Bone Preparation in Cemented UKA Using Pressurized CO_2 Lavage

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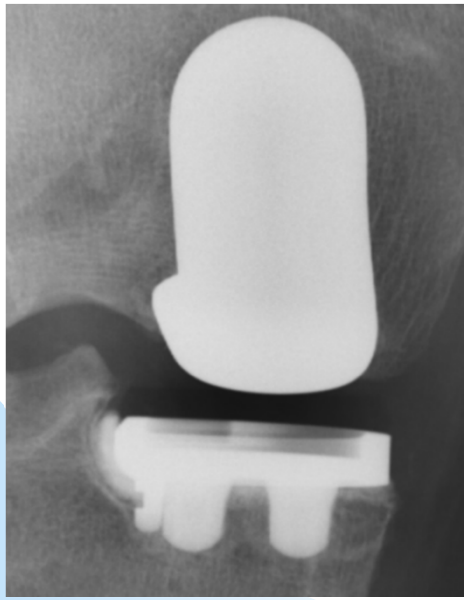
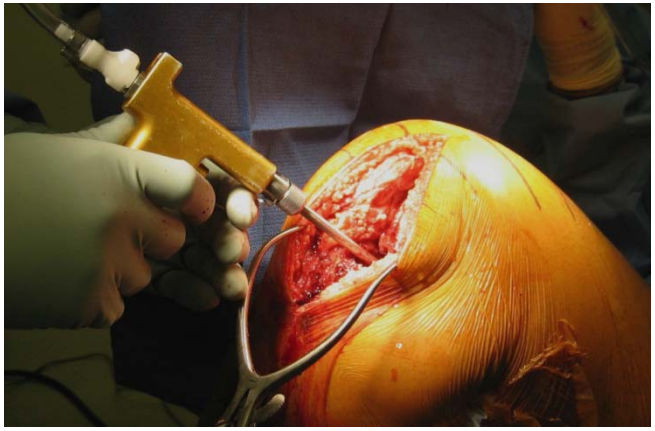
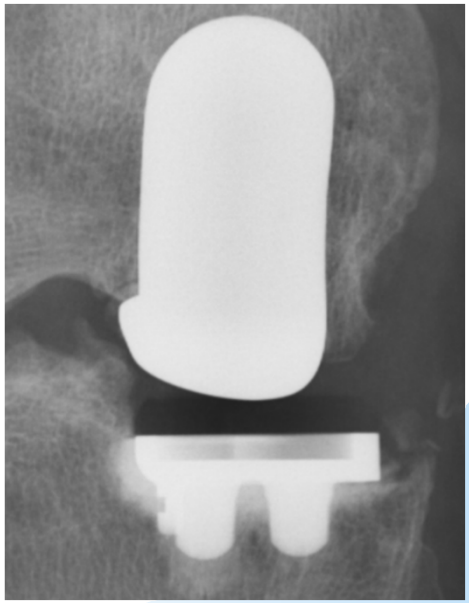




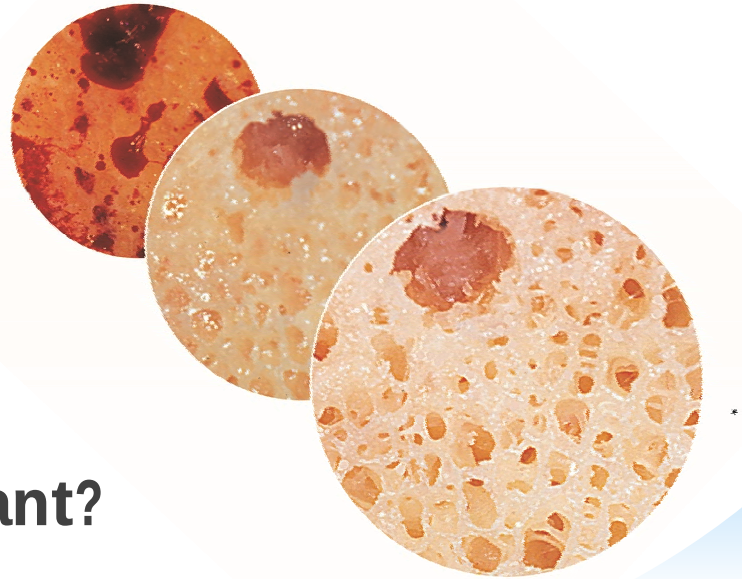


CarboJet CO_2 Lavage System

A Better Way To Clean Bone

Some background on the CO_2 lavage technology….

- **What is it?**
- **What does it do?**
- **Why is this important?**



What is it?

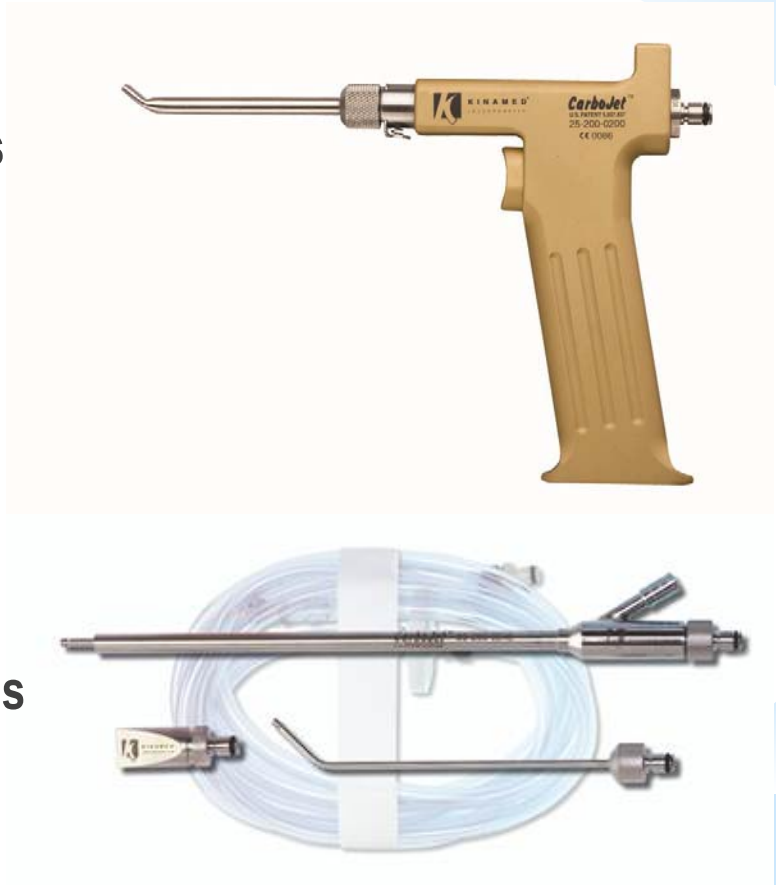
* A gas jet lavage system using dry, flowing CO_2 gas

* It's purpose is to both deep clean and dry the bone bed in preparation for cementation

* Fast and simple to use

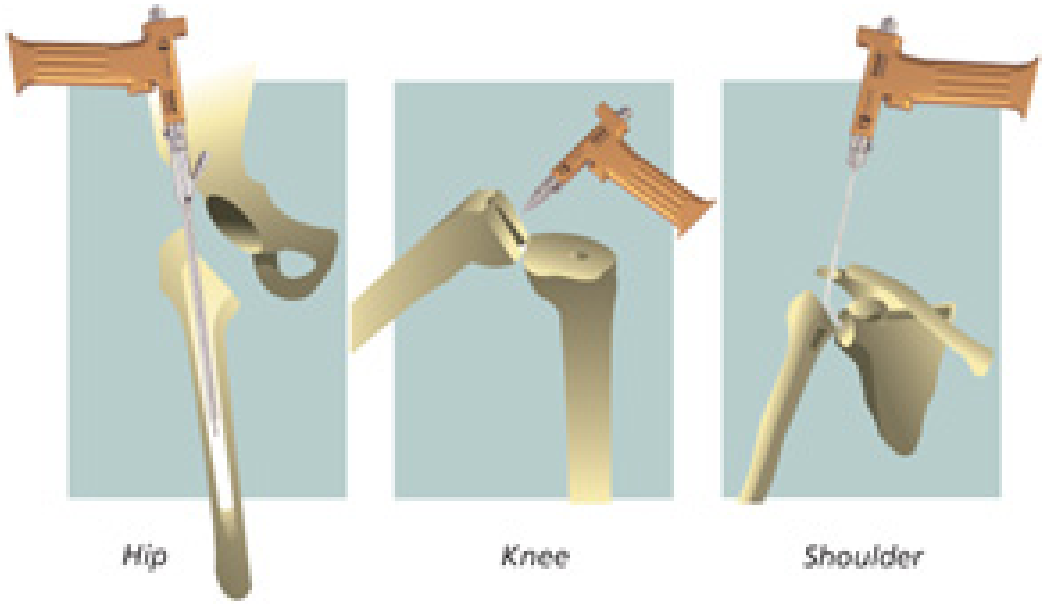
What is it?

* Saline lavage is used first for gross debris removal
* Either pulsatile saline lavage or simple bulb syringe lavage may be used
* Both the saline lavage and the CarboJet CO2 lavage can be accomplished while cement prep is going on resulting in no net increase in surgical time



What is it?

It is used in any procedure that relies on cement fixation

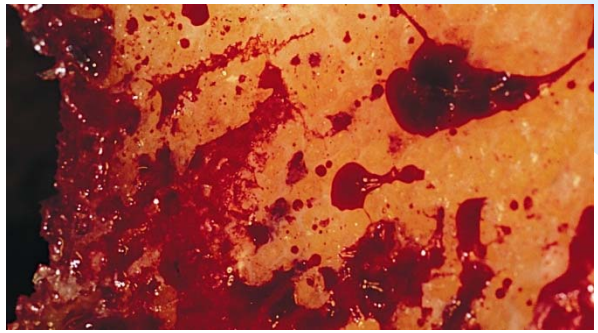


What does it do?

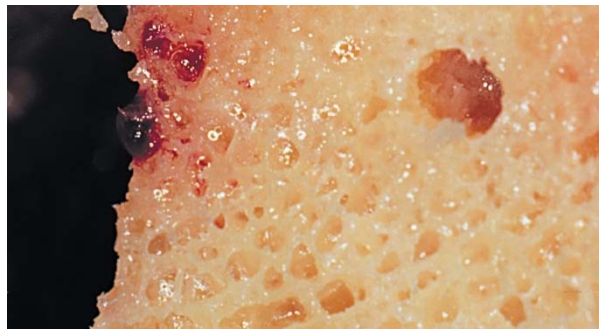
What does it do?

These photos are a good illustration

Resected tibia in a total knee



Same tibia after pulsatile saline lavage



Same tibia after CarboJet CO_2 lavage

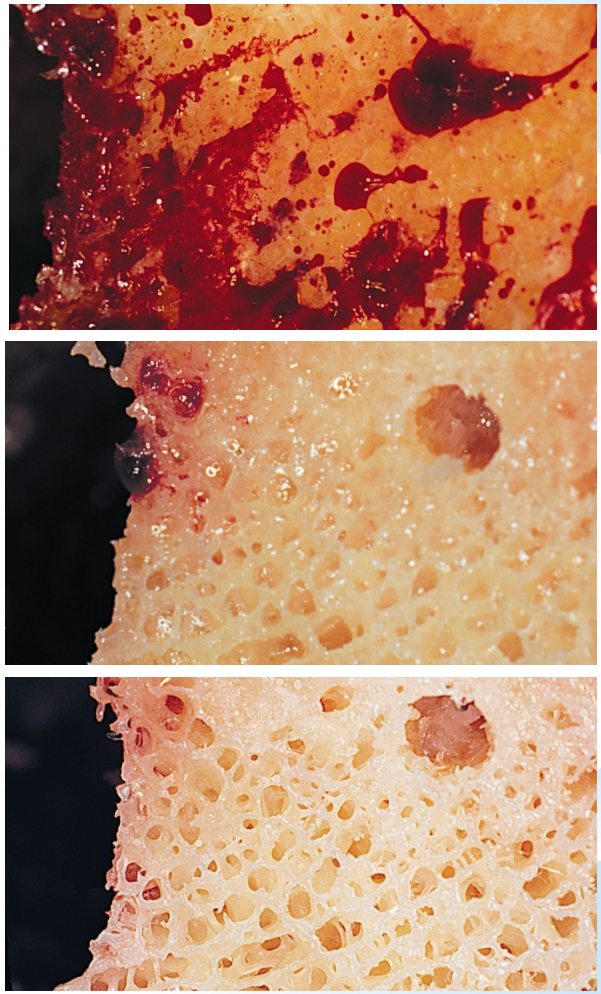
What does it do?

Limitations of pulsatile saline lavage:

"Oil and water don't mix!"

* Although saline is good at washing away blood and particulate debris, it is much less effective at removing viscous fatty marrow material that is essentially "waterproof"

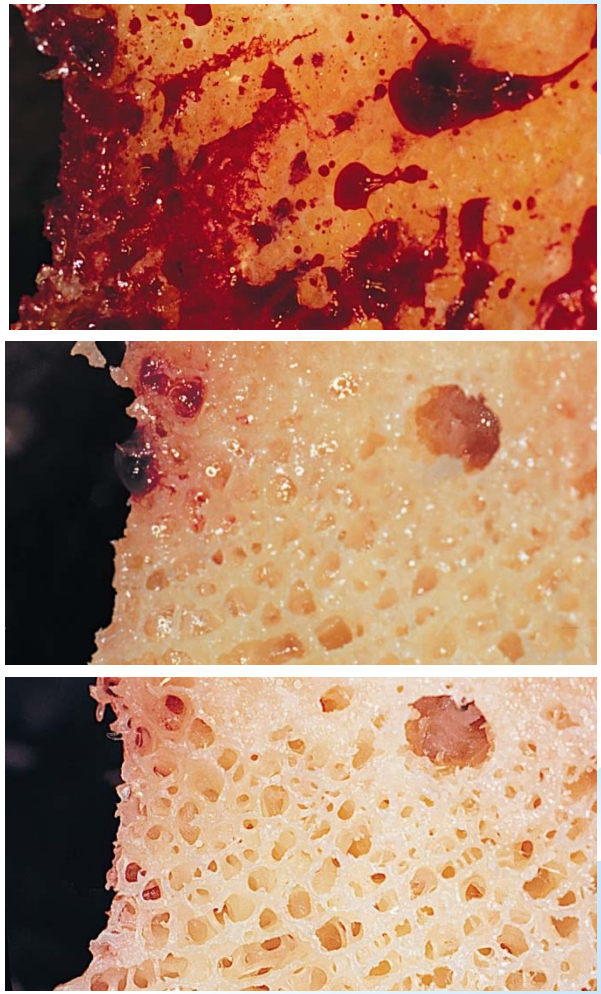
* Saline lavage obviously does not provide for a dry bone bed to cement into



What does it do?

***CarboJet* CO_2 Lavage**

* A compressed gas jet effectively displaces fluid and lifts out fatty marrow debris, thus deep cleaning and drying porous bone structures.
* Cement penetration and adhesion is maximized.



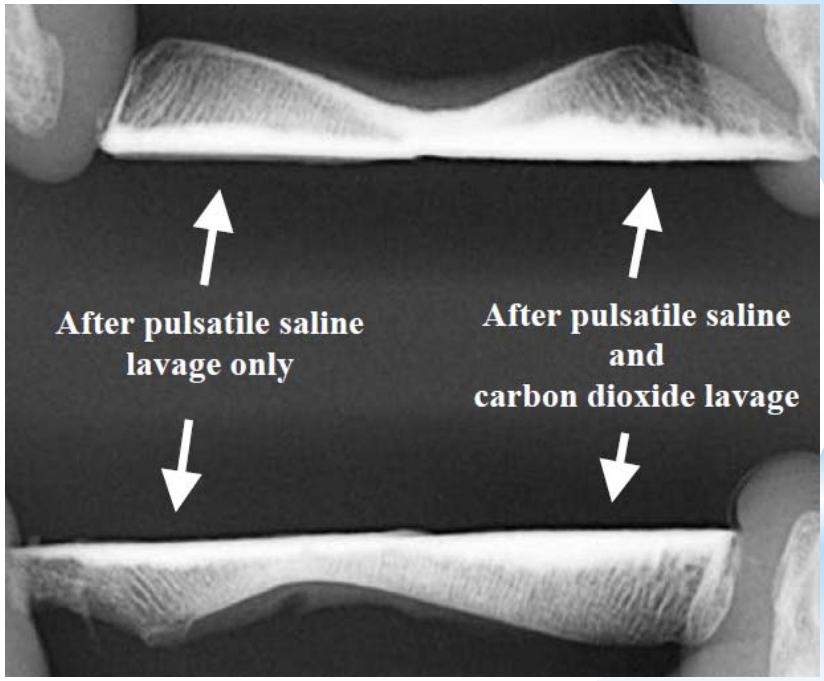
What does it do?

What does it do?

Improves Cement Penetration

Goldstein (2007) Improvement of cement mantle thickness with pressurized carbon dioxide lavage. ISTA. Paris, France.

CarboJet resulted in a 35% increase in cement penetration depth versus use of pulsatile saline lavage alone



Why is this important?

CarboJet Marketing Campaign –

CarboJet and UKA

Mechanism of Primary Knee Arthroplasty Failure: Difference of a Decade

William C. Schroer, MD[1]; Keith R. Berend, MD[2]; Adolph V. Lombardi, MD[2]; C. Lowry Barnes, MD[3]; Michael P. Bolognesi, MD[4]; Michael E. Berend, MD[5]; Merrill A. Ritter, MD[5]; Ryan M. Nunley, MD[6]

Why are UKAs Failing Today?

All Patients	Knees	%
Aseptic Loosening	57	60.6
Pain	10	10.6
Instability	7	7.4
Arthritis Progression	4	4.3
Polyethylene Wear	4	4.3
Malalignment	3	3.2
Periprosthetic Fracture	3	3.2
Other	3	3.2
Arthrofibrosis	2	2.1
Infection	1	1.1

Why are Knees Failing Today?

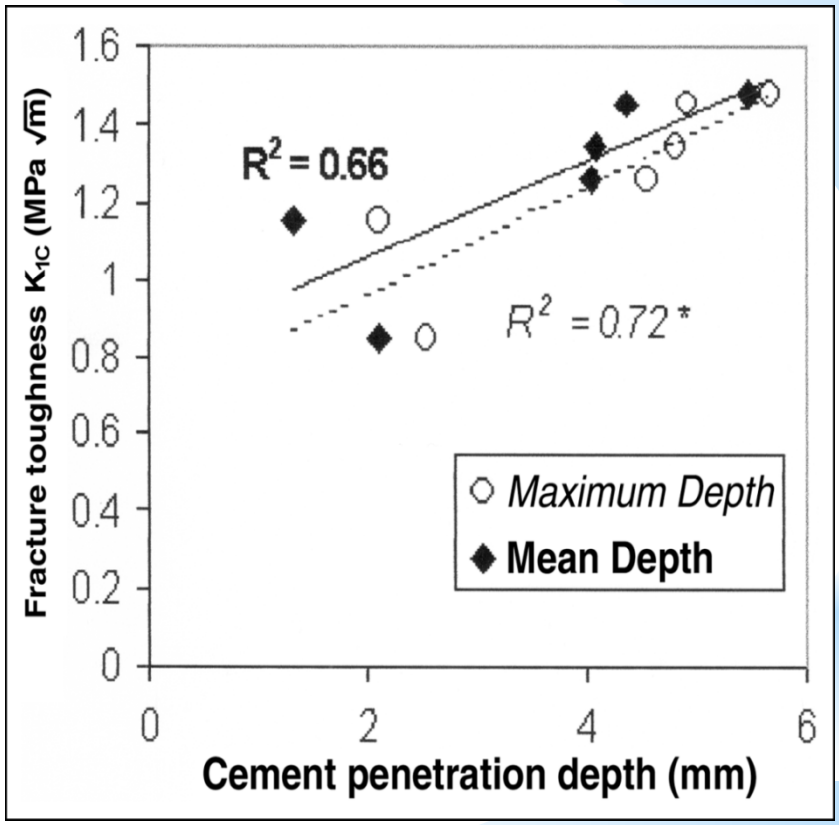
All Patients	Knees	%
Aseptic Loosening	263	28.0
Instability	158	16.8
Infection	137	14.6
Polyethylene Wear	84	9.0
Arthrofibrosis	59	6.3
Malalignment	56	6.0
UKA – separate analysis below	94	10.0
Other	87	9.3

Why is this important?

Increased penetration improves cement mantel toughness

Graham et al (2003) Effect of Bone Porosity on the Mechanical Integrity of the Bone-Cement Interface. J Bone Joint Surg Am.85:1901-1908

* **Demonstrated that cement penetration was significantly positively correlated with cement mantle toughness ($p < 0.033$)**

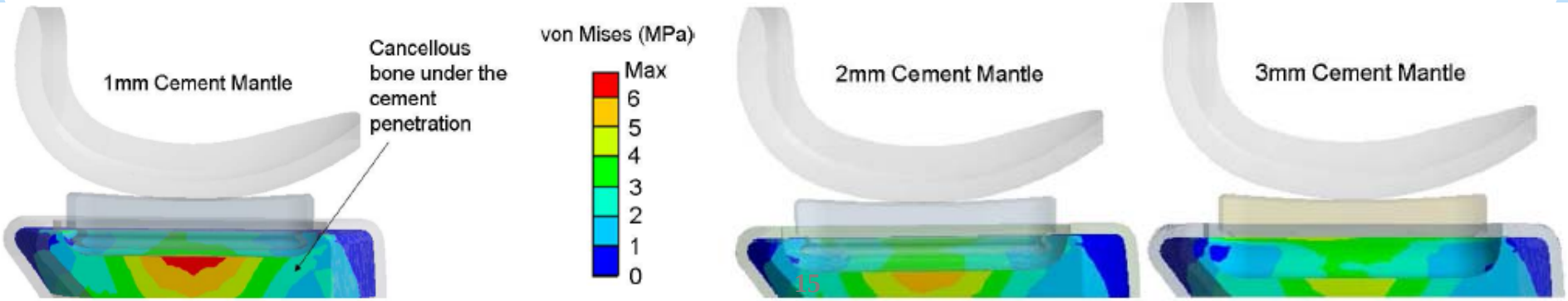


Why is this important?

Increased Cement Penetration reduces bone-cement interface stress

Thompson, et al (2010) The Importance of a Good Cement Mantle with an All-Poly Inlay UKA. ORS. New Orleans, USA

* **“Increasing cement thickness from 1mm to 2mm and 3mm, stresses in the cement fell 10% and 21%, respectively.”**

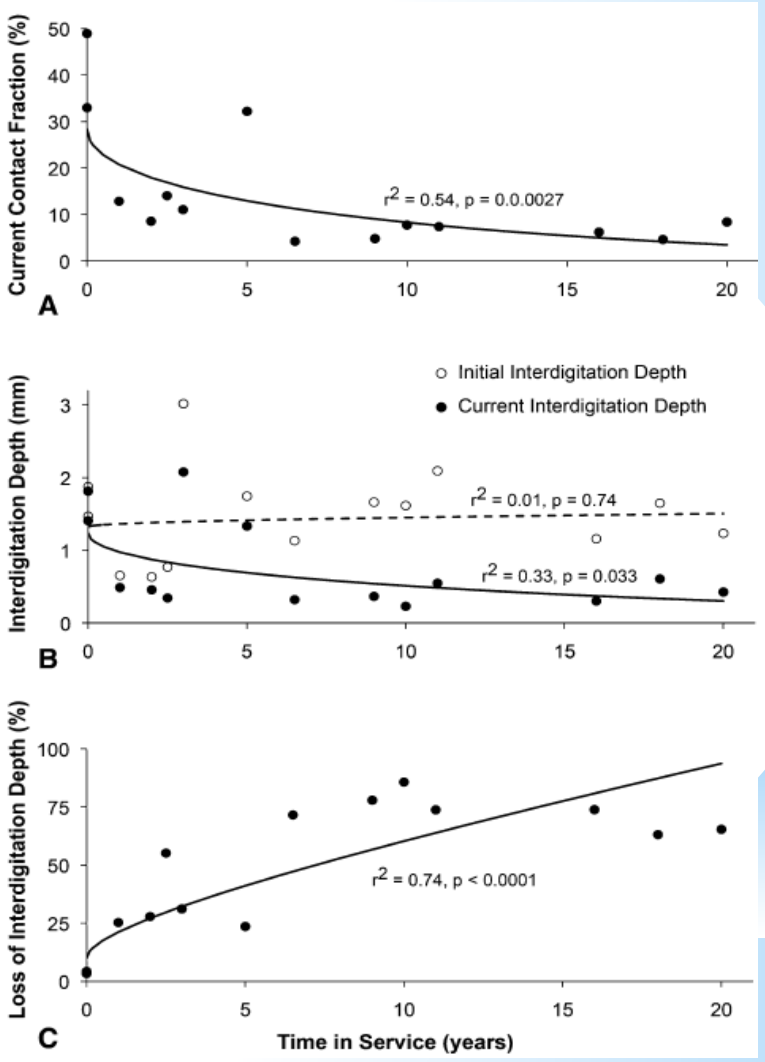


Why is this important?

Increased cement penetration important to counter bone resorption over time

Miller et al (2014) Loss of Cement-bone Interlock in Retrieved Tibial Components from Total Knee Arthroplasties. Clin Orthop Relat Res 472:304-313.

* **Since bone into which cement is interdigitated initially, resorbs steadily with time in service, maximum initial interdigitation is important!**



Why is this important?

Facilitates creation of a

"Grade A Cement Mantle"

* Improves cement penetration depth
* Reduces or eliminates radiolucent lines
* Allows for a complete "whiteout"

Why is this important?

CarboJet Increases Bone-Cement Interface Strength

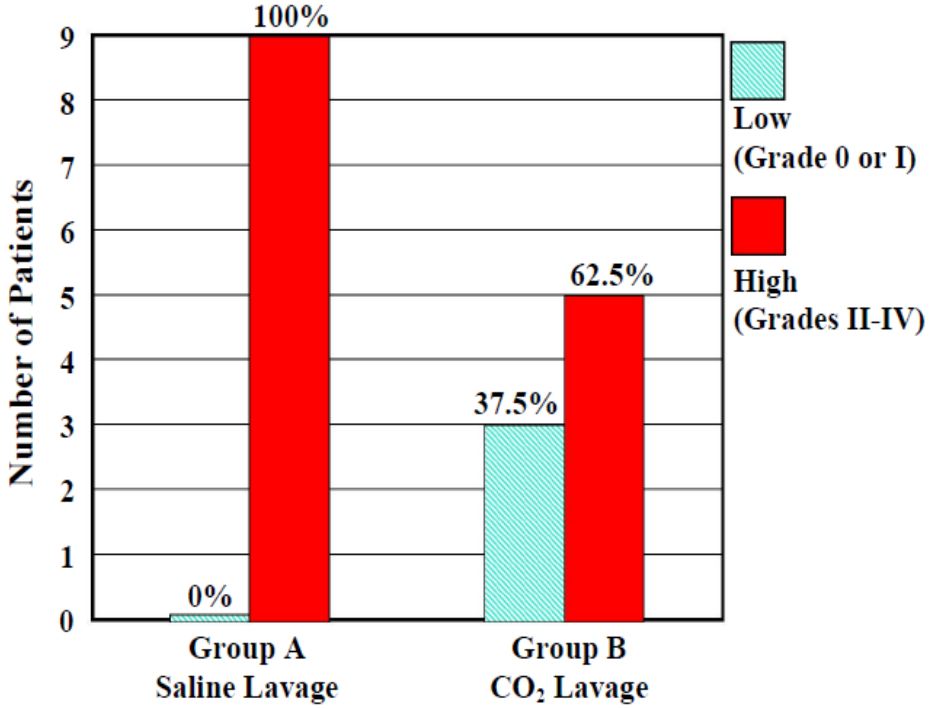
Stanley (2010) Bone-Cement interface strength in distal radii using two medullary canal preparation techniques. Hand Surg 15:95.

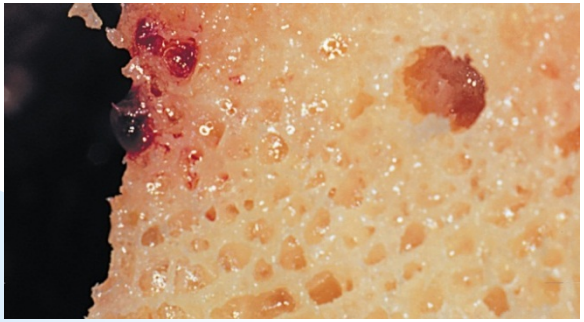
CarboJet resulted in significantly higher cement plug push-out strength versus saline lavage technique (median 581N vs. 366N)

Why is this important?

CarboJet Reduces Opportunity for Micro-Emboli

Lassiter (2010) Intraoperative embolic events during TKA with use of pulsatile saline versus carbon dioxide lavage. ORS. New Orleans, USA.





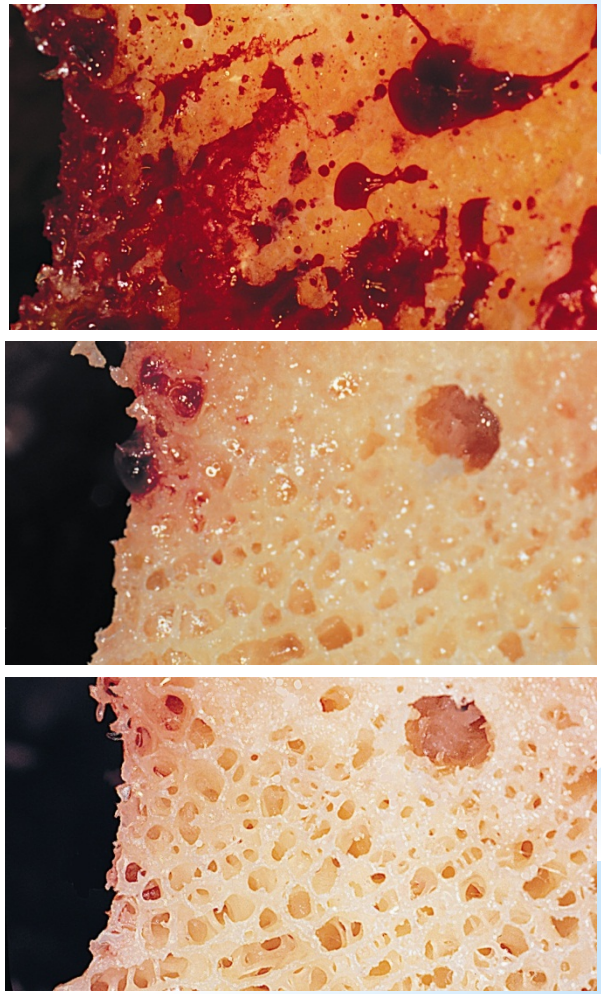
Why is this important?

CarboJet Facilitates Tourniquet-free TKA

Jones (2011) Total Knee Arthroplasty without the use of a tourniquet. Seminars in Arthroplasty 22:176.

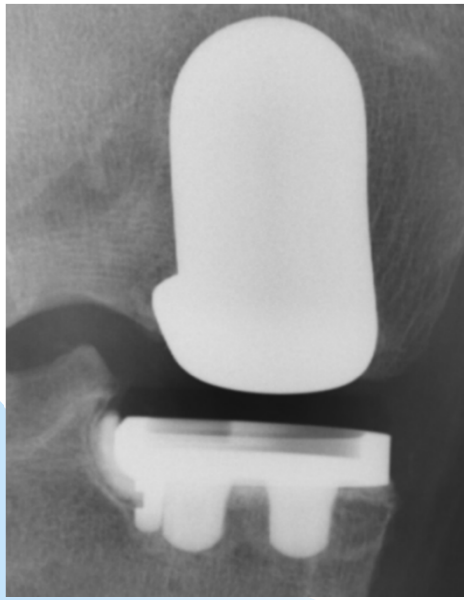
CarboJet provides for a clean, dry bone bed with tourniquet-free technique

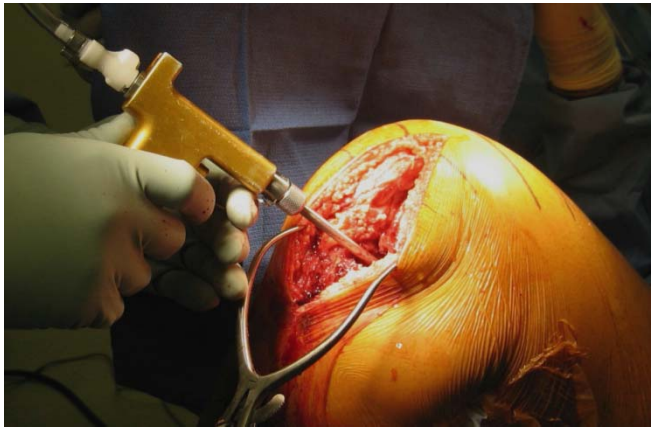
Tourniquet-free technique avoids local and systemic risk factors associated with tourniquet use

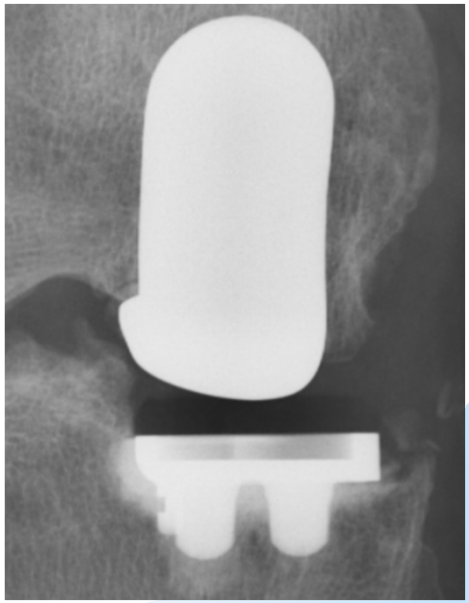


Bone Preparation in Cemented UKA Using Pressurized CO_2 Lavage

Let’s examine the application of CarboJet in partial knee replacement….





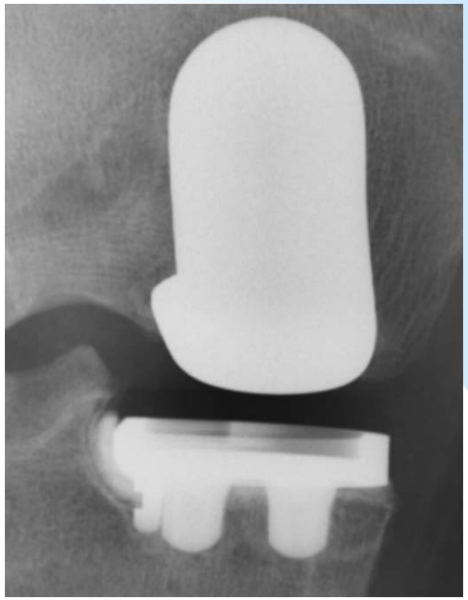


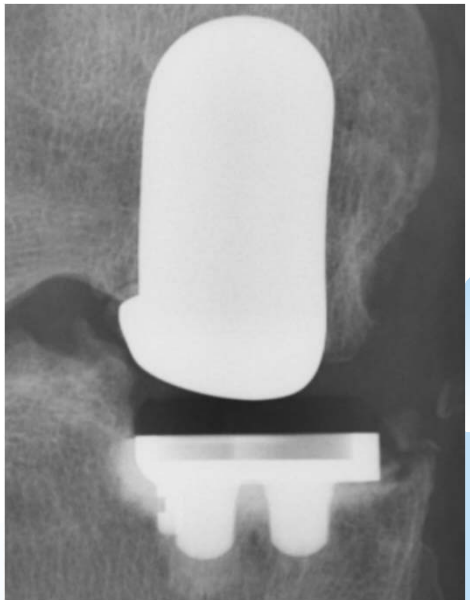
CarboJet in UKA

Aseptic loosening is the most common cause for revision of UKA

Lewold (1998) cites 1975-96 Swedish Knee Arthroplasty Register data:

- **45.1% of medial UKA revisions due to aseptic loosening**
- **Next most common revision cause was progression of OA at 25.2%**





CarboJet in UKA

Aseptic loosening is the most common cause for revision of UKA

Kalra (2011) cites revision data from a series of 949 Oxford cemented UKAs in which 92 were revised:

* **35 revisions due to femoral loosening (38%)**
* **10 revisions due to tibial loosening (11%)**
* **Combined, 49% of revisions were due to aseptic loosening**

Table I. Reasons for revision surgery in the 92 revisions of 949 Oxford phase-3 procedures. Only those 45 with loosening of a component were included into our revision series

Reason	Number of cases
Femoral loosening	35
Tibial loosening	10
Bearing dislocation	14
Unexplained pain	10
Progression of lateral disease	10
Fracture	8
Infection	5
Total	92