yes no
If yes, type	Hysterectomy		Blood Transfusion	yes	no	Anxiety	yes no
Skin Trouble	yes	no	Unexplained weight loss	yes	no	Blood Clots / DVT	yes no
Hives	yes	no	Hepatitis A B C D E	yes	no	Liver Problems	yes no
Eczema	yes	no	Glaucoma	yes	no	if yes, type	
AIDS/HIV	yes	no	Poor Blood Circulation	yes	no	Depression	yes no
Diabetes	yes	no	Atherosclerosis	yes	no		
Difficulty Hearing	yes	no	Hemorrhoids	yes	no	Other:	
Type of Birth Control Used	n/a					Are you claustrophobic?	yes no

Explain all yes answers except childhood illness

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What about at Surgery

Are there steps and principles that can increase outcomes?

Before Final Implantation

- Open biopsy
- Culture x5
- Pathology
- Alpha defensin
- Synovial fluid
- DNA

Multiple surgeries and dysvascular

- All studies here are common sense based – increasing number of surgeries on same extremity increase risk
- Those with skin grafts and muscle flaps are more at risk
- Dysvascular extremities
- ABI <30-40 -- Disaster awaits
- Surgery >5-7 times -- Dramatically increased risks

ARE YOU NUTS?

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When Not To Do Surgery!
Surgical Reasons

- Do not think you can fix something that already had appropriate treatment by good surgeons.
- Carefully consider what you have left to work with.
- Think! What does that heterotopic bone mean?
- What level activity can you expect from the patient?
- If no extensor complex (quad or patella tendon).
- Try and figure out why patient is infected (especially chronic).

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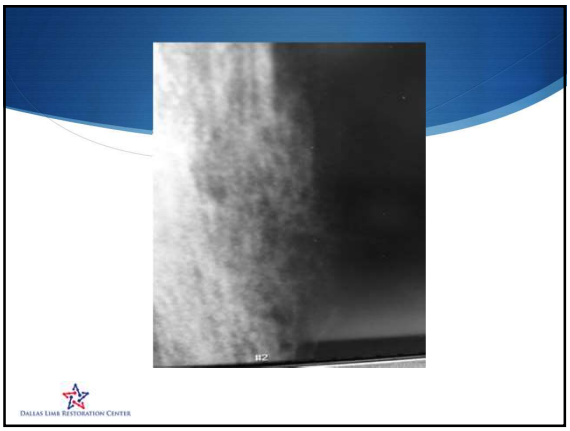
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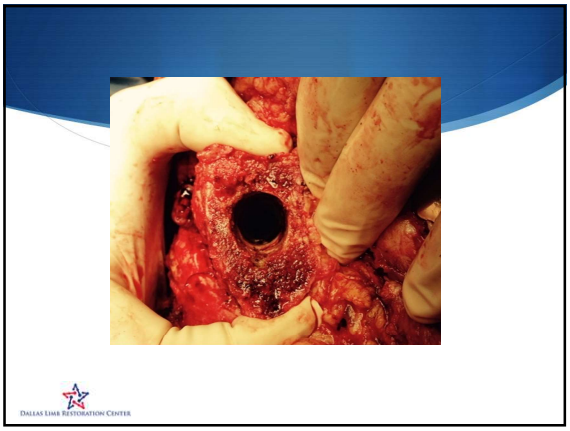
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INVOLUCUM

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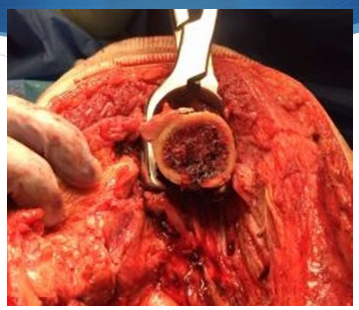
Cerny had it right!



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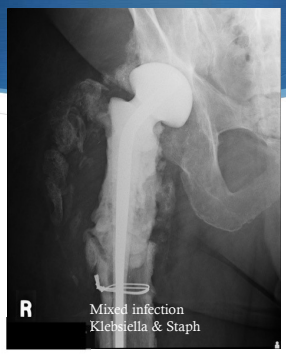

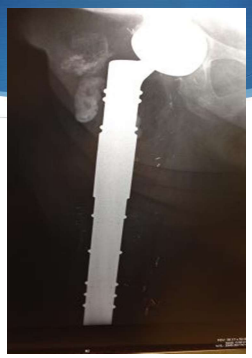

Pick a hole, any hole???

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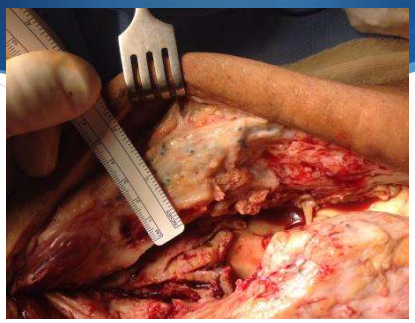

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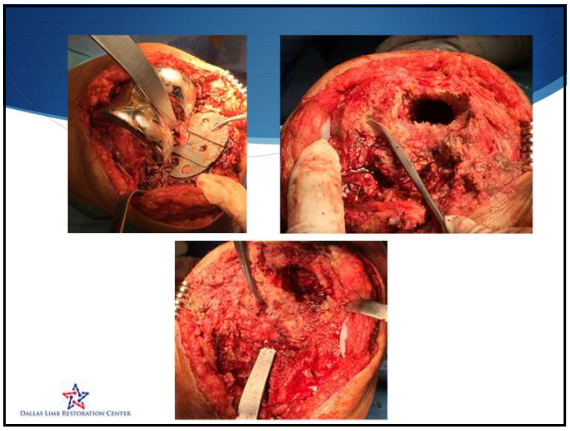

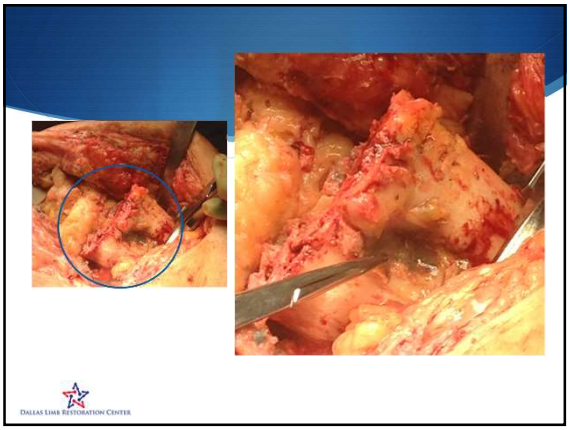
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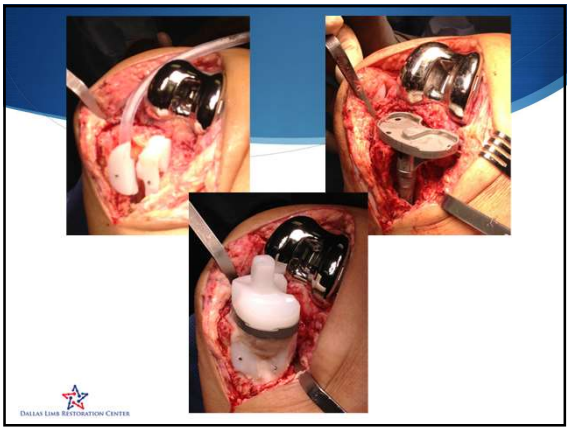
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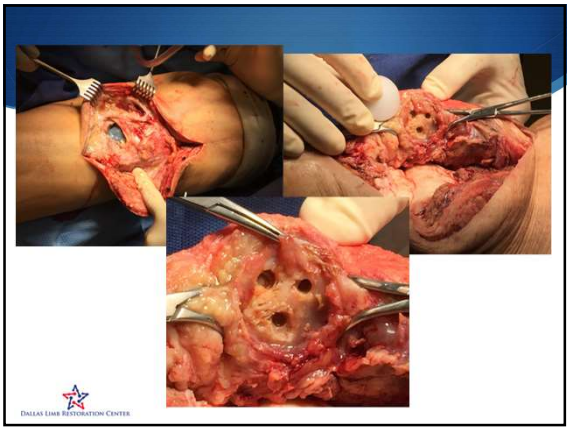
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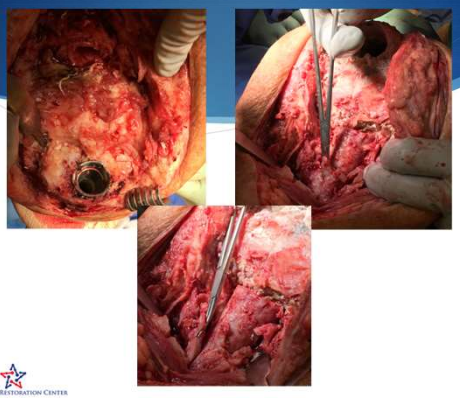
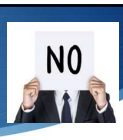


When To Say…



1. Multiple surgeries, flaps, scars
2. Multiple infected knee with no extensor mechanism
3. PVD – severe (check
4. Infected soft tissue and periosteum
5. If someone already staged and implanted with failure. Why do you think you are better?
6. Severe Neuropathy

When To Say No

STOP OPERATING ON:

- Morbidly obese
- Uncontrolled DM
- End stage renal
- Hep C and Cirrhosis
- If patient has > 3 or more comorbidities

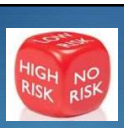
Do not do a surgery because you can.
– ***THINK*** –
Do it for the right reasons.

Ethics and Responsibility

- Morbidity and mortality is from medical problems not from painful arthritic joint.
- Do no harm, means to decrease risks to acceptable levels if you can.
- You **can** correct
  - DM
  - Obesity
  - Nutrition
  - Smoking
  - Cardiac
  - Hep C
  - Procedure Times
  - Operative Environment

Ethics and Responsibility to Treat

- It is a physicians oath and expected duty to provide care regardless.
- Elective TJA may violate that oath.
- To do maleficence is obligation not to inflict harm.
- It is our duty to optimize modifiable risks.
- Healthcare dollars spent replacing joints best served in treating DM, obesity and heart disease.



All these studies mention the high complication rates, but not one of them attempt to help physician by stratifying these risks.

Maybe that would help make decisions on whether to do surgery or not.

Risk Stratification

40-50%	BMI > 45 Dialysis Uncontrolled DM Multiple Surgeries With > 3 Comorbidities		Hep C Hepatitis with Cirrhosis Malnutrition ALB < 2.5
30%	BMI > 40 Malnutrition Alb < 3.0 Chronic Renal Psychosis		Chronic narcotics Controlled DM HIV COPD
15-20%	RA Smoker Anemia ETOH	BMI > 35 HTN	Malnutrition < 3.5 Depression

Two or more of the above, increase the risks 2-10x further, per literature studies.*

Discussion

Risk Stratification Table		
10% - 15%	BMI > 40 RA Smoker Anemia ETOH	Malnutrition (Albumin < 3.5 g/dL) ADOM
20% - 30%	BMI > 45 Malnutrition (Albumin < 3.0 g/dL) Chronic Renal Failure Psychosis	Chronic Narcotic Use HIV Severe COPD
30% - 50%	BMI > 50 Dialysis/Transplant Uncontrolled AODM Multiple Surgeries >6-7	Hepatitis C Hepatitis w/ Cirrhosis Malnutrition (Albumen < 2.5 g/dL)

Conclusion

- These patients have to be treated very aggressively at surgery.
- Consider longer antibiotic course
- Much longer times to implant
- Correct as many comorbidities as possible (DM, obesity, nutrition, smoking, etc.)
- Must treat like cancer with the excision of bone and scar as much as you can and still have salvage options.

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Recommendation

- When considering surgery on patients with uncontrollable risk factors including hepatitis, liver failure, renal failure, etc…
- We strongly recommend when risks factors are > 30%
  - Permanently Fuse
  - Amputation
  - Long Term Spacer
  - No Treatment When Risks > 30%
- Lastly, these types of patients are best treated at centers of excellence that have experience with high-risk patients.

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OR Environment

Conflicting Evidence
- Laminar Airflow
- Body Exhaust Suit
- Double Gloving
- Forced-Air Warming

Proven Effective
- Limited Traffic
- Reduced OR Time (<120 minutes)

Evans, *et al: CORR*, 2011
Hooper, *et al: JBJS Br*, 2011
Gastmeier, *et al: J Hosp Infec*, 2007
Hiner, *et al: Inf Control Hosp Epidem*, 2007

Dunbar, *et al: Orthopaedics*, 2011

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Skin Prep

- Clipper > razor[1]
- Chlorhexidine-based scrub[2]
- Plastic > cloth drapes[3]
- Iodine-impregnated drapes[4]

1. Harrap et al. JAAOS. 2012
2. Saltzman et al. JBJS am. 2009
3. Blom et al. Ann R. Coll Surg Engl. 2000
4. Kramer et al. GMS Krankenhaushyg Interdiszip. 2010

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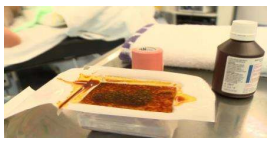
Guideline/Evidence-Based Conclusions

- Skin prep with chlorhexidine/alcohol
- For shoulder procedures, consider adding benzoyl peroxide cream pre-op or hydrogen peroxide to the prep.



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Antibiotic Bone Cement

SPECIALTY UPDATE ARTHROPLASTY
Proceedings of the International Consensus on Periprosthetic Joint Infection

90% consensus that antibiotic bone cement reduces PJI

Parvizi et al. BJJ 2013

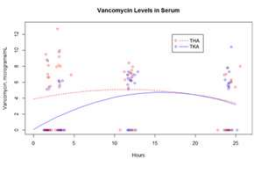
Vancomycin Powder

- SAFE and EFFECTIVE in spine surgery
- Controversial in TJA

O'Neill, *et al*: *Spine*, 2011
Sweet, *et al*: *Spine*, 2011
Bridwell, *et al*: *JBJS Am*, 2011
Gans, *et al*: *Spine*, 2003
Qadir, *et al*: *J Arthrop*, 2004

Vancomycin Powder in TJA

- Vancomycin powder reduces MRSA in rat model of TJA[1]
- Maintains therapeutic levels of vancomycin locally, and low levels systemically[2]
- Lower PJI following primary and revision TKA[3]



1. Higuera, *et al*: *JBJS Am*, 2017
2. Johnson, *et al*: *J Arthrop*, 2007
3. Otte, *et al*: *Srug Technol Int*, 2017

Vancomycin Bone Cement

PROS

- Direct delivery
- Sustained delivery
- Mechanically stable at low doses
- Lower rates of infection reported

Espehaug, *et al*: *JBJS Br*, 1997
Malchau, *et al*: *Acta Orthop*, 1993
Chiu, *et al*: *JBJS Am*, 2002
Hallers, *et al*: *Acta Orthop*, 2010

CONS

- Cost (~$300 / bag)
- Potential mechanical instability
- Antibacterial resistance
- Allergic reactions
- Efficacy questionable

Hinarejes, *et al*: *JBJS Am*, 2013
Namba, *et al*: *J Arthrop*, 2013

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Multivariate Analysis Comparing Adverse Outcomes After Primary, PJI, and Non-PJI Revision Knee Arthroplasty

	Primary TKA, 162,981	Revisions		Multivariate Analysis[a]					
		Non-PJI, 10,584	PJI, 2196	Non-PJI vs Primary		PJI vs Primary		PJI vs Non-PJI	
				OR	P-Value	OR	P-Value	OR	P-Value
Any complication (major or minor)	3.54%	4.72%	13.66%	**1.26**	**<.001**[b]	**3.64**	**<.001**[b]	**2.81**	**<.001**[b]
Major complication	2.08%	3.00%	11.7%	**1.35**	**<.001**[b]	**5.00**	**<.001**[b]	**3.64**	**<.001**[b]
Death	0.11%	0.16%	0.18%	1.24	.398	**4.30**	**<.001**[b]	**3.25**	**.001**[b]
Cardiac complications	0.27%	0.35%	0.64%	1.14	.457	1.48	.156	1.52	.196
Renal complications	0.18%	0.25%	1.50%	1.15	.497	**5.83**	**<.001**[b]	**5.08**	**<.001**[b]
Respiratory complications	0.46%	0.58%	1.87%	1.07	.800	**2.68**	**<.001**[b]	**2.43**	**<.001**[b]
Deep vein thrombosis	0.92%	0.85%	1.37%	0.92	.422	1.42	.060	1.49	.066
Stroke/cerebrovascular accident	0.09%	0.09%	0.09%	1.07	.834	0.85	.819	0.68	.629
Sepsis	0.22%	0.55%	5.37%	**2.27**	**<.001**[b]	**19.9**	**<.001**[b]	**8.73**	**<.001**[b]
Deep surgical site infection	0.15%	0.64%	2.14%	**3.74**	**<.001**[b]	**11.0**	**<.001**[b]	**3.16**	**<.001**[b]
Minor complication	1.65%	1.98%	2.64%	1.14	.068	1.44	.007	1.27	.128
Urinary tract infection	0.93%	0.90%	1.32%	0.94	.588	1.36	.107	1.43	.103
Wound dehiscence	0.20%	0.38%	0.64%	**1.68**	**.002**[b]	**2.42**	**.002**[b]	1.67	.113
Superficial surgical site infection	0.55%	0.76%	0.77%	1.26	.049	1.19	.482	0.96	.878
Nonhome discharge	28.01%	27.73%	41.53%	0.94	.010	**1.67**	**<.001**[b]	**1.75**	**<.001**[b]
Blood transfusion	8.16%	11.87%	23.95%	**1.44**	**<.001**[b]	**3.08**	**<.001**[b]	**2.07**	**<.001**[b]
Thirty-day readmission	3.42%	5.49%	10.31%	**1.51**	**<.001**[b]	**2.57**	**<.001**[b]	**1.67**	**<.001**[b]

[a] Binary logistic multivariate regression.
[b] Significance defined as $P < .0029$ after Bonferroni correction, significant values are in bold.

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Intraoperative Frozen Section

- Frozen section
  - Sensitivity 73.7%
  - Specificity 98.8%
  - Positive predictive value 94.1%
  - Negative predictive value 93.3%

JOA 2017

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Intraoperative Frozen Section

- Frozen section
  - Sensitivity 73.7%
  - Specificity 98.8%
  - Positive predictive value 94.1%
  - Negative predictive value 93.3%

JOA 2017

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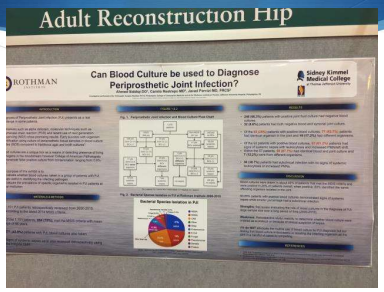
Adult Reconstruction Hip



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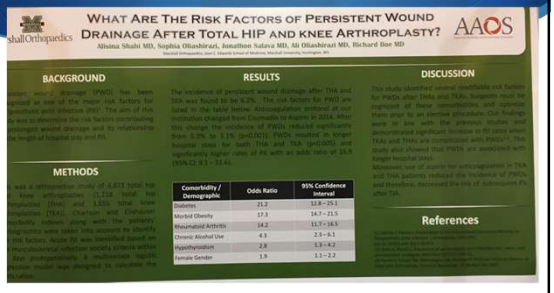

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What are the Risk Factors of Persistent Wound Drainage After Total Hip and Knee Arthroplasty

Comorbidity / Demographic	Odds Ratio	95% CI
Diabetes	21.2	12.8 – 25.1
Morbid Obesity	17.3	14.7 – 21.5
Rheumatoid Arthritis	14.2	11.7 – 16.5
Chronic Alcohol Use	4.3	2.3 – 6.1
Hypothyroidism	2.8	1.3 – 4.2
Female Gender	1.9	1.1 – 2.2

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Shahi, *et al: AAOS Annual Meeting*

The Efficacy of Various Irrigation Solutions in Removing Slime-Producing *Staphylococcus*

- Power irrigation >100x more effective at bacterial removal than bulb syringe of same volume, no matter which solution!
- Antibiotics had no significant effect on bacterial removal compared to saline alone.
- Liquid Soap significantly (p=0.001) removed bacteria almost 10-fold, compared to polymyxin (best antibiotic solution in the study).

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Anglen, *et al: J Orthop Trauma*, 1994

Irrigation and Debridement

Indications

- Hematogenous infection <3 weeks
- Susceptible organism
- Good soft-tissue coverage
- Well-fixed prosthesis
- Patient should be optimized prior to surgery

Contraindications

- Duration >3 weeks
- Multiple joint arthroplasties
- Sinus tract or poor soft-tissue coverage
- Loose prosthesis
- Antibiotic-resistant bacteria

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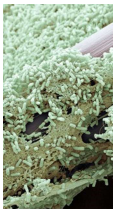
■ SPECIALTY UPDATE: ARTHROPLASTY
Proceedings of the International Consensus on Periprosthetic Joint Infection

Parvizi, *et al: Bone Joint J*, 2013

- Best reported success rate for acute hematogenous infection is 71%[1]
- Chronic infection and MRSA are predictors of failure!
  - 60% – 90% failure rate[2]
  - Treatment of Biofilm???



Sherrell, *et al: CORR*, 2011
Bradbury, *et al: J Arthrop*, 2009

Dilute Betadine Lavage Before Closure for the Prevention of Acute Postoperative Deep Periprosthetic Joint Infection

Povidone-Iodine (prophylaxis)

- Dilute betadine lavage (0.35%) for 3 minutes after implantation
- Reduced 90-day PJI incidence compared to control group (0.15% vs. 0.97%, p = 0.04)

Brown, *et al: J Arthrop*, 2012

Hydrogen peroxide Wound Irrigation in Orthopaedic Surgery

Hydrogen Peroxide (in the protocol)

- 50:50 dilution of 3% hydrogen peroxide and NS for 3 min
- Irrigation with 3L normal saline
- 0.3% dilute povidone-iodine for 3 min
- Irrigation with 3L normal saline
- 4% chlorhexidine gluconate for 3 min
- 3L NS with 500,000 units polymyxin B and 50,000 units bacitracin

Lu, *et al: JBJ Infection*, 2017

Chlorhexidine Antiseptic Irrigation Eradicates *Stephylococcus epidermis* From Biofilm: An *In-Vitro* Study

Chlorhexidine Gluconate

- Anti-biofilm properties of available antiseptics at different concentrations and exposure times
- CHG: anti-biofilm effect with short exposure (as low as 0.05% / 1 min)
- Betadine, sodium hypochlorite and triple antibiotic solution (bacitran + gentamicin + polymyxin) limited utility with short exposure

Schmidt, *et al*: *CORR*, 2018

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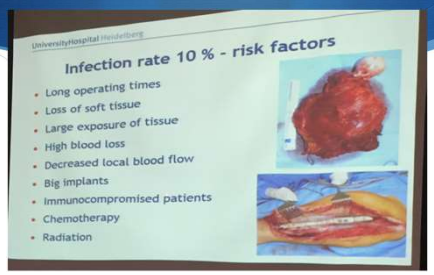

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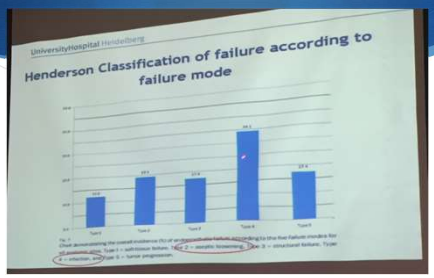

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Is it the patient?
Staph aureus infection – 80% patients own staph




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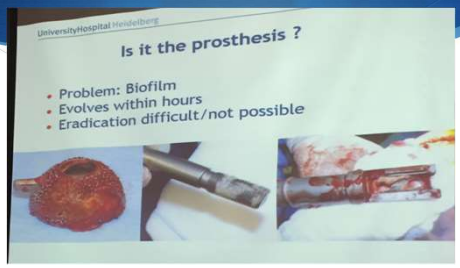

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What proportion of patients report long-term pain after total hip or knee replacement for osteoarthritis? A systematic review of prospective studies in unselected patients.

- 14 articles describing 17 cohorts (6-THR, 11-TKR)
- Unfavorable long-term pain outcome
  - 7% to 23% after THR
  - 10% to 34% after TKR
- In the best quality studies
  - 9% or more after THR
  - Approximate 20% after TKR

Incidence of low-grade PJI: ~5%

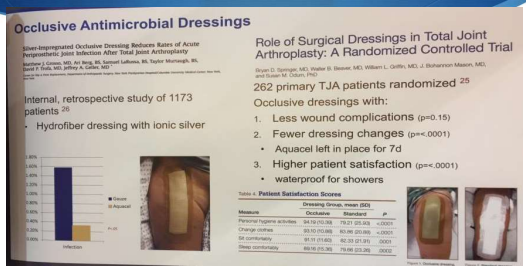
Beswick, *et al: BMJ – Open Access*, 2012

Minimize Transfusions

- Transfusions increase risk of PJI [1]
- ID risk factors [2]
  - Low hemoglobin
  - Female
  - Prolonged operative times
  - High Charlson comorbidity Index
- Minimize blood loss [3,4]
  - Cell saver
  - Reinfusion drain
  - Tranexamic acid

1. Newman et al. JBJS Am. 2014 2. Park et al. JBJS Am. 2013 3. Perazzo et al. Blood Transfu. 2013 4. Sukelf et al. JBJS am 2011

Occlusive Antimicrobial Dressings



S. Aureus ID

- Nasal carriage
  - Nasal carriers of MRSA 3-6x higher infection risk
- Nasal decolonization
  - Cost effective & simple
- Adaptation of antibiotic course

Bode et al. NEJM. 2010
Chen et al. CORR. 2013

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Drains

- Efficacy Controversial
- Risk
  - Retrograde infection
  - Early drain removal key (24-48h)

Kapedla et al. Expert Rev Med Devices. 2013

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Background | Debridement | Antimicrobial Solutions | Local Antibiotics | Other Agents

Calcium sulphate beads

- Kallala el al. Bone Joint J 2015
  - 15 infected hip/knee joints
  - Mean follow up of 16 months
  - 14 out of 15 pts cleared infection
  - Hypercalcemia in 3 pts

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1. Kallala R, Haddad FS. Hypercalcemia following the use of antibiotic-eluting absorbable calcium sulphate beads in revision arthroplasty for infection. Bone Joint J 2015 Sep;97-B (9):1237-41 doi: 10.1302/0301-620X.97B9.34532.
2. George DA, Gant V, Haddad FS. The Management of periprosthetic infection in the future: a review of new forms of treatment. Bone Joint J. 2015 Sep;97-B (9) 1162-9 doi: 10 1302/0301-62ox. 97B9.35295

Readmission Rates

- Readmission rates were significantly higher when patients did not go home after surgery.
- After the implementation of an enhanced recovery pathway for primary total joint arthroplasty, the rate of discharge disposition to home continued to be high with increased readmission rates for patients discharge to a post-acute care facility. Effort should be made in a bundled system to drive patients towards a home discharge destination to reduce readmission.

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Stratification by Hospital Bed Size and Teaching Status

- An increasing trend in PJI prevalence was particularly seen in large (>500beds) hospitals (24.4% in 2003 to 27.4% in 2013 P<0.0001) while dressing trends were seen in small and medium size hospital.
- With small differences between hospitals, the lowest and PJI prevalence were seen in small hospitals (>299 beds; 22.5%)
- The highest prevalence of TKA PJI was seen in urban teaching hospitals (26.8%).

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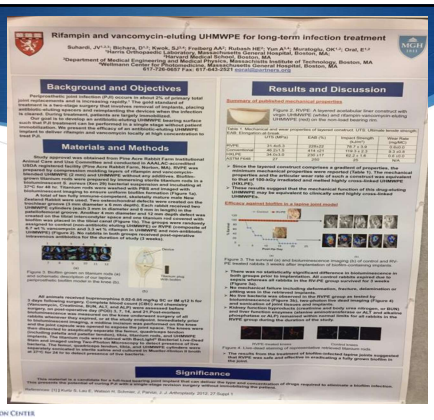
Rifampin and vancomycin-eluting UHMWPE for long-term infection treatment

Background and Objectives

Materials and Methods

Results and Discussion

Significance

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Background | Debridement | Antimicrobial Solutions | Local Antibiotics | Other Agents

- **Anticancer drugs**
- Cisplatin, 5-flurocytosine, and mitomycin
  - In-vitro eradication of all biofilm-embedded microbes
- **Electric current**
  - Decreased biofilm load in rabbit model

Del Pozo JL. Rouse MS, Euba G, Kang C-I, Mandrekar JN, Steckelberg JM, et al The electricidal effect is active in an experimental model of Staphylococcus epidermidis chronic foreign body osteomyelitis Antimicrob Agents Chemother 2009, 53 4064-6 doi 10 1128/AAC 00432-09

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Background | Debridement | Antimicrobial Solutions | Local Antibiotics | Other Agents

D-amino acids

Disrupts biofilms without toxicity

- Sanchez et al. 2013 Biomaterials
  - Effective at dispersing biofilm formation in rat model of osteomyelitis

1.Sanchez Jr. C. J., Preito E. M., Krueger C. A., Zienkiewicz K. J., Romano D. R., Ward C. L., Akers K. S., Guelcher S.A., Wenke J. C., Effects of local delivery of d-amino acids from biofilm-dispersive scaffolds on infection in contaminated rat segmental defects. Elseiver Biomaterials 34 (2013) 7533-7543
2.Harmata AJ, MA y, Sanchez CJ, Zienkiewicz KJ, Elefteriou F, Wenke JC, Guelcher SA. Clin Orthop Relat Res, 2015 Dec;473(12):3951-61. doi:10.1007/s11999-015-4465-9Epub 2015 Jul 23

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Thank You!

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