



SunCoast Seminars

presents

New Technologies affecting Post-operative Rehabilitation for Orthopedic Joint Procedures (2015 Edition)

Educator:

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Last updated March 2015

Program Objectives

- The attendees of this seminar will have a comprehensive understanding of the latest technologies in the surgical management of joint dysfunction and their affect on post-operative rehabilitation
- Why should we be aware of the latest implant technology?
 - You might treat these patients post-operatively in the various settings (Acute/Rehab/HomeCare/OP)
 - Patients might ask you for advice regarding these procedures.
 - With the anticipated growth of elective orthopedic joint procedures, we are more likely to see patients who underwent these procedures.
 - As our autonomy will grow as part of the APTA's Vision 2020, we should be aware of these technologies for referral and discussion reasons

Topics of discussion

- History of Joint Replacement surgery (Shoulder, Hip, Knee)
- New Implant Technologies
- Functional outcomes and how they are affected by these new implant technologies
- New anesthesia technologies
- When does Rehabilitation begin?
- Other important factors to consider
 - WB status
 - Education
 - Discharge Planning
 - Surgical Approach

A Few Rules



- We are in a hospital and should be aware of any codes that might be called.
- Bathrooms are right outside of this room
- We will break for lunch are around noon and we will break for an hour
- Please turn off all cell phones.
- I would like to make this lecture as interactive as possible. Please feel free to ask questions, share your experiences, opinions etc. with the rest of the group.

About the educator

- Background
- Education
- Work experience
- Hobbies

About SunCoast Seminars

- 4 educators
 - Dr Brian Healy, DC, MSPT
 - Dr Jorit Wijnmaalen, DPT, MBA, MTC
 - Dr Willem Stegeman, DPT, MTC
 - John Van Ooijen, PT
 - Nathan Possert, DPT, ATC



About SunCoast Seminars

More courses:

- New Technologies affecting Post-op rehab 9.5 CEU
- Comprehensive Management of back & neck pain: 9.5 CEU
- Introduction to Manual therapy for Pt's and PTA's: 9.5 CEU
- HIV/Medical Errors/Abuse: 4 CEU
- Setting Specific Orthopedic Exercise: 9.5 CEU
- Imaging for the Rehab Specialist 9.5 CEU
- CORS, 9 CEU

Founded in 2007, SunCoast Seminars has had more than 5000 therapist attend courses.

We have hosted more than 300 seminars in Florida, Illinois, Georgia and The Netherlands



History of Joint Replacement surgery

- Let's discuss the history of the total joint procedures here and the history of post-operative feedback.
- We will also take a look at future projections (projected number of joint procedures) and the affect on the physical therapy profession will be discussed.

History of Joint Replacement

surgery

In 1925, a surgeon in Boston, Massachusetts, M.N. Smith-Petersen, M.D., molded a piece of glass into the shape of a hollow hemisphere which could fit over the ball of the hip joint and provide a new smooth surface for movement.

While proving biocompatible, the glass could not withstand the stress of walking and quickly failed.

After this failure, Dr. Smith-Petersen pursued other materials for his "mold arthroplasty" including plastic and stainless steel.

In the shipping industry stainless steel was first used to resist the corrosion of ocean going vessels. Its application to surgery, where it might well resist corrosion by bodily fluids, seemed natural.

During the 1940's, mold arthroplasty was "state of the art."

History of Joint Replacement surgery

- In 1936 scientists manufactured a **cobalt-chromium alloy** which was almost immediately applied to orthopaedics.
- This new alloy was both very strong and resistant to corrosion, and has continued to be employed in various prostheses since that time.
- While this new metal proved to be a great success, the actual resurfacing technique **was found to be less than adequate**.
- It became clear that pain relief was not as predictable as hoped, and hip movement remained limited for many patients.
- **Mold arthroplasty** also did not allow surgeons to treat the numerous and varied arthritic deformities of the hip. The search for different types of prostheses continued.

History of Joint Replacement surgery

- Frederick R. Thompson of New York, and Austin T. Moore of South Carolina, separately developed replacements for the entire ball of the hip.
- These could be used to treat hip fractures and also certain arthritis cases. This type of hip replacement, called hemi-arthroplasty, only addressed the problem of the arthritic femoral head (the ball).
- The diseased acetabulum (hip socket) was not replaced.
- The prosthesis consisted of a metal stem which was placed into the marrow cavity of the femur, connected in one piece with a metal ball which fit into the hip socket.
- While very popular in the 1950's, results remained unpredictable and arthritic destruction of the socket persisted.

History of Joint Replacement

surgery

- In addition, there was no truly effective method of securing the component to the bone.
- Large numbers of patients developed pain because of this loosening of the implant.
- As early as 1938, Dr. Jean Judet and his brother, Dr. Robert Judet, of Paris, attempted to use an acrylic material to replace arthritic hip surfaces.
- This acrylic provided a smooth surface, but unfortunately tended to come loose.
- The idea did lead Dr. Edward J. Haboush from the Hospital for Joint Diseases in New York City to utilize a "fast setting dental acrylic" to actually glue the prosthesis to the bone. A new era in fixation techniques had begun.



History of Joint Replacement

surgery

- In England, a very innovative surgeon, John Charnley, was also attempting to solve these ongoing problems.
- Some of his ideas were so bold and creative that he was seriously questioned by many of his colleagues.
- Charnley aggressively pursued effective methods of replacing both the femoral head and acetabulum of the hip.
- In 1958, he addressed the eroded arthritic socket by replacing it with a Teflon implant.
- When the Teflon did not achieve this goal, he went on to try polyethylene. This worked wonderfully well.

History of Joint Replacement surgery

- In order to obtain fixation of this polyethylene socket as well as the femoral implant to the bone, Charnley borrowed polymethylmethacrylate from the dentists.
- This substance, known as bone cement, was mixed during the operation then used as a strong grouting agent to firmly secure the artificial joint to the bone. **Truly this was the birth of "total hip replacement."**

The First Replacement surgeries



Joint replacement surgeries in general, are considered one of the most important surgical advances of the last century

The first total hip replacement was performed in 1960 (Sir John Charnley).

The first knee was replaced in the 1950's. These “joints” were nothing more than crude hinges.

- The first UniCondylar Knee replacements date back to the 1970's

The First Replacement surgeries

- The first recorded attempt of shoulder joint replacement occurred in 1892 but 1953 should be recognized as the year of the first successful shoulder replacement (actually, this was merely a 1-piece replacement (Monoblock) with only the humeral head being replaced)).
- A newer type of shoulder replacement is called the reverse total shoulder arthroplasty. This surgery was developed in Europe in the 1980s, and it was approved by the Food and Drug Administration (FDA) for use in the United States in 2004

Something to take into Consideration...Level of Activity

- The convention in measuring the clinical success of hip replacements is to measure the number of years an implant survives before it needs replacing, so the success (or “survivorship”) of any given implant is usually measured at ten years, for example. However, this convention does not consider all the factors involved.
- Joint survival is inextricably linked to joint activity, and the best way of measuring this is the number of “cycles” the joint has performed.
- More active people will use more cycles a year and therefore put more strain on their implants.
- Typically, Hip Resurfacing devices are implanted in much younger (and therefore more active) patients than a conventional Total Hip Replacement (THR).
- So if a Hip Resurfacing device has the same “survivorship” as the total joint implant, then the Resurfacing is actually lasting longer.

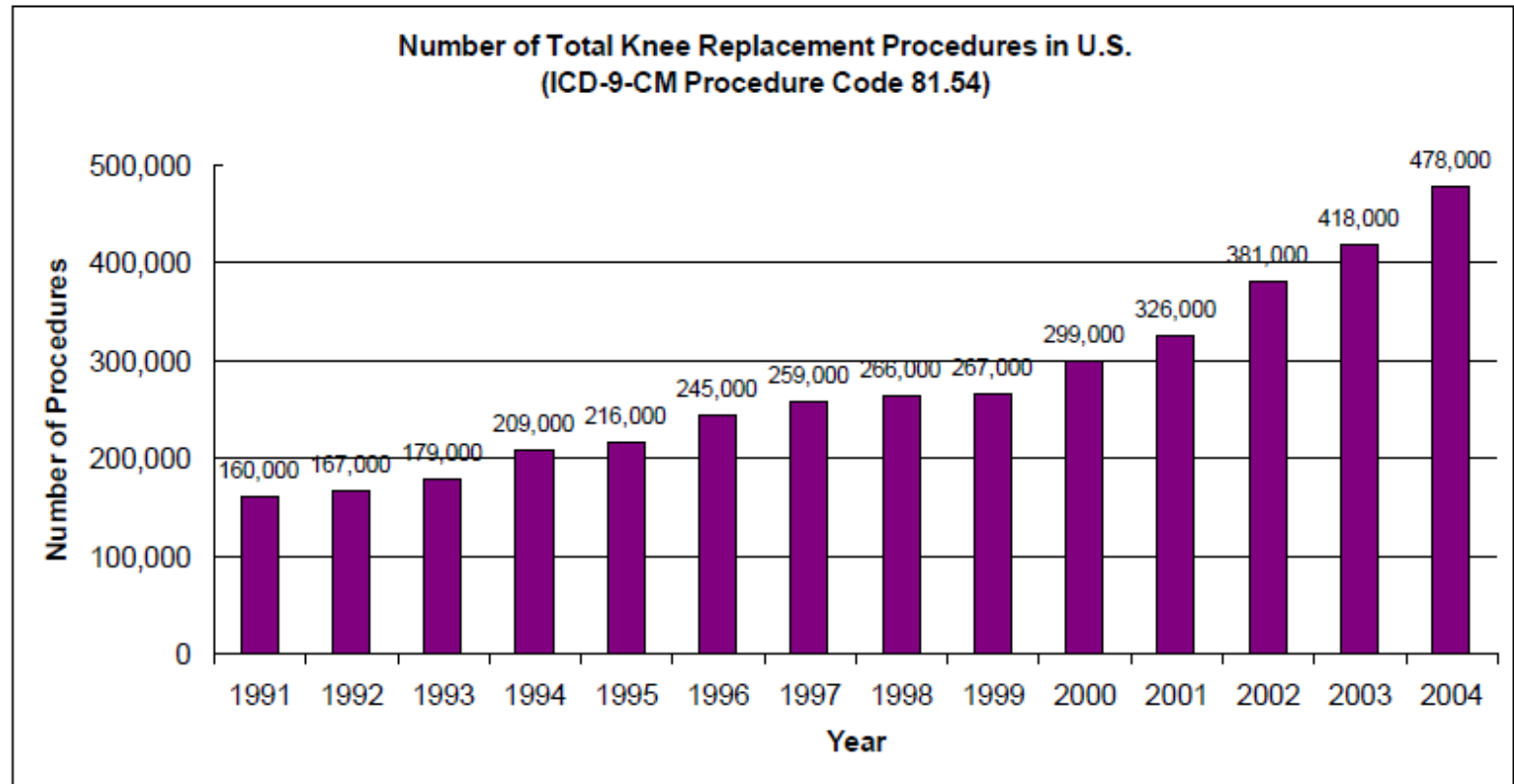
Something to take into Consideration...Level of Activity

- One study reports a variation from 0.5 million cycles per year in elderly patients to 5.4 million cycles in active younger patients(1).
- Another study quotes an average of 1.7 million cycles per year in a population of subjects between the ages of 25 and 74(2).
- A third quotes a 45-fold variation in a subject group ranging from 23 to 82 years old(3).
- Obviously, there is a massive variation in activity levels depending on age, fitness and occupation.
- Therefore, the manufacturers are (finally) acknowledging this by developing different joints for different levels of activities and even different gender.



Procedure Volumes in the United States (con't)

Figure 2.3: Number of Total Knee Replacements in the U.S. 1991-2004¹⁸

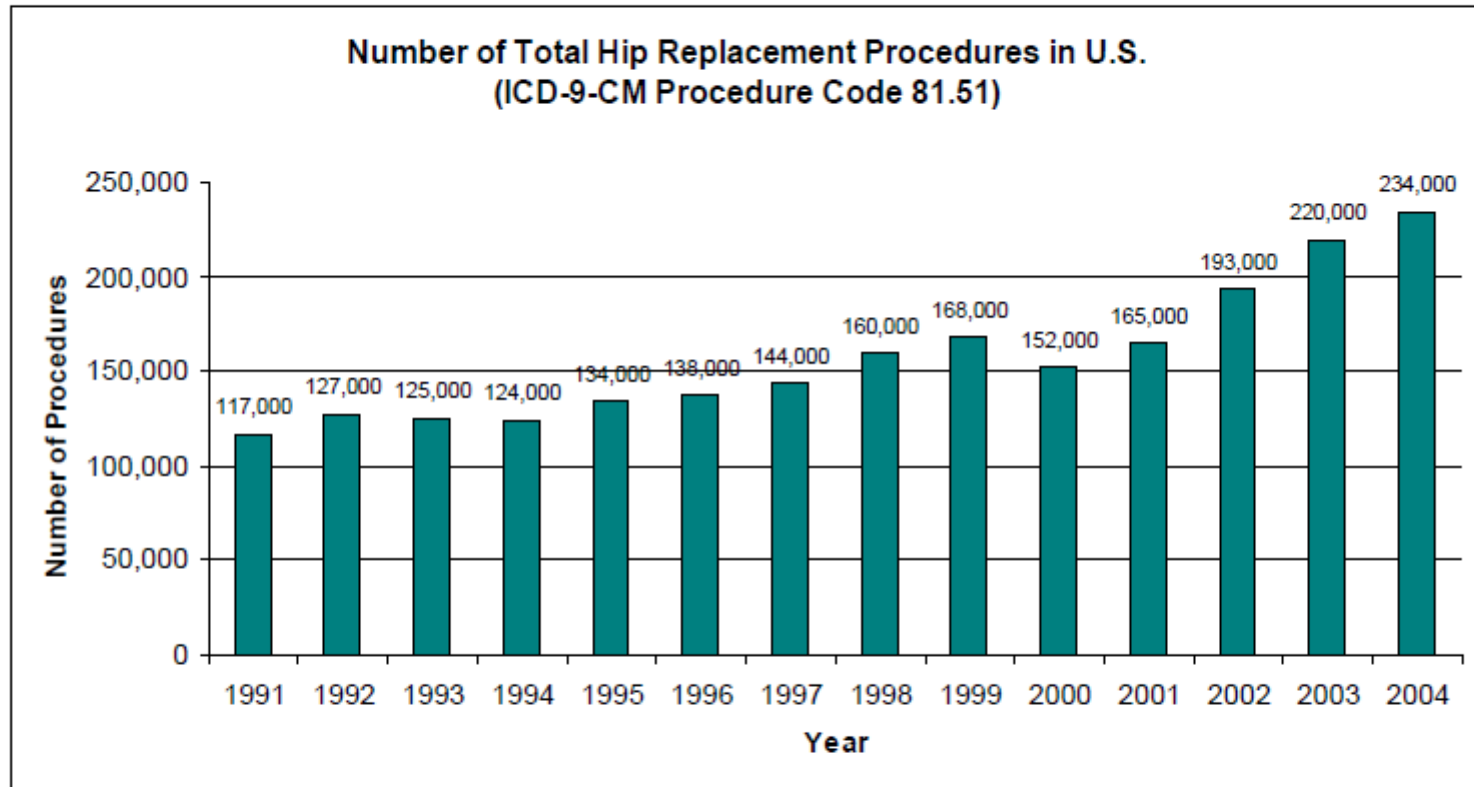


¹⁸ Source: National Hospital Discharge Survey 1991-2004. Available from National Center for Health Statistics, Centers for Disease Control and Prevention. Numbers have been rounded to the nearest thousand. Because of the possibility that multiple procedures were listed per patient, the above chart represents the sum of all instances of the target procedure code across all patient records.



Procedure Volumes in the United States (con't)

Figure 2.2: Number of Total Hip Replacements in the U.S. 1991-2004¹⁷



¹⁷ Source: National Hospital Discharge Survey 1991-2004. Available from National Center for Health Statistics, Centers for Disease Control and Prevention. Numbers have been rounded to the nearest thousand. Because of the possibility that multiple procedures were listed per patient, the above chart represents the sum of all instances of the target procedure code across all patient records.

A Few Numbers

Here are few numbers of joint surgeries:

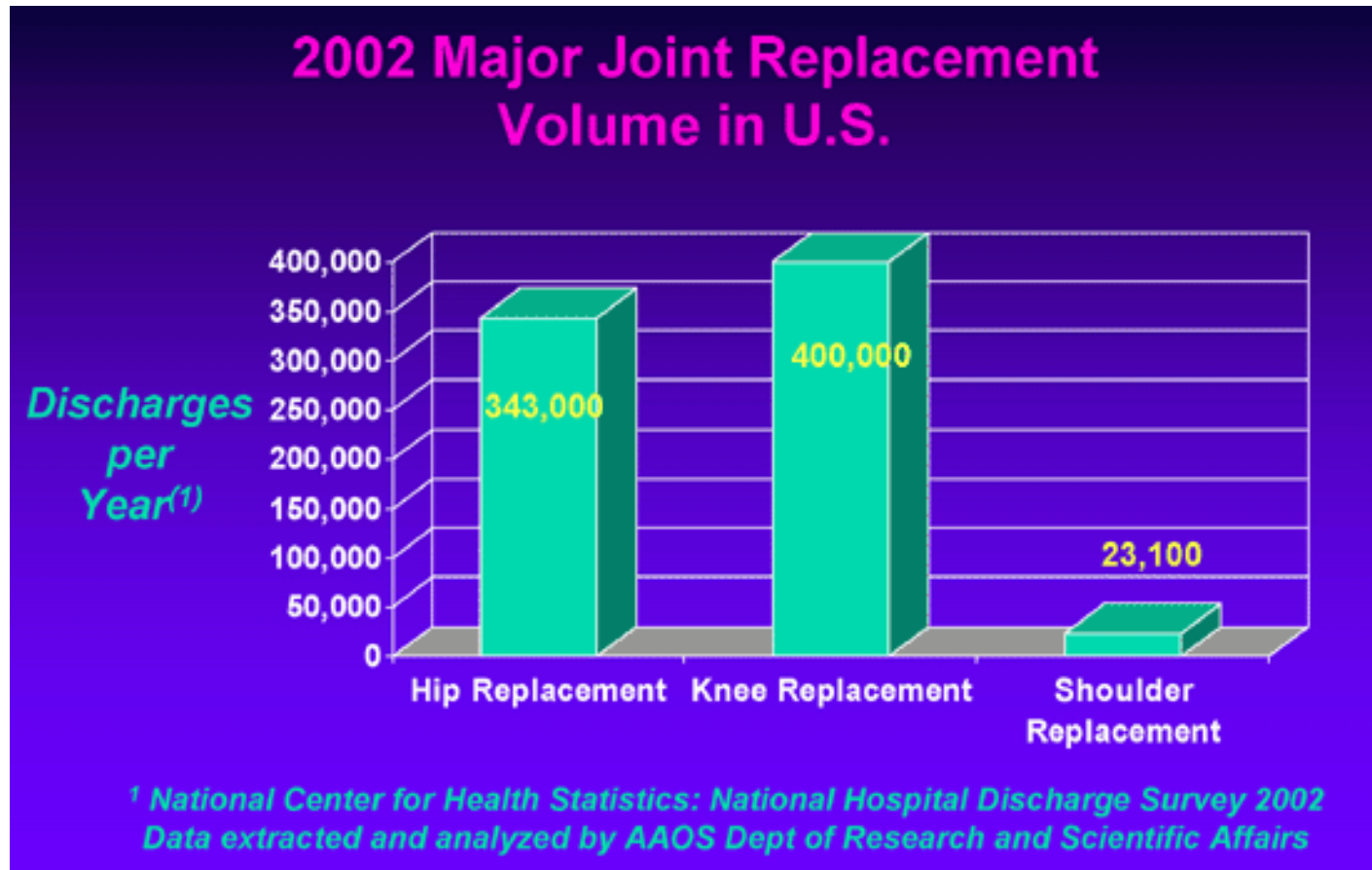


Figure 1.



Total Joint Replacement Trending 1996-2030						
Year	THA	THA-R	TKA	TKA-R	TSA	TSA-R
First one	1960		1950's		1953	
1993	125000	10000	179000	?????	10900	654
1996	138000	11040	245000	?????	14900	894
1997	144000	11520	259000	?????	15700	942
1998	160000	12800	266000	?????	16100	966
1999	168000	13440	267000	?????	16200	972
2000	152000	12160	299000	?????	18200	1092
2001	165000	13200	326000	17000	19800	1188
2002	193000	15440	381000	38000	23100	1386
2003	220000	17600	418000	39000	25300	1518
2004	234000	18720	478000	?????	41000	2834
2005	375000	18800	534000	46000	?????	0
2030	572000	174% increase from 2005	3,500,000	309580	?????	0
		8%		8-10%		6%

A Few Numbers

Number of selected procedures performed in 2010:

- Arteriography and angiocardiology using contrast material: 2.4 million
- Cardiac catheterizations: 1.0 million
- Endoscopy of small intestine with or without biopsy: 1.1 million
- Endoscopy of large intestine with or without biopsy: 499,000
- Diagnostic ultrasound: 1.1 million
- Balloon angioplasty of coronary artery or coronary atherectomy: 500,000
- Hysterectomy: 498,000
- Cesarean section: 1.3 million
- Reduction of fracture: 671,000
- Insertion of coronary artery stent: 454,000
- Coronary artery bypass graft: 395,000
- Total knee replacement: 719,000
- Total hip replacement: 332,000

A Few Numbers: 2009

Total Joint Replacement Figures– Hip, Knee, Ankle, Shoulder and Elbow

2009: National estimates

Source: Department of Research & Scientific Affairs, American Academy of Orthopaedic Surgeons. Rosemont, IL: AAOS; January 2012. Based on data from the HCUP Nationwide Inpatient Sample, 2009; Agency for Healthcare Research and Quality.

Patient and hospital characteristics for

ICD-9-CM all-listed procedure code

81.51 Total Hip Replacement

		Total number of discharges		Standard errors
				Total number of discharges
All discharges		285,471	100.00%	14,846
Sex	Male	125,267	43.88%	6,861
	Female	159,427	55.85%	8,049
	Missing	777	0.27%	150

A Few Numbers: 2009

**Patient and hospital characteristics for
ICD-9-CM all-listed procedure code
81.52 Partial Hip Replacement**

		Total number of discharges		Standard errors
				Total number of discharges
All discharges		103,392	100.00%	3,148
Sex	Male	29,460	28.49%	919
	Female	73,874	71.45%	2,316
	Missing	58	0.06%	17

**Patient and hospital characteristics for
ICD-9-CM all-listed procedure code
81.54 Total Knee Replacement**

		Total number of discharges		Standard errors
				Total number of discharges
All discharges		621,029	100.00%	26,489
Sex	Male	229,548	36.96%	10,285
	Female	390,038	62.81%	16,303
	Missing	1,443	0.23%	238

A Few Numbers: 2009

ICD-9-CM all-listed procedure code

81.56 Total Ankle Replacement

		Total number of discharges		Standard errors	
				Total number of discharges	
All discharges		1,601	100.00%	254	
Sex	Male	793	49.54%	140	
	Female	795	49.62%	123	
	Missing	*	*	*	

Patient and hospital characteristics for

ICD-9-CM all-listed procedure code

81.80 Total Shoulder Replacement

		Total number of discharges		Standard errors	
				Total number of discharges	
All discharges		33,012	100.00%	2,220	
Sex	Male	14,366	43.52%	1,046	
	Female	18,442	55.87%	1,196	
	Missing	*	*	*	

A Few Numbers: 2009

**Patient and hospital characteristics for
ICD-9-CM all-listed procedure code
81.81 Partial Shoulder Replacement**

		Total number of discharges		Standard errors	
				Total number of discharges	
All discharges		19,394	100.00%	824	
Sex	Male	6,513	33.58%	366	
	Female	12,808	66.04%	544	
	Missing	*	*	*	

**Patient and hospital characteristics for
ICD-9-CM all-listed procedure code
81.84 Total Elbow Replacement**

		Total number of discharges		Standard errors	
				Total number of discharges	
All discharges		2,775	100.00%	198	
Sex	Male	811	29.21%	80	
	Female	1,944	70.05%	150	
	Missing	*	*	*	

A Few Numbers: 2010

2010: TKA: 721,443 vs. THA 453,621

Table 115 (page 1 of 3). Cost of hospital discharges with common hospital operating room procedures in nonfederal community hospitals, by age and selected principal procedure: United States, selected years 2000–2010

Updated data when available, Excel, and PDF: <http://www.cdc.gov/nchs/hus/contents2012.htm#115>.

[Data are compiled by the Agency for Healthcare Research and Quality using discharge data from participating states]

<i>Age and principal operating room procedure¹</i>	<i>2000</i>	<i>2005</i>	<i>2010</i>	<i>2000</i>	<i>2005</i>	<i>2010</i>	<i>2000</i>	<i>2005</i>	<i>2010</i>
	Mean inflation-adjusted cost per hospitalization: 2010 dollars ²			Number of discharges with operating room principal procedure			Total inflation-adjusted national costs: 2010 dollars (in millions)		
All ages									
Treatment, fracture or dislocation of hip and femur.	12,322	14,913	17,549	244,706	259,071	258,181	3,066	3,861	4,528
Arthroplasty knee (knee replacement).	13,517	15,240	16,348	328,118	549,867	721,443	4,409	8,384	11,799
Hip replacement	14,661	16,682	17,510	304,709	381,318	453,621	4,523	6,355	7,940
Spinal fusion.	17,068	24,214	28,665	210,677	331,912	463,470	3,512	8,045	13,290



A Few Numbers: Total Knee Replacement

Knee Replacement



Statistics

THE BIG NUMBERS



| Knee replacement was the **14th** most common inpatient procedure in 2009.

A Few Numbers

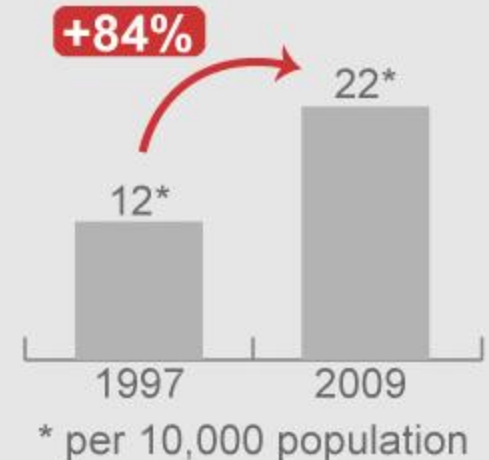
More than **4.5 million** Americans are currently living with at least one Total Knee Replacement (TKR), and make up **4.7%** of the population age **50 years or older**.

Over **650,000** knee replacements occurred in 2010.

Less than 10% of knee replacements are partial knee replacements. All others are total knee replacements.

5% of patients have **both knees** replaced at the same time.

Knee replacements increased by **84%** from 1997 - 2009.





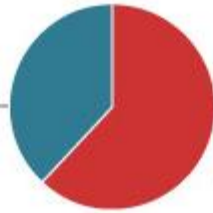
A Few Numbers

BREAKDOWN

BY GENDER



37%
Males



63%
Females



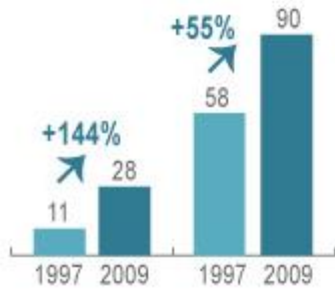
2010

The rate of knee replacements from 1997 to 2009 increased by

57%

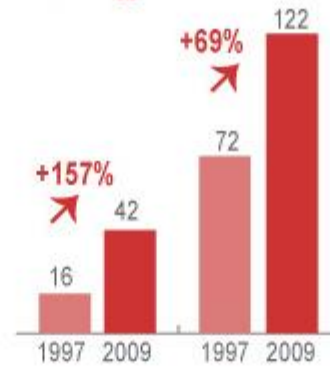
more for females than for males.

(84% vs. 22%)



AGE 45-64 AGE 65-84

Number of discharges per 10,000 population



AGE 45-64 AGE 65-84

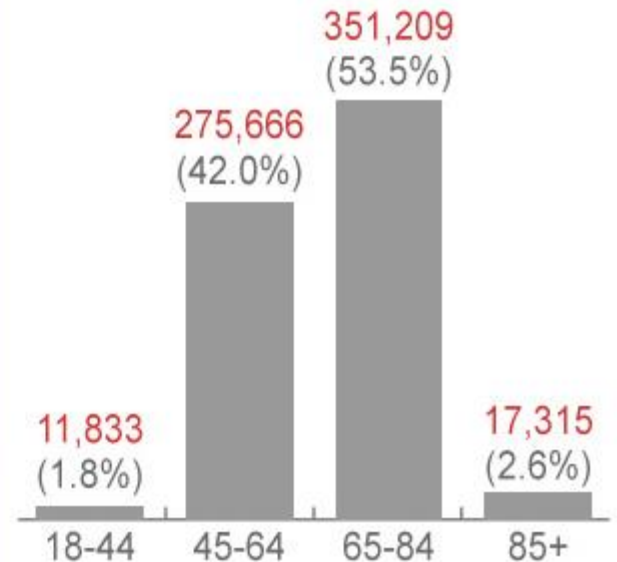
Number of discharges per 10,000 population

5.3% of American women and **4.1%** of men over the age of 50 have at least one TKR.

BY AGE



Number and percentage of discharges in 2010



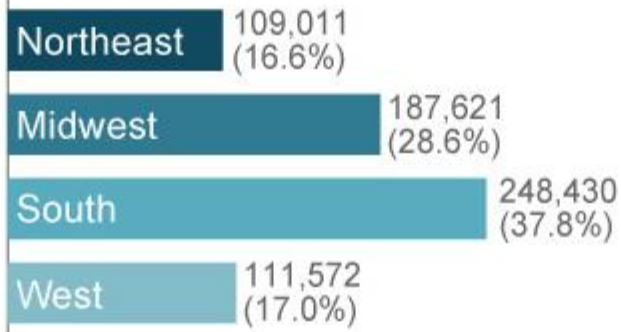
0.1% were unreported or under the age of 17.

10% of Americans age 80 and older are currently living with at least one TKR.

A Few Numbers

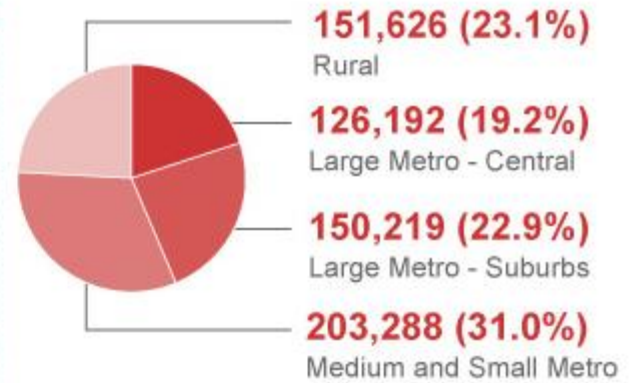
BY REGION

Number and percentage of discharges in 2010



BY PATIENT RESIDENCE

Number and percentage of discharges in 2010



A Few Numbers

SUCCESS RATE



9/10 patients experience dramatic pain relief.

95% of patients report that they are satisfied with their procedure.

90% of knee replacements last 10 years.

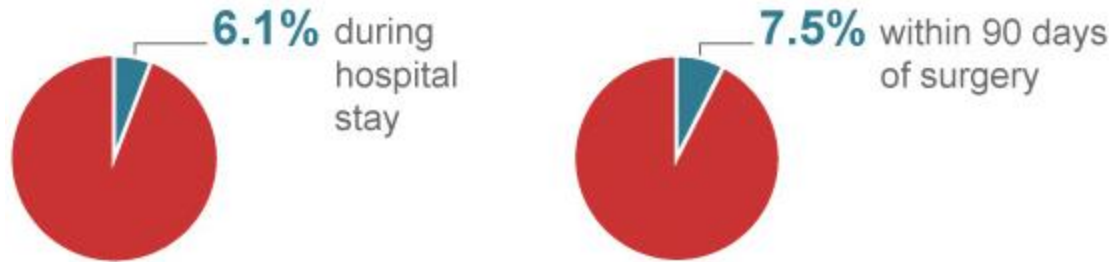
80% of knee replacements last 20 years.

A Few Numbers

COMPLICATION RATE



Rates are based on ~1.82 million patient records (all age groups).



Common Complications	Hospital Stay	90 Days
Mechanical complication of implant	0.7%	4.3%
Deep vein thrombosis (DVT) (blood clots)	1.6%	3.9%
Complications due to hematomas	1.3%	3.4%
Cardiac complications	1.2%	3.2%
Postoperative infection	1.1%	1.8%
Complication of operative wound	0.4%	1.4%
Respiratory complications	0.7%	1.0%

REVISION RATE



Short-term rates are based on ~1.82 million patient records (all age groups).

SHORT-TERM* revision rates:

0.2%
within 90 Days

3.7%
within 18 Months

LONG-TERM† revision rates:

6% after 5 years

12% after 10 years

More than **54,000** knee revisions are performed in the US each year.

Revision surgery removes and replaces the original knee implant, due to complications from the initial knee replacement.

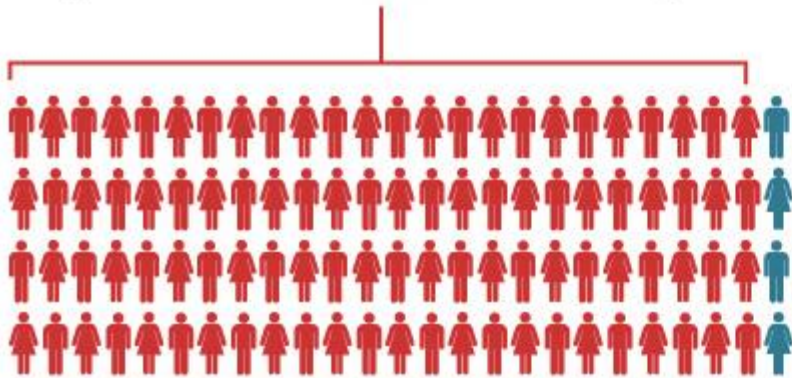
*usually due to infection or mechanical complications of the implant.

†usually due to long term wear and loosening of the implant.



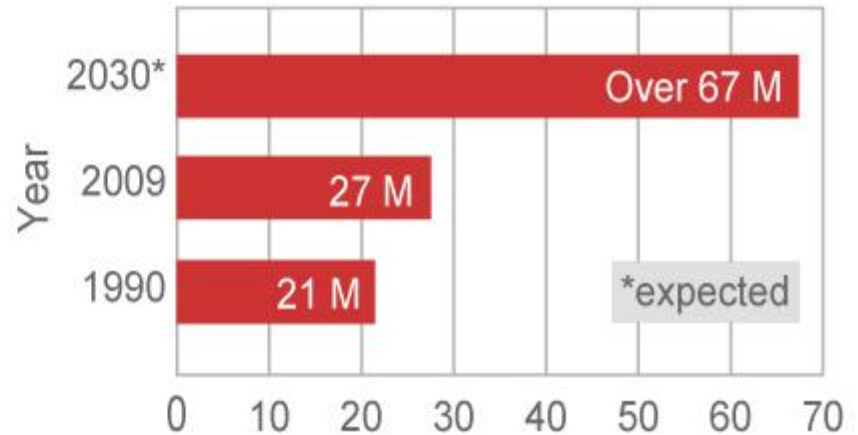
LEADING CAUSE: OSTEOARTHRITIS

Osteoarthritis is the number one cause of knee replacement, and the principal diagnosis of **96%** of TKR recipients.



Approximately **12%** of adults over 60 have symptoms of knee osteoarthritis.

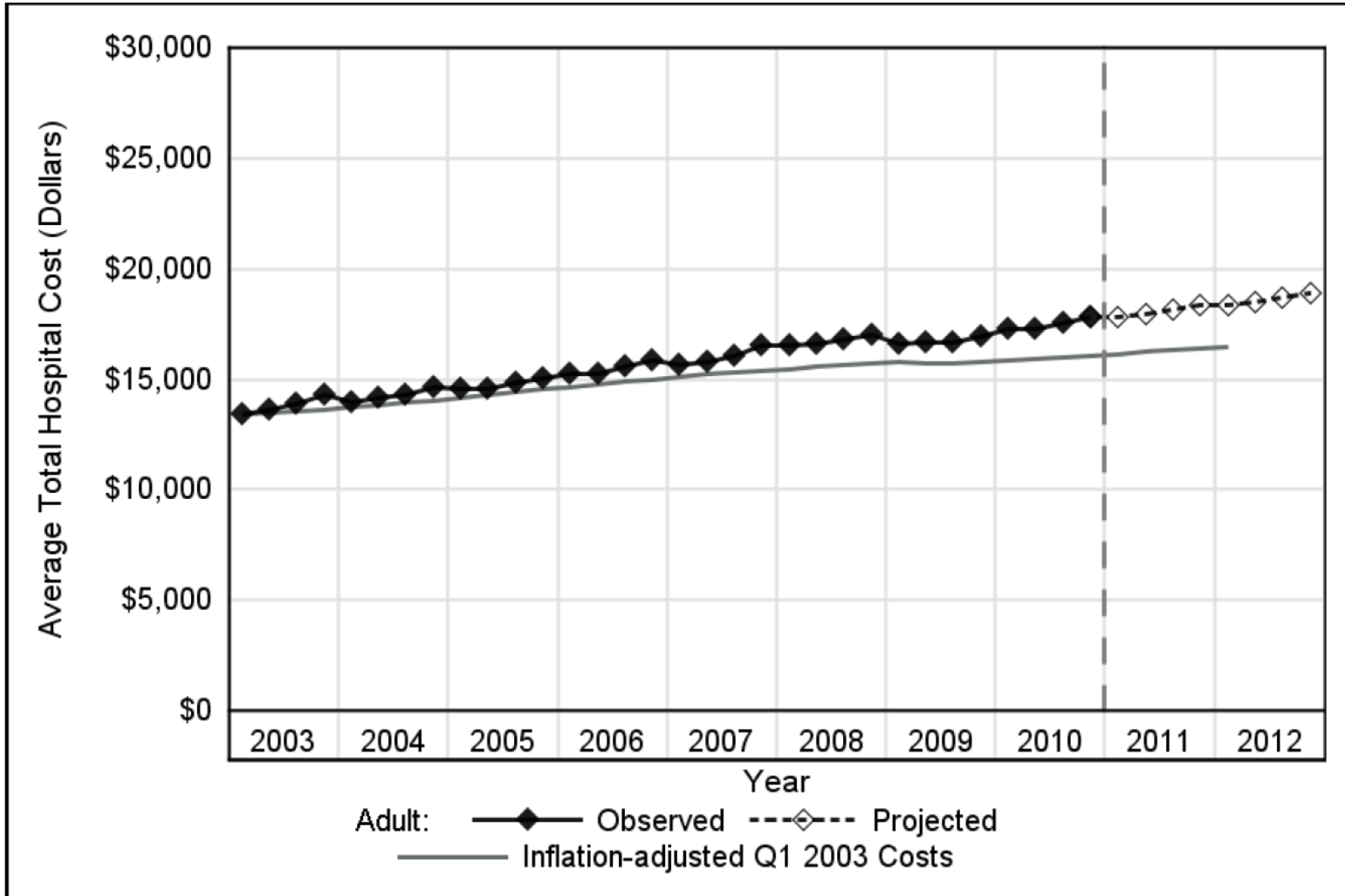
Americans with osteoarthritis (millions)



Osteoarthritis was the **4th** most frequent principal diagnosis for hospital stays in 2009.

Stays per 10,000 population for osteoarthritis increased **95%** from 1997 to 2009.

A Few Numbers: Cost



Inflation-adjusted Q1 2003 Costs: Cost per admission in the first quarter of 2003, adjusted for economy-wide inflation.
 Source: Agency for Healthcare Research and Quality, Center for Delivery, Organization, and Markets, Healthcare Cost Report Survey

A Few Numbers

Two proposed reasons for this increase:

- 1 Obesity**
- 2 Aging of the population**

BUT: Growth of the TKA volume more than doubled between 1997-2007 (264,000 to 550,000) but there has only been an 25% increase in obesity and the age group with the largest growth is the <65

A Few Numbers: Increase by age group with obesity rates

Age Groups	Population	Obesity rates	Number of TKA's
18-44	+2%	+15%	+2.11 fold
45-64	+36%	+5%	+3.27 fold
65-84	+6%	+3%	+1.66 fold
85 and older	+41%	(included in previous age group)	+ 1.70 fold

So why the increase?

- **Increasingly more active population**
- **Expanded indication (better implants, new anesthesia techniques, less invasive procedures)**
- **Younger patients opting earlier for surgery**

A Few Numbers: Cost

- Within the US, over 600,000 total hip and total knee replacements are performed each year.
- By the year 2030, that number is projected to exceed 4 million
- Annual Hospital cost in 2015 for Total Joint Surgeries: 65 Billion dollars
- Patients below age 65 represent 35-45% of all TJA recipients in the US
- As TJA is marketed more as a lifestyle operation than as a final option to retain mobility for end-stage arthritis, the proportion of patients below age 65 may increase
- Although implants vary widely in cost, there is little evidence to support the use of new, more expensive designs instead of more established, traditional designs.

A Few Numbers: Cost.

- The US accounts for 50% and Europe 30% of the total procedures worldwide.
- The 2005 revenues for hip implants in the US were \$2 billion and \$1.4 billion in Europe, while knee implant revenues comprised \$2.4 billion in the US and \$774 million in Europe.
- Medicare was the major source of payment in 2004 (55.4% for primary hip replacements, 59.3% for primary knee replacements)
- In 2004, the national bill for hip and knee replacements was \$26 billion.

A Few Numbers

What do these numbers mean to us?

- More surgeries= more post-operative patients requiring post-operative Rehab.
- As the technologies improve, more patients will opt for the replacement surgery earlier in life, accelerating the growth of these procedures
- According to the Arthritis Foundation, the total number of Americans with arthritis will grow from 43 million today, to 67 million by 2030. 50% of these will have OA, so the need for conservative management of OA will grow significantly as well. We (can) play a vital roll here, but we need to claim this (Vision 2020)

APTA Vision 2020

- By 2020, physical therapy will be provided by physical therapists who are doctors of physical therapy, recognized by consumers and other health care professionals as the practitioners of choice to whom consumers have direct access for the diagnosis of, interventions for, and prevention of impairments, functional limitations, and disabilities related to movement, function, and health.
- In other words, we have the opportunity to play a key role in the conservative management of these patients.
- Consumers will have direct access to physical therapists in all environments for patient/client management, prevention, and wellness services.

- According to the Department of Labor, Physical therapists held about 185,500 jobs in 2008
- In 2009, there were 212 physical therapist education programs. Of these accredited programs, 12 awarded master's degrees; and 200 awarded doctoral degrees.
- About 60 percent of physical therapists worked in hospitals or in offices of other health practitioners.
- Employment of physical therapists is expected to grow by 30 percent from 2008 to 2018
- Changes to restrictions on reimbursement for physical therapy services by third-party payers will increase patient access to services and, thus, increase demand

PT Shortage?

- Between 2008 and 2018, there will be PT job growth of about 30%! (up to around 241.000 PT's)
- However, The impact of proposed Federal legislation imposing limits on reimbursement for therapy services may adversely affect the short-term job outlook for physical therapists. *Keep in mind that we stated that PT may play a very important role in the cost containment of the growth in patients with arthritis. We need to sell this to the Federal Government!*
- The inability to increase our reimbursement will limit the salary growth as well.
- Job opportunities should be particularly good in acute hospital, rehabilitation, and orthopedic settings, because the elderly receive the most treatment in these settings.



PT Shortage? Other Contributing Factors

- We have only talked about arthritis but the same goes for other illnesses such as heart disease, DM and CVA.
- People live longer and will have a greater likelihood of needing our services
- Widespread interest in health promotion also should increase demand for physical therapy services.

PTA shortage?

- In 2009, there were 223 accredited programs
- Physical therapist assistants held about 63,800 jobs in 2008
- Not all States require licensure or registration in order for the physical therapist assistant to practice!?!?!?!?!?!?!?!?
- Employment of physical therapist assistants and aides is expected to grow by 35 percent from 2008 through 2018
- Physical therapists are expected to increasingly utilize assistants to reduce the cost of physical therapy services

PT/PTA shortage: A Solution?

- If I had the answer to this question, I would not be standing here...
- More PT/PTA programs?
- The effect of the DPT. Is it helping the shortage or promoting it?
- Once we get direct access acknowledged by Medicare, reimbursement will change, which will increase salaries and the interest in our profession (not always good).

New Implant Technologies

- We will discuss the development of new technology of three joints: Shoulder, Hip, Knee.
- We will discuss these developments by technology and when indicated, by vendor.

The Shoulder

- This course will only discuss partial and/or complete joint replacements since it would be impossible to discuss all other surgeries such as Rotator Cuff surgeries, SLAP, etc.
- Also, precautions will be listed, but no protocols since that will be different per surgeon.

The Shoulder

The following procedures will be discussed:

- Total Shoulder Replacement
- Reverse Shoulder Replacement
- Partial Shoulder Replacement/Hemiarthroplasty
- Osteocapsular arthroplasty
- Synovectomy
- Arthrodesis





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The Shoulder



Shoulder Arthritis



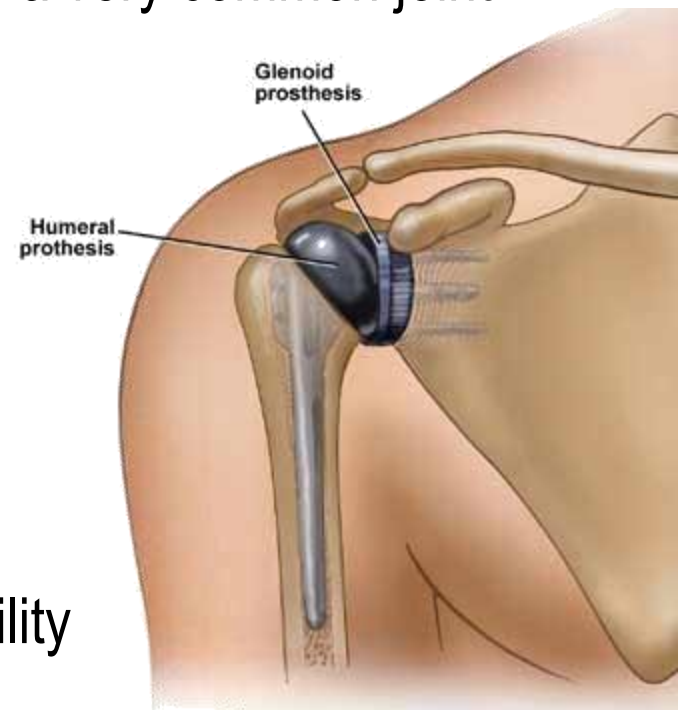
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End stage Shoulder OA



Total Shoulder Arthroplasty

- Total shoulder arthroplasty is a very common joint replacement in the US.
- Indications:
 - Pain
 - Loss of ROM
 - recurrent shoulder instability
 - Osteoarthritis
 - inflammatory arthropathies, including psoriatic arthritis and rheumatoid arthritis.
 - avascular necrosis



Total Shoulder Arthroplasty

- Contra-indications:
 - Combined rotator cuff / deltoid paralysis
 - Recent (joint) infection
 - Severe osteoporosis
 - in these rare circumstances, arthrodesis may be considered

When total shoulder arthroplasty is considered, the following factors play a role:

- status of rotator cuff
- bone stock
- asymmetric wear
- type and extent of soft tissue contractures

Total Shoulder Arthroplasty

Prognosis:

- patients should not generally expect to achieve elevation above 130 degrees
- improvements in function will continue for up to 18 months postoperatively
- if posterior glenoid bone loss is present, consider altering amount of humeral retroversion from the normal 35 deg to a less retroverted position, this will prevent posterior instability and eccentric glenoid loosening
- Sometimes, a glenoid bone graft may be used to improve the stability of the glenoid cup.
- **ALWAYS READ THE OP. REPORT!**

Total Shoulder Arthroplasty

Surgical approach:

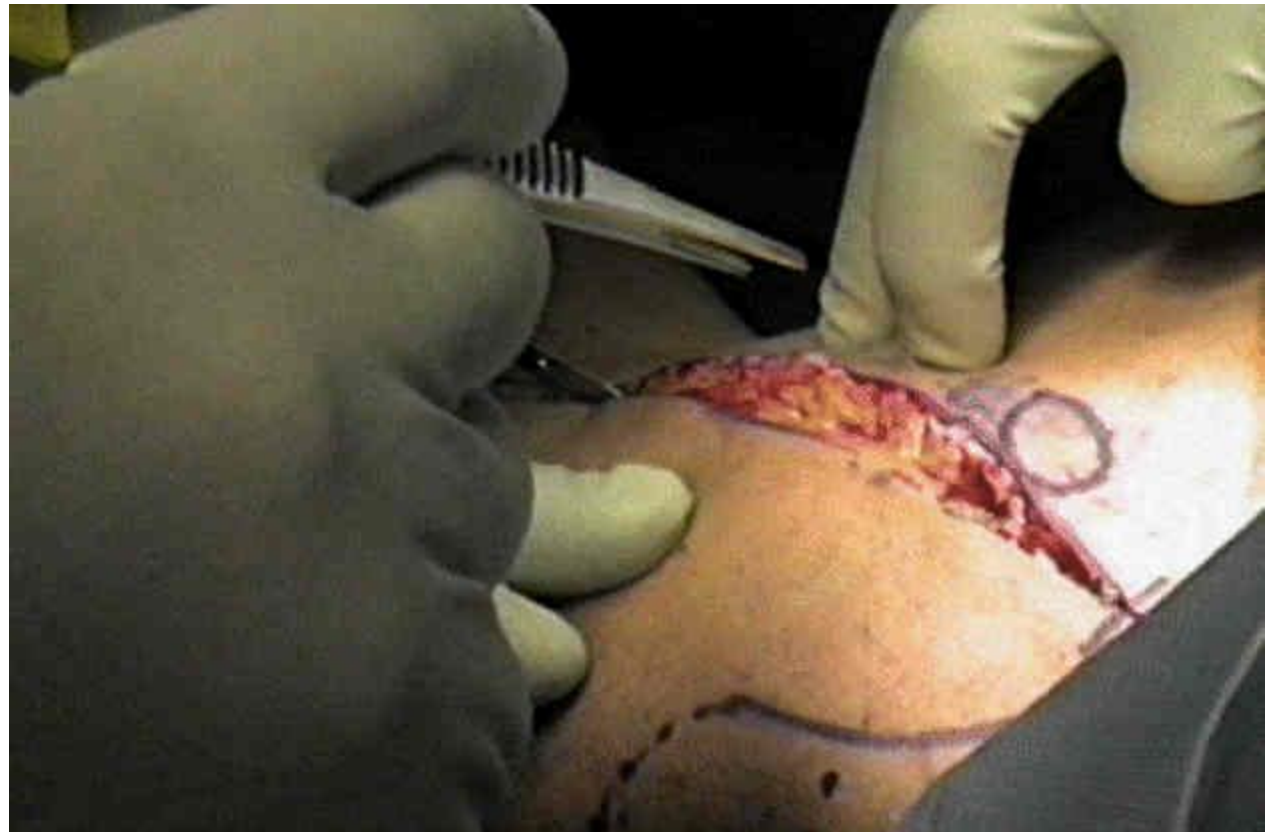
- Extended Deltopectoral Approach



Total Shoulder Arthroplasty

Surgical approach:

- Extended Deltopectoral Approach



Total Shoulder Arthroplasty

Surgical approach:

- Extended Deltopectoral Approach



Total Shoulder Arthroplasty



Patient is being prepped for surgery

The patient is in a modified beach chair position

Total Shoulder Arthroplasty



The deltopectoral incision is extended from the clavicle to the deltoid tuberosity. The coracoid can be used as a reference to ensure proper positioning of the incision

Total Shoulder Arthroplasty

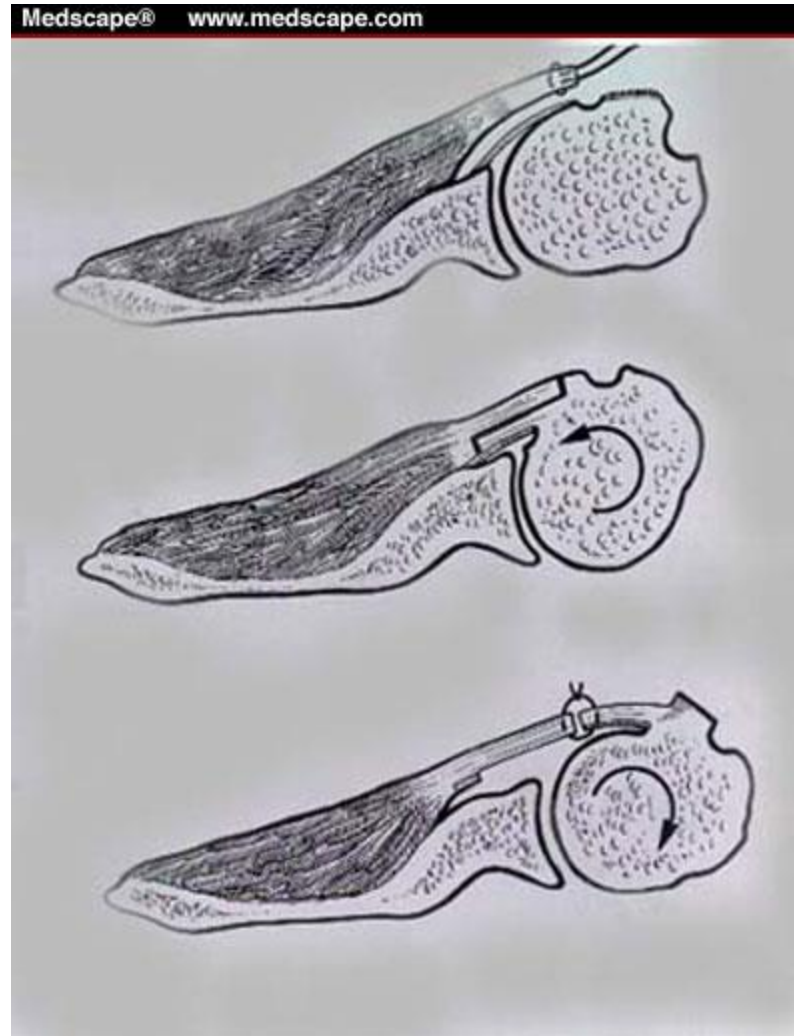


Self-retaining retractors can retract the deltoid and pectoralis major reducing the need for a second assistant

Total Shoulder Arthroplasty

- Occasionally, it will be necessary to lengthen the subscapularis tendon, particularly in patients with long-standing osteoarthritis or posttraumatic arthritis associated with malunion.
- Preoperative range external rotation should be 20° to 30° or more with the patient anesthetized. If significant restriction of motion is noted, the subscapularis tendon should be lengthened

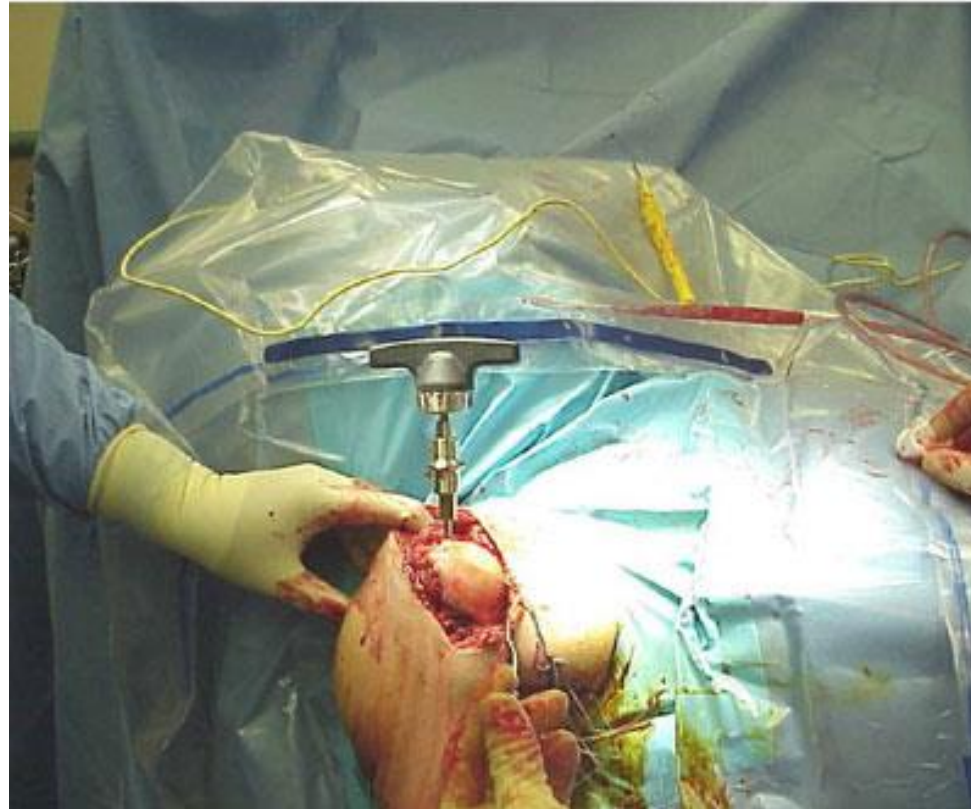
Total Shoulder Arthroplasty



If there is a need to lengthen the subscapularis tendon, a plane is created between the subscapularis and joint capsule similar to that of a Neer anterior-inferior capsular shift. The capsule remains attached to the humerus laterally and is resected off of the labrum medially (middle illustration). After the prosthesis is inserted, the capsule can be used to appropriately lengthen the subscapularis as shown (lower illustration).

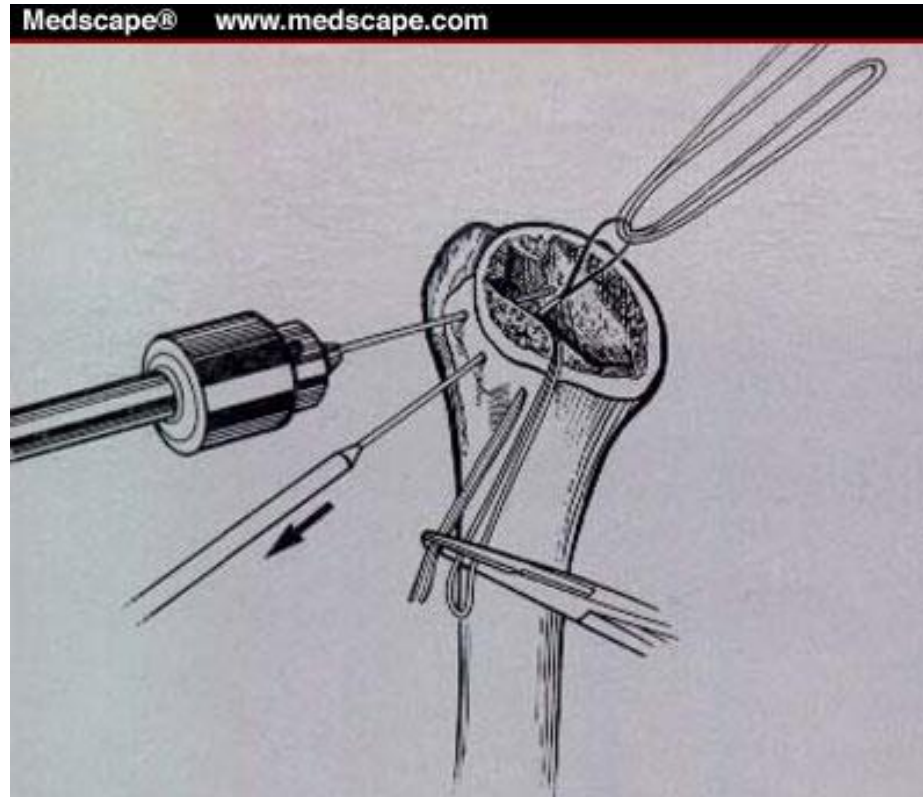
Total Shoulder Arthroplasty

Medscape® www.medscape.com



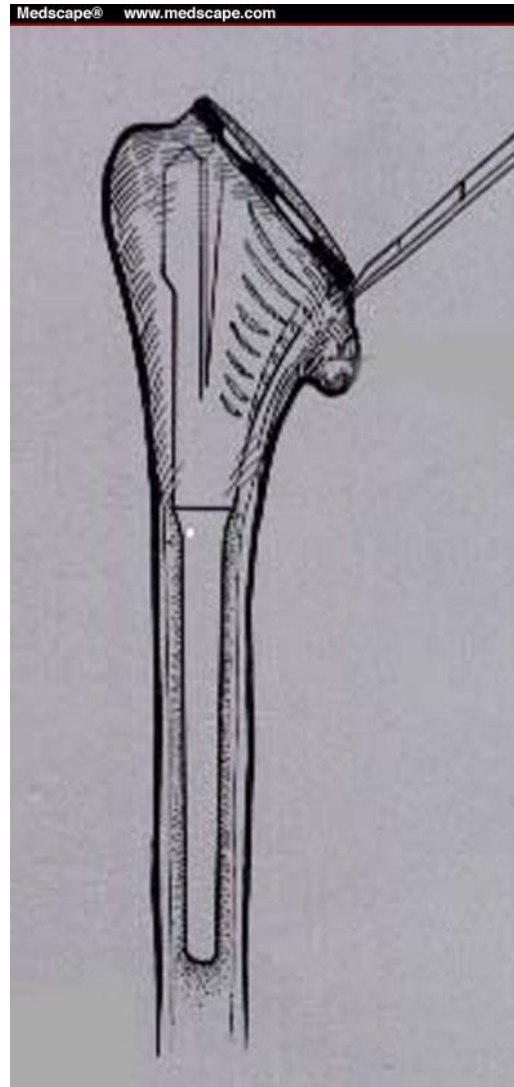
Once adequate capsular releases are performed, the shoulder is easily dislocated with gentle external rotation and extension. In this photograph, a canal reamer is inserted through the humeral head as part of another procedure.

Total Shoulder Arthroplasty



One method to reattach the subscapularis tendon. If this method is to be used, the bone tunnels must be drilled and the sutures passed before inserting the humeral component. As the bone cement is curing, it is helpful to slide the sutures 1 or 2 times to prevent binding of the sutures

Total Shoulder Arthroplasty



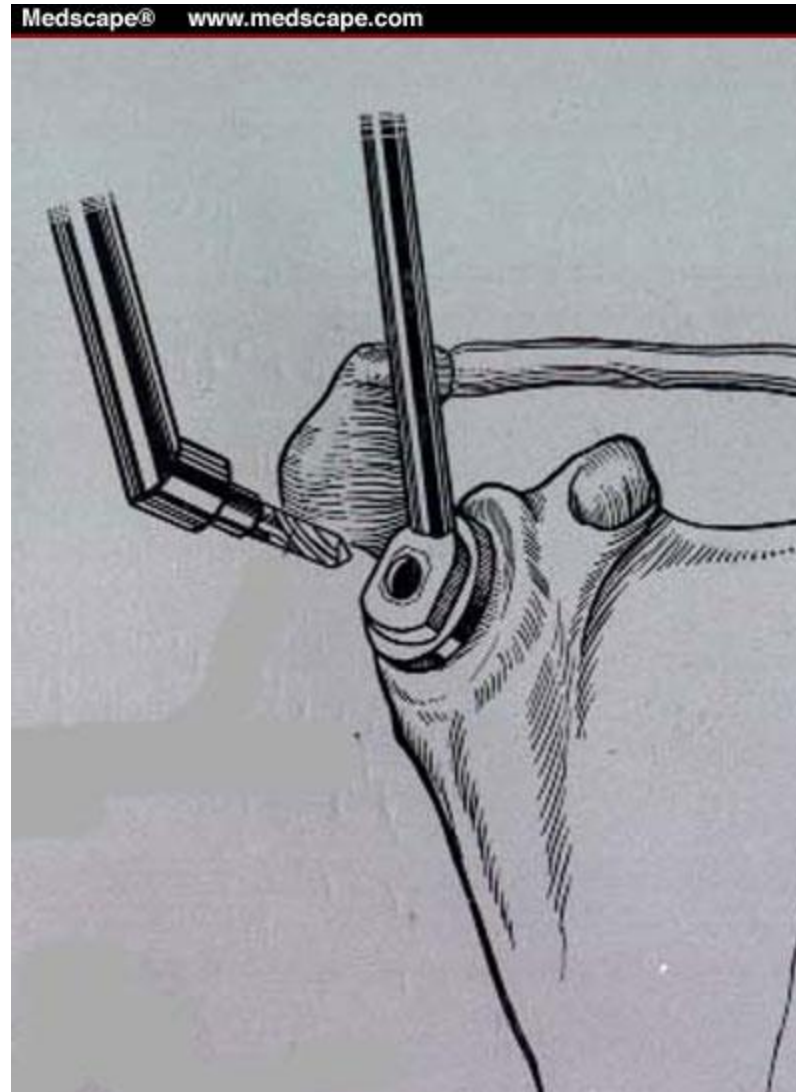
With the trial prosthesis in place, any overhanging osteophytes are removed

Total Shoulder Arthroplasty



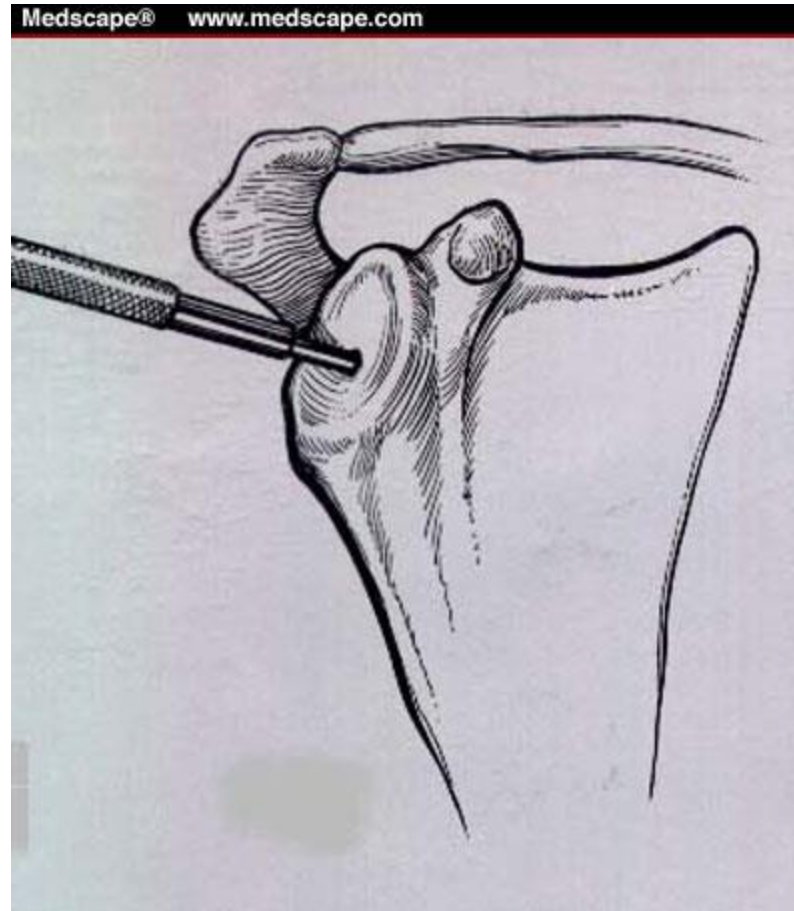
The humeral component and head replacement in place before relocation

Total Shoulder Arthroplasty



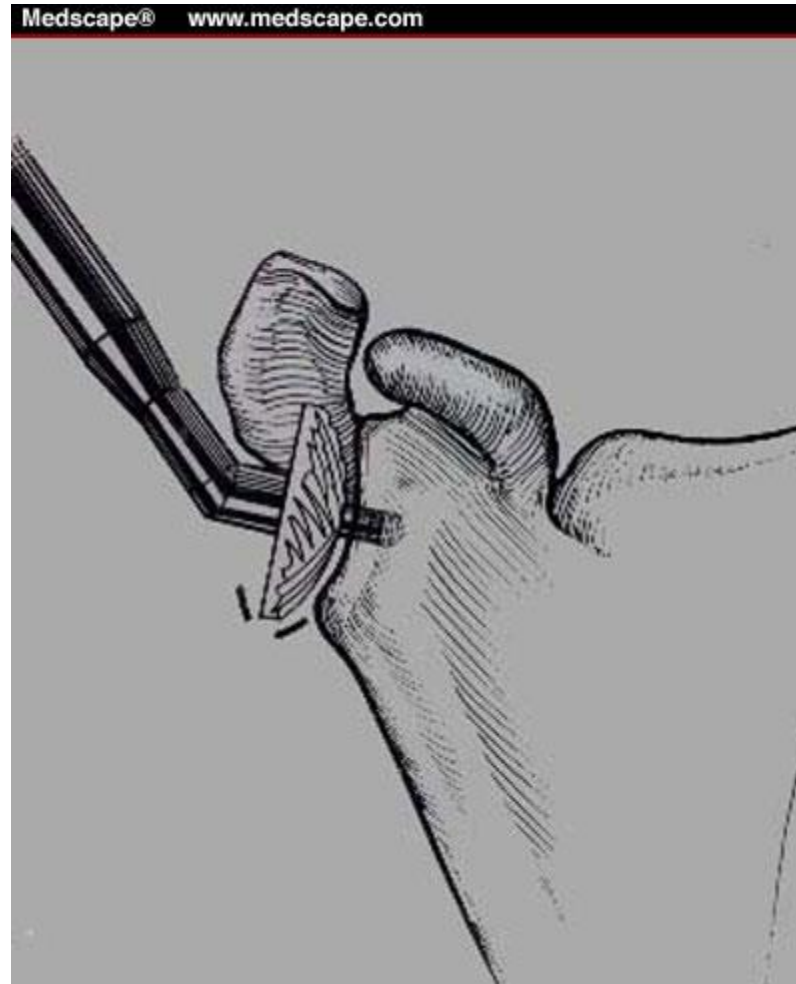
The glenoid drill guide and drill bit are used to make an exact size hole in the center of the glenoid to accommodate the peg on the glenoid reamer.

Total Shoulder Arthroplasty



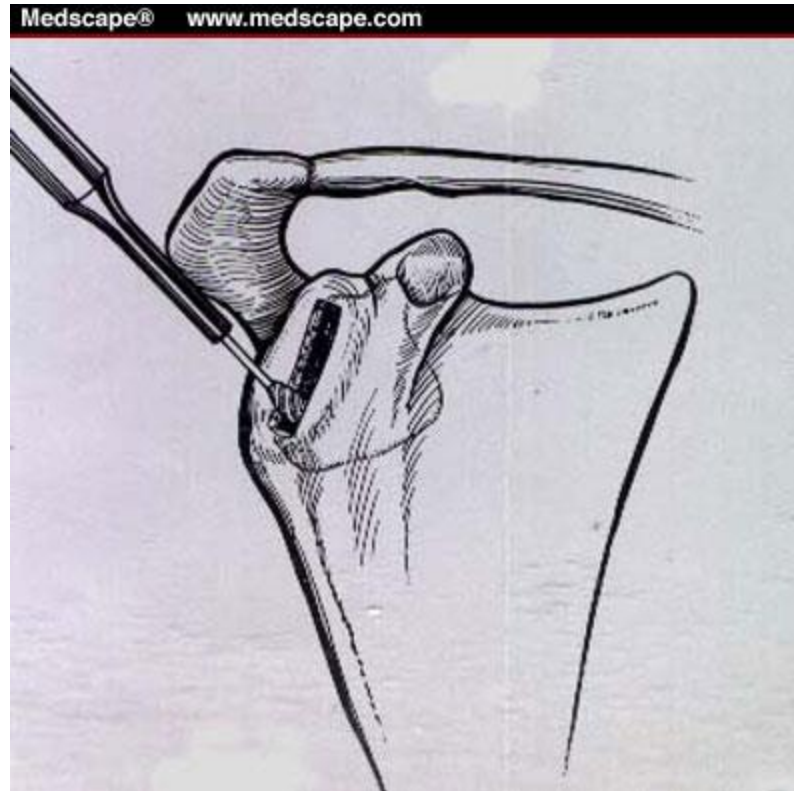
The appropriate glenoid sizing disk is selected and the center of the glenoid is marked with an awl

Total Shoulder Arthroplasty



The glenoid reamer is used to create an exact fit with the back surface of the glenoid components. With this system, the back of every size glenoid component will conform to the radius of the reamer

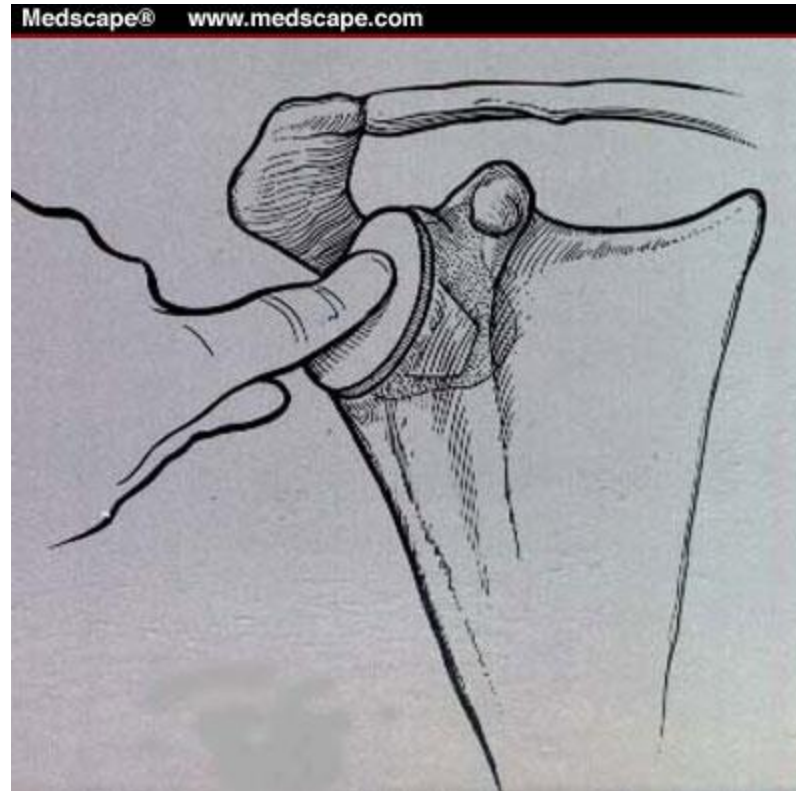
Total Shoulder Arthroplasty



A burring template assists in creating the appropriate size slot to accommodate the keel of the prosthesis



Total Shoulder Arthroplasty



Once the glenoid is packed with cement, the glenoid component is slowly inserted with finger pressure until it is firmly seated on the glenoid surface. Pressure must be maintained until the cement has hardened

Total Shoulder Arthroplasty

Post-operative precautions

- No AROM, pendulum exercises only
- NWB
- Use a sling as instructed
- Follow dressing instructions
- No lifting objects
- Use pain medication as described
- No driving for three weeks
- *See print out for a proposed protocol*



The Shoulder: Total Arthroplasty options, sorted by vendor

Zimmer

DePuy/Johnson&Johnson

Smith & Nephew

Stryker

Biomet



The Shoulder: Total Arthroplasty options, sorted by vendor

Zimmer, founded in 1927, is a worldwide leader in joint replacement solutions for knee pain and hip pain, and provides comprehensive spine care solutions for acute and chronic back pain. Their sales reach around \$1 Billion a quarter with 50% coming from their knees. Shoulder accounted for \$30 million in the second quarter of 2009.

Zimmer Shoulder options

Bigliani/Flatow® The Complete Shoulder Solution

- The Bigliani/Flatow Shoulder allows for the restoration of shoulder joint function in cases of shoulder replacement surgery.
- The Bigliani/Flatow Shoulder System is designed to replicate the natural shoulder's mobility, balance, and stability with a multitude of component sizes.
- Since the glenoid articular surface and the shoulder's head design are key in achieving proper articulation Zimmer offers variable conformity approach is designed to help achieve joint stability throughout the range of motion.



Zimmer Bigliani/Flatow Shoulder Arthroplasty



Shoulder Joint Replacement Components

Zimmer Bigliani/Flatow Shoulder Arthroplasty

Features:

- Designed to enhance cement fixation and minimize polyethylene wear which helps ensure stability through range of motion
- A range of sizes matches patient anatomy, maximizing bone stock preservation
- The glenoid articular surface provides a central conforming zone surrounded by a nonconforming zone. This patented variable conformity helps ensure stability throughout the range of motion, while reducing edge loading and associated wear

Bigliani/Flatow Shoulder Arthroplasty: Possible Complications

- Loosening of the prosthetic shoulder components
- Dislocation of the prosthetic shoulder
- Malalignment of the prosthetic shoulder components
- Bone fracture resulting from the shoulder replacement surgery or rehabilitation or from trauma
- Pain
- Infection
- Adverse reactions to the materials in the prosthetic shoulder. These reactions may range from an allergic reaction to cancer and/or tumors.
- Osteolysis (bone disintegration) and loosening of the prosthetic shoulder components caused by unavoidable wear of the prosthetic shoulder.
- Corrosion of the prosthetic shoulder components.

DePuy/Johnson&Johnson

DePuy is a designer, manufacturer and distributor of orthopedic implants.

DePuy is part of Johnson & Johnson and DePuy had \$5.4 Billion in sales in 2009

Key Shoulder Products:

- Global Advantage Shoulder Arthroplasty System
- Global CAP (Conservative Anatomic Prosthesis)
- Global™ Advantage™ CTA Head
- GLOBAL FX shoulder Fracture System
- Anchor Peg Glenoid Anchor Peg Glenoid

DePuy Global Advantage Shoulder Arthroplasty System

The GLOBAL ADVANTAGE Shoulder is a system that brings together a proximal-filling humeral body and low profile standard and eccentric humeral head options with easy to use instruments

Features	Advantages
Recessed collar	Helps optimize glenohumeral contact area
Low profile standard and eccentric humeral heads	Increase articular surface area by 25-33%
Medial fin hole	Provides additional fixation opportunities if used for fractures
Reverse Morse taper locking mechanism	
	Provides maximum surgical exposure with stem and broach
	Allows humeral head removal without remaining stem
Anchor Peg and keeled glenoids	Anatomic mismatch allows natural translation
	Gas plasma sterilization helps reduce oxidative potential



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DePuy Global Advantage Shoulder Arthroplasty System



Global Advantage.

SHOULDER ARTHROPLASTY SYSTEM

DePuy Global CAP

(Conservative Anatomic Prosthesis)

- This conservative, resurfacing implant is an option for a younger patient population seeking a bone sparing option.
- The implant is secured by a short, cruciate stem and undersurface Porocoat® porous coating or DuoFix® HA on porous coating.



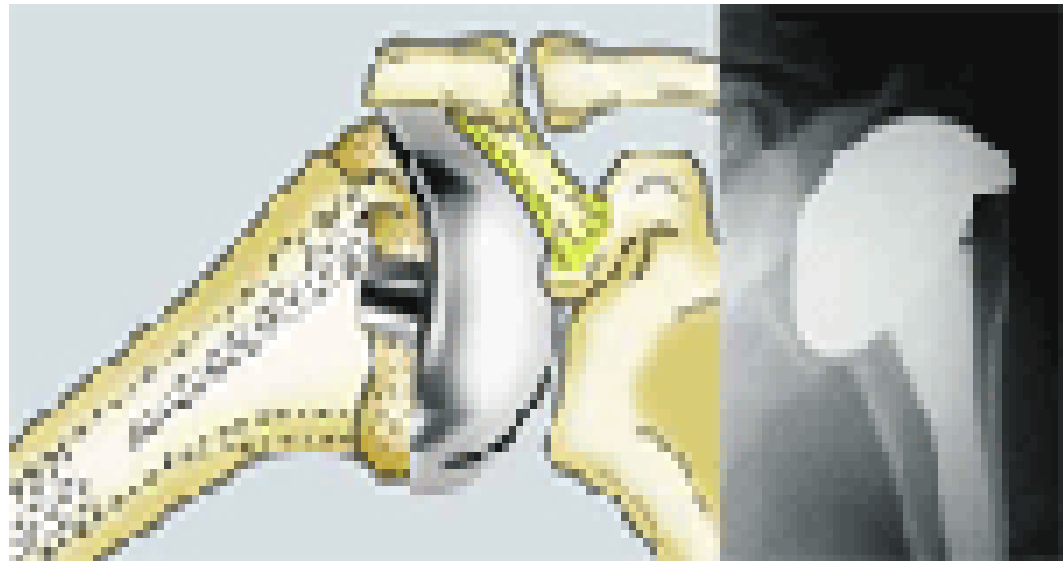
DePuy Global CAP

(Conservative Anatomic Prosthesis)

Features	Advantages
Recessed undersurface to ensure best contact on undersurface of implant and humeral head	Better implant contact on undersurface of implant, decrease risk for loosening
Sharper reamers and alignment guide for centering	Ensure adequate implant seating and contact, accurate fit of implant to bone
Anatomic sizing	Implant fits to varying patient anatomy
Press-fit cruciate stem for secure fixation	Secure implant fit

Global™ Advantage™ CTA Head

The DePuy GLOBAL™ ADVANTAGE™ Cuff Tear Arthropathy (CTA) humeral head prosthesis is indicated for use in patients with a massive, irreparable rotator cuff tear and arthritis.



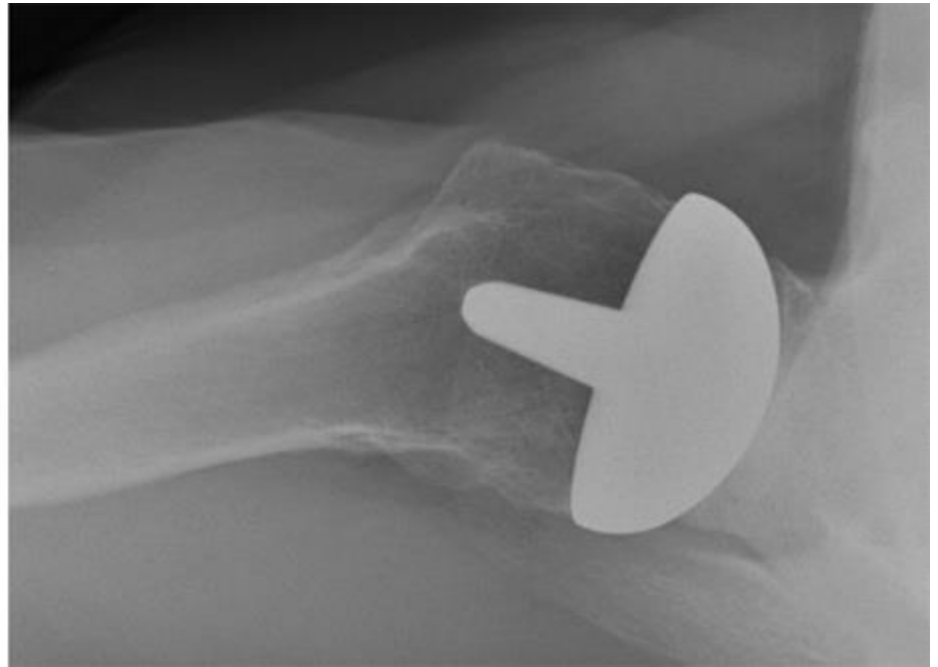
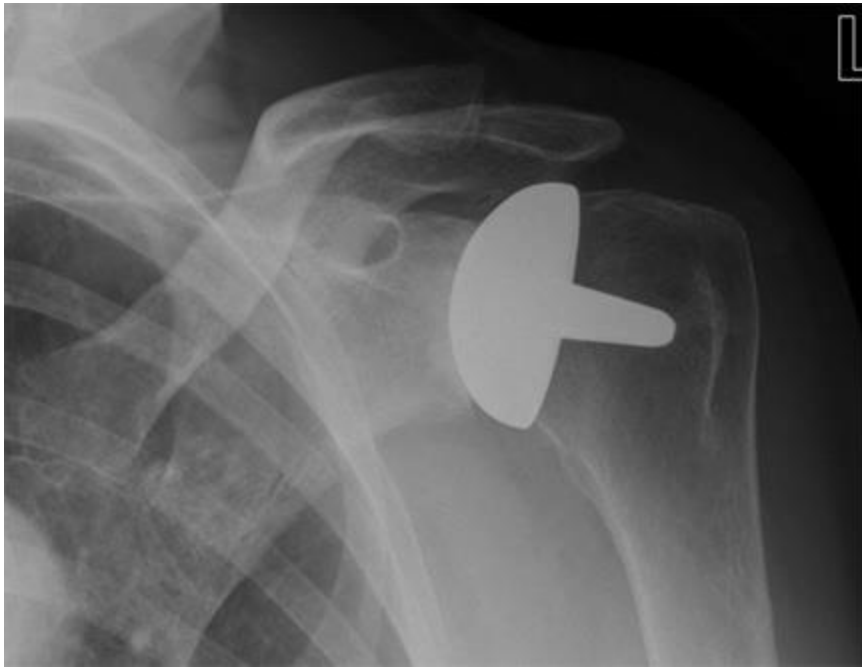


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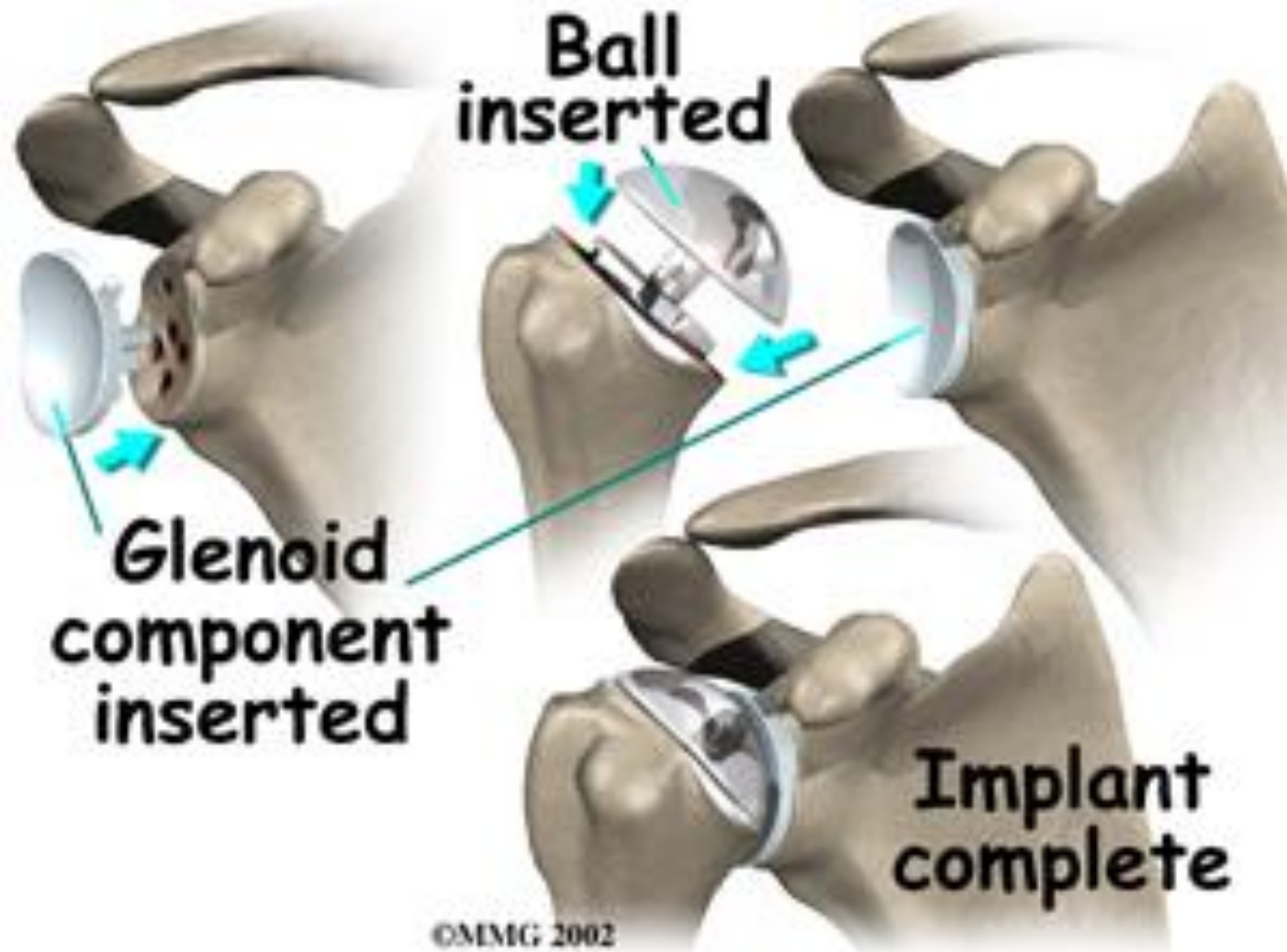
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Global™ Advantage™ CTA Head



DePuy Global™ Advantage™ CTA Head



Cuff Tear Arthropathy (CTA) humeral head prosthesis

Key advantage of this prosthesis:

- most patients with massive rotator cuff tears have proximal migration of the humerus.
- this prosthesis has a larger area of lateral articulation, allowing the CTA extended head to articulate with a low coefficient of friction with the acromion.
- This is needed, increasing abduction and external rotation outcomes.



DePuy Global™ Advantage™ CTA Head

Features:

- Extended humeral head design; CTA head seats on Global advantage stem. Compared to implantation of a Global Advantage Head, only one additional humeral resection required for CTA head implantation

Advantages:

- Quick, easy procedure
- Implantation of Global Advantage stem with an additional head resection compared to humeral head implantation

GLOBAL FX shoulder Fracture System



globalfx
Shoulder Fracture System

Features

Trial and Implant Height Markings

Reduced proximal body

Modular humeral head design

Medial fin hole

Fracture alignment jig

Advantages

- Assist in re-establishing anatomical height

- Preserve bone stock for tuberosity attachment

- Maximizes articular surface area

- Provides additional fixation opportunities

- Height and version alignment



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DePuy Anchor Peg Glenoid Anchor Peg Glenoid



anchor
PEG GLENOID

Advantages:

- Minimal thickness does not overstuff
- Reduced possibility of thermal necrosis
- Provides immediate stability

Features:

- All-polyethylene
- Minimally cemented
- Circumferentially fluted, central, interference fit peg
- Three small, cemented, peripheral pegs

Smith & Nephew

Cofield 2 Total Shoulder

- Cemented use only
- Restoration of Rotator Cuff Fixation
- Modular system
- Keeled and Pegged glenoids
- Different type head including lateral offset, standard and eccentric



Smith & Nephew

Neer 3 Total
shoulder

- Monoblock
- Fins for better fixation
- medial-lateral head offset available



PROMOS Modular Shoulder
system

Stryker

Founded in 1941, Stryker has grown into one of the world's leading medical technology companies with the most broadly based range of products in orthopaedics. Sales reached \$ 6.9 Billion in 2009.

Key Shoulder products:

- Solar® Shoulder System



Stryker: Solar® Shoulder System

- The Solar® Total Shoulder is a completely modular system
- All components are compatible which allows any humeral component to be used with any humeral head on any glenoid component.
- Forged Titanium alloy for superior strength and biocompatibility.



Stryker: Solar® Shoulder System

Features:

- 11 primary humeral components
- Dual Offset Humeral Heads
- The Solar® Dual Offset Humeral Head has a 360° orientation range



Advantages:

- Superior resistance to pull off and torque loads
- The 4mm offset combined with 360° orientation range will accommodate most patients' anatomy
- The 8mm offset can help to re-establish proper head position and arm length in fracture cases

Stryker: Solar® Shoulder System

- angled inferior peg design to improve long-term fixation

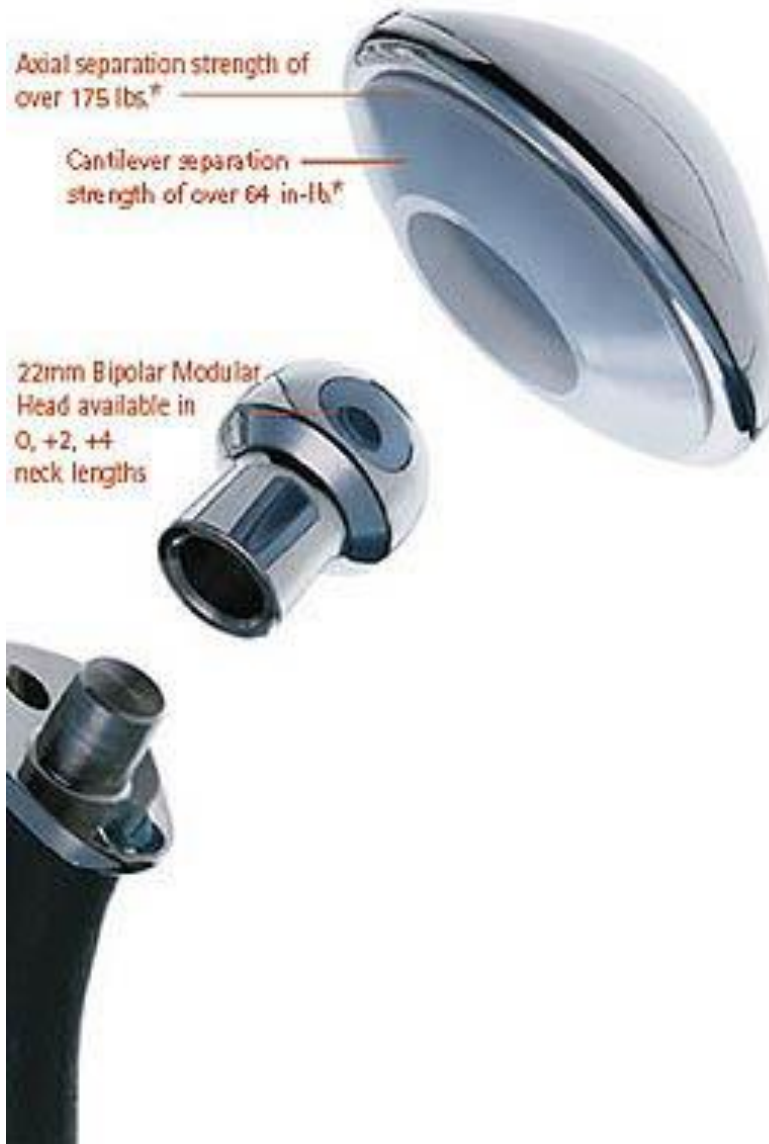
The patented Angled Inferior Peg is designed to resist "rock out" generated by superior loading forces.





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Stryker Solar® Bipolar Shoulder System



Features:

- Dual radius head design addresses broad patient population

Advantage:

- Requires only 28mm of joint capsule space

Biomet

- Biomet designs, manufactures and markets musculoskeletal products four major market segments:
 - reconstructive products (71%)
 - fixation devices(11%)
 - spinal products (10%)
 - other products (8%)
- Biomet is located in over 100 countries and reached a net sales of \$2.1 Billion.



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BIOMET



E1™ Antioxidant
Infused
Technology

Biomet

Shoulder products:

- Mosaic™ Humeral Replacement System
- Integrated™ Shoulder System
- Copeland™ EAS™ Humeral Resurfacing Head
- Comprehensive® Fracture System
- IBP™ Elbow System
- Maestro™ Wrist Reconstructive System (WRS)

Antioxidant Infused Technology

- **Biomet is the only manufacturer to use the only polyethylene infused with vitamin E to provide strength and oxidative stability without compromise**
- Infused with vitamin E, a natural antioxidant, E1™ Technology defines a new class of bearings by uniting true oxidative stability, high mechanical strength and ultra-low wear.

Oxidative Stability *“E1™ Antioxidant Infused Technology prevents oxidative degradation of polyethylene (so no cracking).”*

Mechanical Strength

Unlike many highly crosslinked polyethylenes, E1™ material is never remelted and therefore maintains its strength.^{1,2}

Antioxidant Infused Technology

Ultra-low Wear high levels of crosslinking for wear resistance.¹

Cruciate Retaining (CR) E1™ Tibial Bearings had a wear rate that was 86% less than conventional direct compression molded polyethylene.¹

Posterior Stabilized (PS) E1™ Tibial Bearings had a wear rate that was 87% less than conventional direct compression molded polyethylene.¹

Biomet Mosaic™ Humeral Replacement System



- Designed for Complex revisions and salvage/oncology surgeries . Addresses properly tensioning the glenohumeral joint and restoring joint function.
- Three-piece modular humeral stem, providing the maximum amount of customization in a standard-line system.

Biomet Integrated™ Shoulder System



Integrated™ Shoulder System

Features:

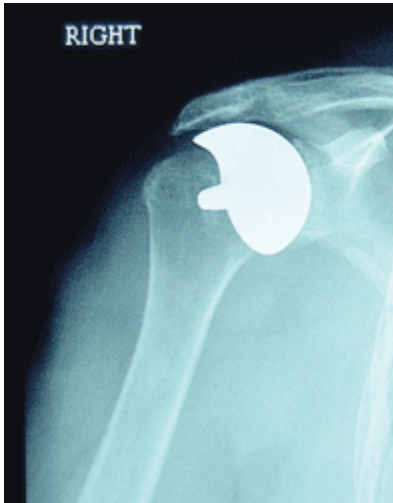
- Cobalt chrome (with proximal porous coating available)
- Anterior, posterior, and lateral (with suture holes) fins
- Modular Head
- Glenoid direct compression molded Arcom® polyethylene

Biomet Copeland™ EAS™ Humeral Resurfacing Head

- Offers a conservative option for cuff tear arthroplasty

Features:

- Extended Articular Surface for Metal-On-Bone Articulation
- Indicated for hemi- or total shoulder replacement in patients with massive, irreparable rotator cuff tears and arthritis.



Copeland™ EAS™
Humeral
Resurfacing Head



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Comprehensive®
Shoulder System

- Comprehensive® Shoulder System
Ideal option for hemi and total shoulder arthroplasty that provides for patient specific implant selection
- The Comprehensive® Shoulder System features a broad array of options, including wide-ranging sizes, customizable offset, potential for enhanced fixation and easy-to-use instrumentation. It also offers the flexibility to move from a hemi-arthroplasty to a total arthroplasty, or revise if necessary.

Biomet Comprehensive® Fracture System

- Designed for complex fractures of the proximal humerus
- The stem has clearance for use in fracture or non-fracture cases and can be cemented or press-fit
- Compatible with the other Biomet Modular shoulder components.



Total Elbow Replacement

Indications:



Biomet IBP™ Elbow System

INDICATIONS

- End stage rheumatoid arthritis
- Severe intractable pain in association with severe grade 3,4,5
- Major cysts at olecranon-coronoid junction, in association w/ severe grade 3-5 erosions
- Progressive loss of extension beyond 60 degrees
- Instability which indicates very severe bone destruction and endangered ligamentous stability
- Fracture: comminuted humeral intercondylar fracture in patients over age 70

Biomet IBP™ Elbow System

Important facts to keep in mind

- Keeping the extensor mechanism intact will have a tremendous, positive effect on the recovery of the patient. Strength will be back to pre-surgical levels within a matter of days.
- The average strength improvement after surgery is 71%
- The axis of motion of the elbows with the capitello-condylar implants averaged 2.1 +/- 2.3 degrees more varus angulation than that of the intact elbows because of the design of the implant
- Patients suffering from RA will benefit better from a semi constrained elbow replacement.

Biomet IBP™ Elbow System

Complications:

- **P**osterior elbow dislocation;
 - may occur in approximately 10% of patients undergoing unconstrained arthroplasty
- Ulnar nerve dislocation
- Impingement of the radial head
- Proximal ulna fracture
- Hardware failure
- Worn bushings
- Fracture of ulnar component
- Infection:
 - may range from 1 to 10%;

Biomet IBP™ Elbow System



- Instrumented Bone Preserving (i.B.P.™)
- Humeral component is made of Cobalt Chrome
- Ulnar component is made of Titanium alloy with an ArCom® Polyethylene bearing
- Non-constrained design allows for medial lateral translocation.



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Biomet Discovery™ Elbow System



- Replicates anatomy while providing a superior *hinge* mechanism
- Spherical *hinge* design
- Anatomic articulation reduces the chance of stem loosening
- Easily revised
- Posterior assembly screws mean never having to drill through the epicondyles

Biomet Huene™ Biaxial Elbow System



- Biaxial design more accurately reproduces normal anterior posterior translocation of the Ulna, increasing flexion.
- Sixteen degrees of varus-valgus laxity and ten degrees of rotation
- Titanium alloy humeral component with porous coated collar and anterior flange.
- Titanium alloy ulnar component with blast coated collar





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Elbow Replacement





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Elbow Replacement



Elbow Replacement



Elbow Replacement

- Total elbow replacement usually involves a hospital stay of 1-2 nights.
- The elbow is splinted for approximately 2 weeks, and then motion is begun.
- Pain relief and function are very good, but elbow replacements can loosen over time.
- To protect against this, there is a lifetime lifting limit of **1-2 pounds** repetitively and **5-10 pounds** for a single time once in a while



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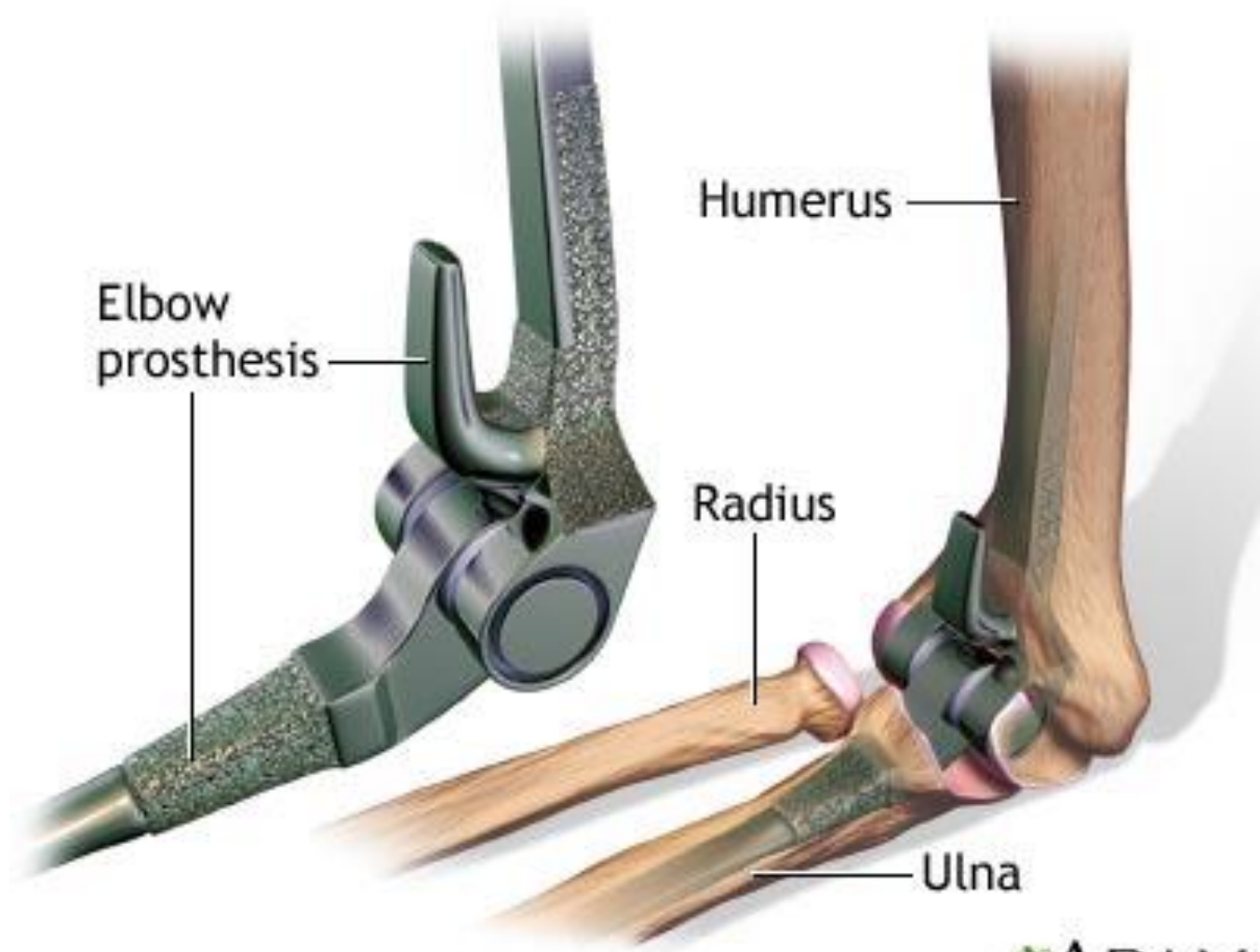


Elbow Replacement



- One patient sustained a fracture of the ulna in the region of the olecranon during a forceful manipulation by a **physical therapist**.
- The patient was managed non-operatively, but a fibrous union of the olecranon developed and the patient had active extension strength that was only grade 3 of 5 and a marked extension contracture.

Zimmer





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Biomet Maestro™

Wrist Reconstructive System (WRS)



- Modular Design - Interchangeable plates and stems
- Screw Fixation - Variable screw placement
- Revolutionary Design - Metal carpal components and poly radial body articulation
- Scaphoid Augment - Allows for complete removal of scaphoid bone.
- Multiple Options - Facilitates total wrist replacement as well as carpal hemiarthroplasty

Biomet Maestro™

Wrist Reconstructive System (WRS)

Indications:

- Non-inflammatory degenerative joint disease including osteoarthritis, traumatic arthritis and avascular necrosis.
- Rheumatoid arthritis.
- Revision where other devices or treatments have failed.
- Scapholunate Advanced Collapse (SLAC) and other functional deformities.
- Trauma, including fractures of the distal radius and/or carpal bones.



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Wrist
Arthroplasty



Total Shoulder Arthroplasty

The longevity (length of life) of a prosthetic shoulder varies from patient to patient. It depends on many factors including:

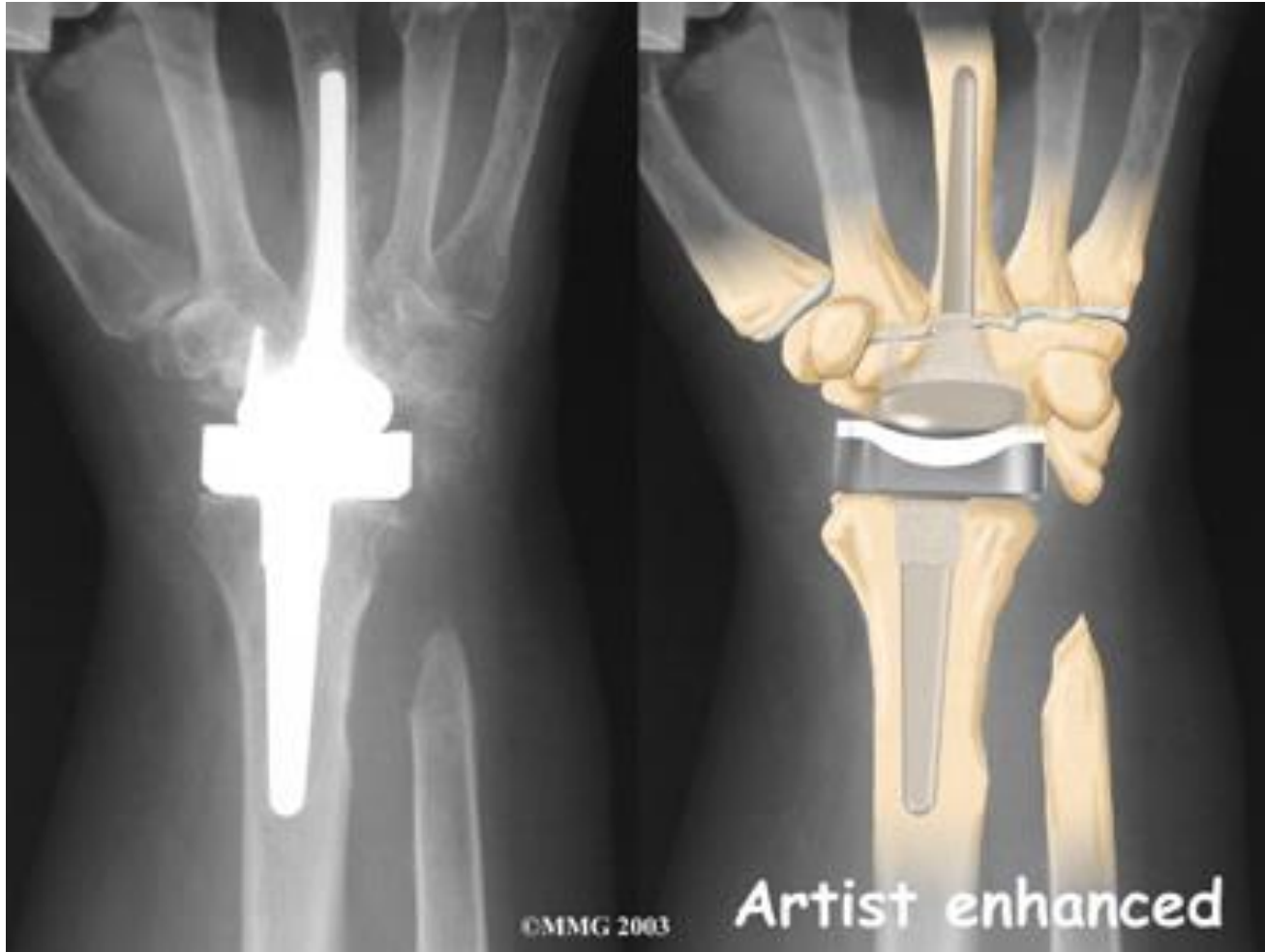
- Patient's physical condition
- Ability and willingness of the patient to follow instructions, including control of weight and activity levels
- Activity level
- good nutritional state of the patient/smoking
- the patient must have reached full skeletal maturity
- Surgical technique.

A prosthetic joint is not as strong or durable as a natural, healthy joint, and there is no guarantee that a prosthetic shoulder will last the rest of a patient's life.

All prosthetic shoulders may need replacement at some point.



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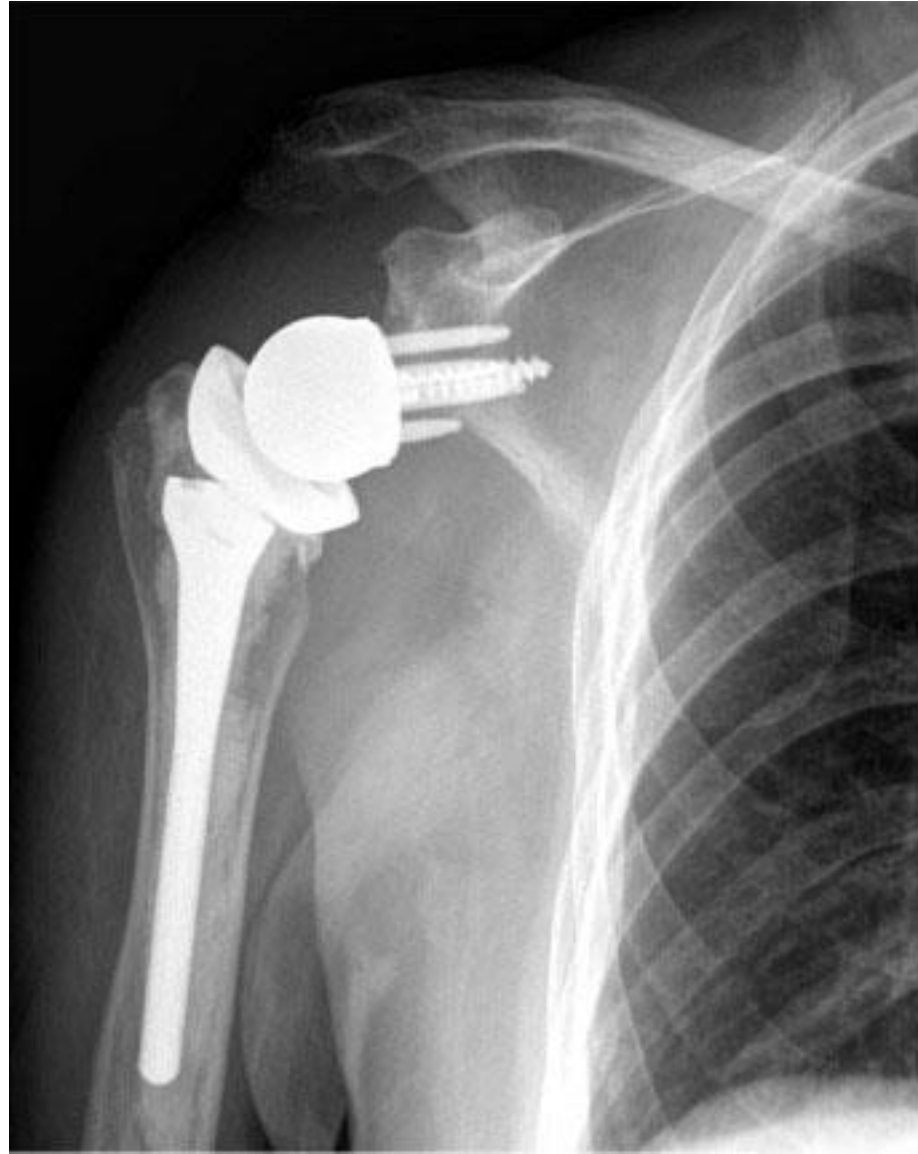
Reverse Shoulder Replacement

- The procedure just received FDA approval in November 2004, but it has been in use in Europe for the past 20 years
- With the Reverse Shoulder Prosthesis, the anatomy, or structure, of the shoulder is reversed.
- The implant is designed so that the ball portion is attached to the scapula and the socket is placed at the upper end of the humerus
- The Reverse Shoulder Prosthesis is mainly used for (older) patients with rotator cuff tear arthropathy
- This procedure can also be used in revision surgery, for failed shoulder replacement and shoulder fractures



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Encore Medical: Reverse® Shoulder Prosthesis



Reverse Shoulder Replacement

Who is the ideal candidate?

- People who have significant pain and little to no movement in their shoulder are the best candidates.
- It is ideal for patients with chronic, longstanding rotator cuff tears with arthritis. The deltoid muscle will take over the rotator cuff function by stabilizing the shoulder upon contraction.

Contra-indications:

- Infections
- Deficiencies in the scapula
- Patients without functioning deltoid muscles



Though in use in Europe for about 15 to 20 years, the reverse shoulder replacement procedure was only approved by the FDA for use in the U.S. in March 2004. Since then, this new kid in town has made a dramatic impact on the shoulder repair market. From 2004 through 2008, total shoulder replacements, including reverse and partial replacements, have grown by almost 60% in the United States according to the PearlDiver Patient Record Database, United States healthcare reports and information from other databases. The market for reverse shoulder replacements, which had barely 2,000 patients in 2004, has grown to an estimated 15,000+ patients in the past five years.

Reverse Shoulder Replacement

Benefits:

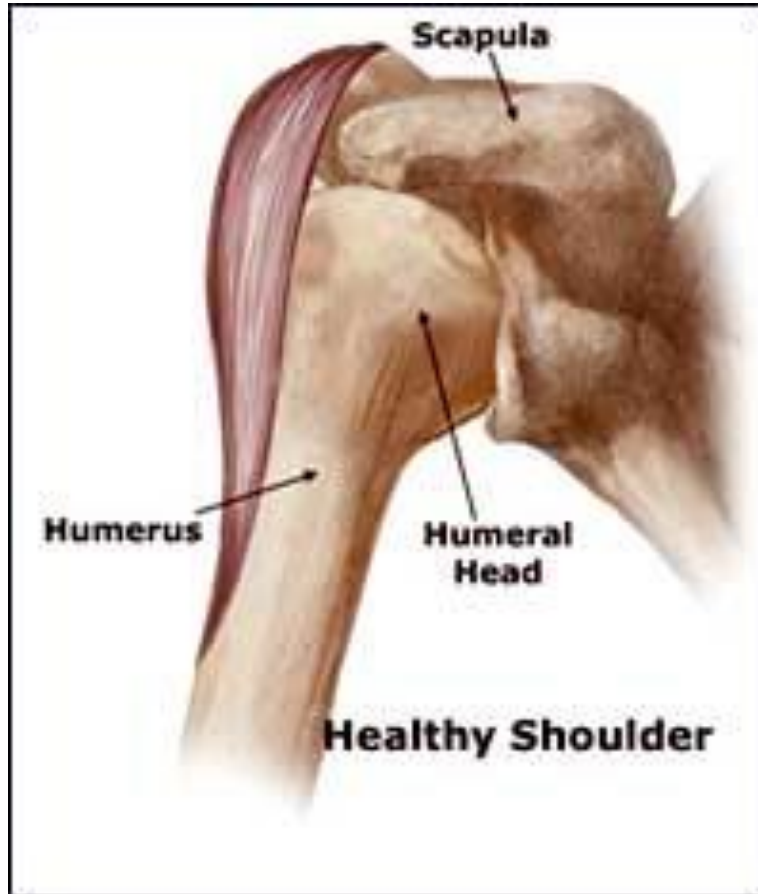
- Drastic difference in ROM
- Drastic improvement in ability to perform daily activities, such as eating, drinking, combing their hair

Rehab:

- 1 day hospital stay
- Patients will need outpatient physical therapy for ...



Reverse Shoulder Replacement

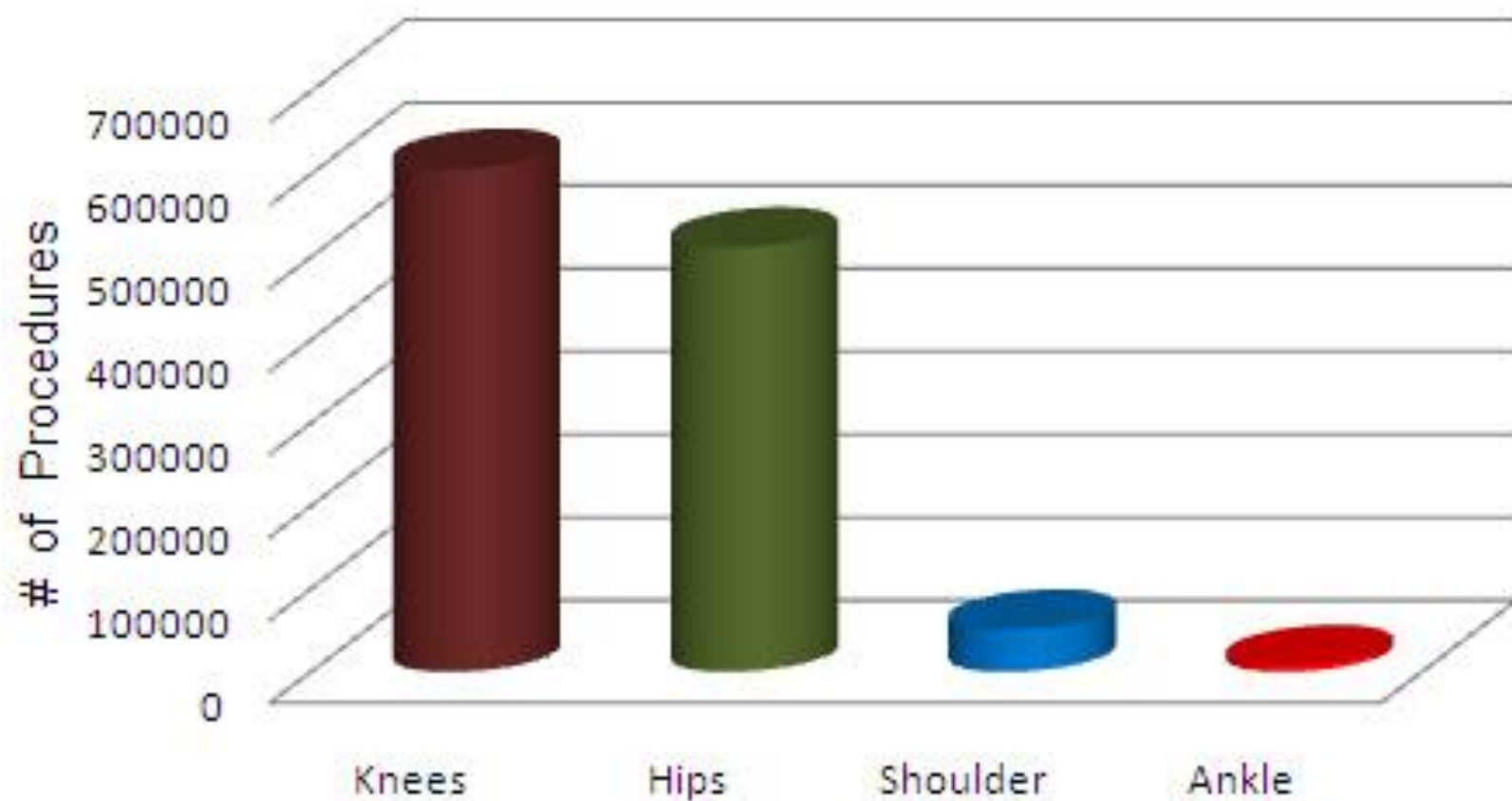


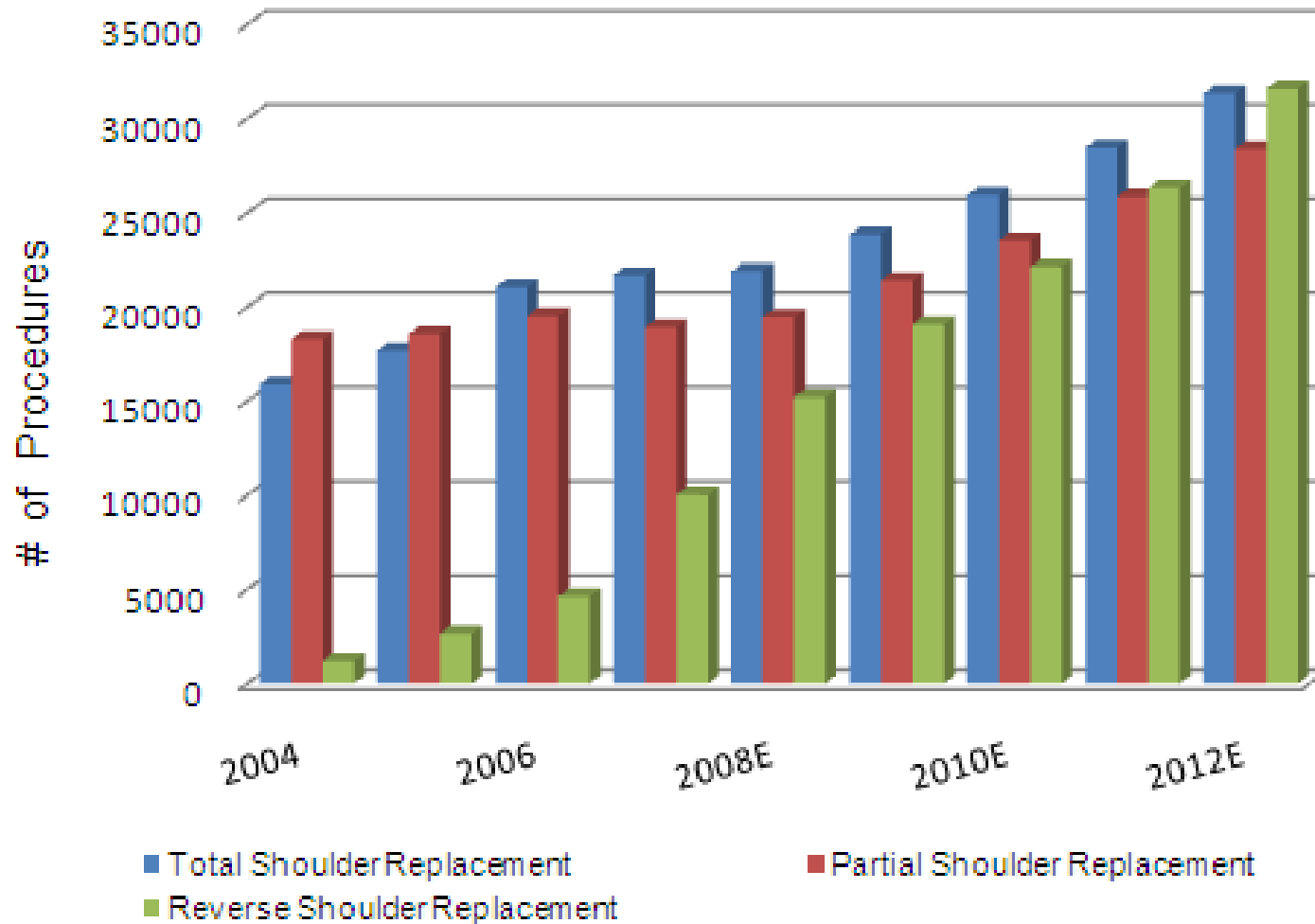
Some Numbers

- Data reveals that **almost 47% of the patients who received a total shoulder replacement through 2004 to 2007 had either partial or full rotator cuff tears**, one of the common symptoms experienced by patients who received a reverse shoulder replacement.
- These patients have experienced fewer complications, and the reverse shoulder replacement procedure appears to provide the best care for patients who have rotator-cuff-tears as well as arthritis in their shoulders

Some Numbers

- The shoulder is the third most commonly replaced joint in the United States. While the numbers for shoulder replacements are not anywhere near those for hip and knee joint replacements, the growth in this segment, especially since the advent of **reverse shoulder replacement** procedures, has been no less than phenomenal.
- Reverse shoulder procedure provides a far more sophisticated option for patients with complicated shoulder joint injuries.
- Chart 1 shows the 2008 procedure volume for shoulder joint replacement patients (including reverse, total, and partial) compared to other segments of the joint replacement market.





Reverse Shoulder Replacement

Outcomes

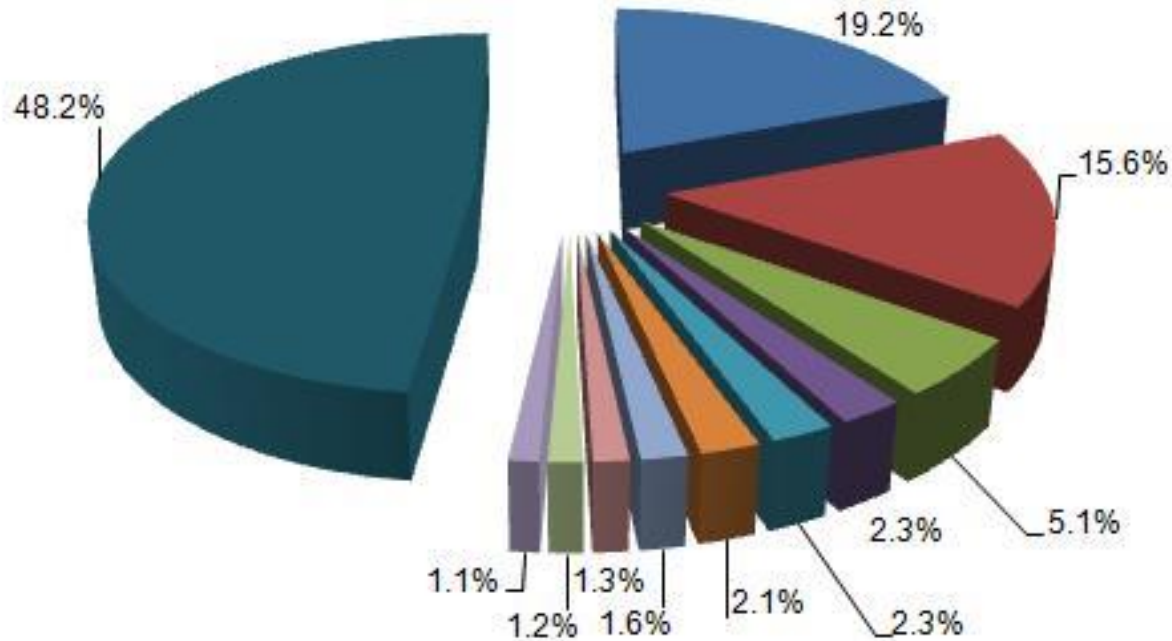
ROM:

- Forward flexion: No impingement
- Adduction -9 to 8 degrees
- Abduction 71 to 98 degrees
- ER 10 to 30 degrees
- IR 26 to 53 degrees

Precaution

- Avoid extension past neutral for 12 weeks
- Avoid combination of adduction and internal rotation for 12 weeks.
- Dislocation will NOT occur with AB/ER but with IR/AD in conjunction with EXT i.e. when tucking in a shirt.

Common diagnoses in Reverse Shoulders



- Primary localized osteoarthritis, shoulder
- Unspecified hypertension
- Pain in joint, shoulder
- Disorders of bursae and tendons in shoulder
- Complete rupture of rotator cuff
- Others
- Localized osteoarthritis, primary or secondary, shoulder
- Rheumatoid arthritis
- Osteoarthritis, generalized or localized, shoulder
- Rotator cuff sprain
- Bicipital tenosynovitis

Reverse Shoulder Replacement

- The intent of this class is NOT to provide you with protocols for the procedures described but rather to show the attendees an example of such a protocol. Always discuss any protocol used with the surgeon performing the procedure.
- Please refer to the Brigham and Woman's Hospital rTSA protocol.

Shoulder replacements

- The shoulder repair market represents almost three–fourths of the total extremities market, due mainly to the enormous progress made by orthopedic companies in developing the total shoulder, partial shoulder, and the new reverse shoulder replacement products. The shoulder repair market is now close to being a \$500 million market worldwide and is growing at 15% or more annually.

Shoulder replacements

- DePuy, Inc. and Tornier, Inc. are the current industry leaders, and these two giants share half of the global shoulder repair market.
- Zimmer Holdings, Inc., Biomet, Inc., Encore Medical Inc. (Reable Therapeutics), and Exactech Inc. are other key players within this market.

Shoulder replacements

- The rapid success of shoulder repair devices is not only due to better clinical outcomes and performance but also the continuous improvement of products and technology, such as reverse shoulder systems. The leading reverse shoulder products and their manufacturers are Delta Xtend from DePuy, Aequalis from Tornier, Anatomical Reverse System from Zimmer, and the Equinoxe System from Exactech.

Shoulder replacements

- A key product on the market today is the second generation reverse shoulder system from Biomet introduced in May 2009. Called the Comprehensive Reverse Shoulder System, the device provides more intraoperative flexibility and has fewer limitations than did the first generation device.

Shoulder replacements

- Reimbursement for a reverse shoulder replacement is similar to that for a total shoulder replacement which is remarkable considering the more advanced technology involved and better patient outcomes that a reverse shoulder replacement provides. According to PearlDiver research based on Medicare data, the average reimbursement for the facility is \$9,835 and the average physician reimbursement is \$1,280.
- Even though shoulder repair represents a minuscule portion of an estimated \$31 billion global orthopedic market, recent revenue growth has made shoulder repair a well-defined market that is targeting high growth driven by continuously improving technology. The result is a variety of innovative products that are providing improved outcomes for patients with very sore shoulders.



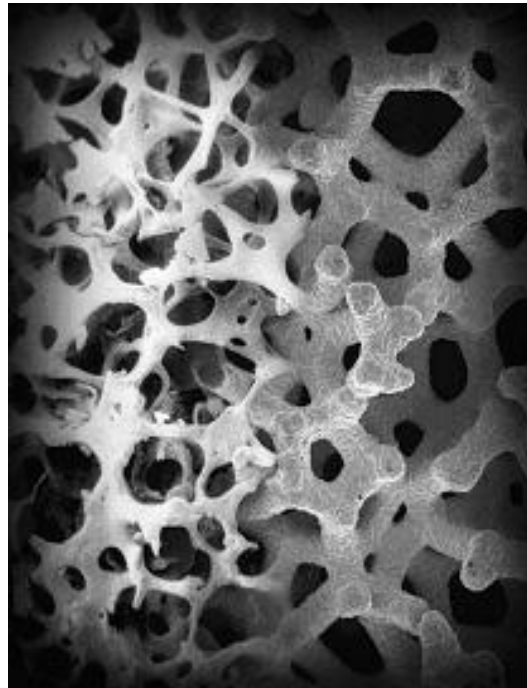
The Shoulder: Reverse Total Arthroplasty options, sorted by vendor

Vendors:

- Zimmer
- DePuy
- Encore Medical
- Biomet

Zimmer: *Trabecular Metal*

- The cellular structure of *Trabecular Metal** resembles bone and approximates its physical and mechanical properties more closely than other prosthetic materials



- It is a structural biomaterial that is 80% porous, allowing approximately 2-3 times greater bone ingrowth compared to conventional porous coatings and double the interface shear strength

Zimmer: *Trabecular Metal*

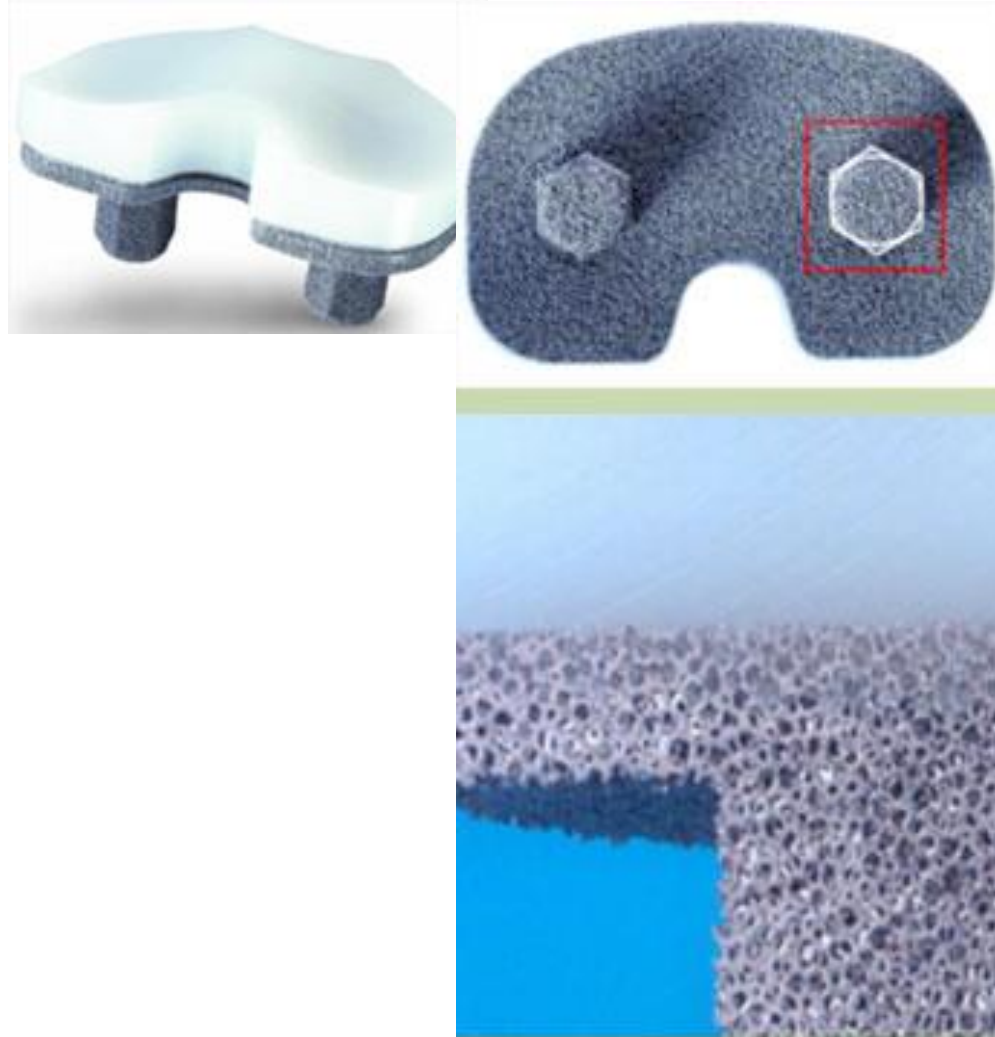


- *Trabecular Metal* possesses a high strength-to-weight ratio, with mechanical properties capable of withstanding physiologic loading. The compressive strength and elastic modulus of *Trabecular Metal* are more similar to bone than are other prosthetic load-bearing materials.
- The material's low stiffness facilitates physiologic load transfer and helps minimize stress shielding.
- The pore size and high volume porosity of *Trabecular Metal* supports vascularization and rapid, secure soft tissue ingrowth.
- Studies have shown that Soft tissue attachment strength was five times greater than with sintered bead coatings at 4 and 8 weeks.

Zimmer: *Trabecular Metal*

Other Applications:

- Trabecular Metal Monoblock Tibial Components



Zimmer: *Trabecular Metal*

Other Applications:

- Augmentation Patella

The Augmentation Patella is intended to help compensate for defects in the patella during revision total knee arthroplasty. The All-Polyethylene Patella is cemented into the

Trabecular Metal Base and remaining patella bone stock. Additional fixation is provided by suture attachment to soft tissue.



Zimmer: *Trabecular Metal* *Other Applications:*

- Trabecular Metal Monoblock Acetabular Cup System

Designed to meet the demands of both primary and revision arthroplasty, the Monoblock Acetabular Cup System combines the outstanding mechanical properties and characteristics of trabecular metal to deliver performance like nature intended.

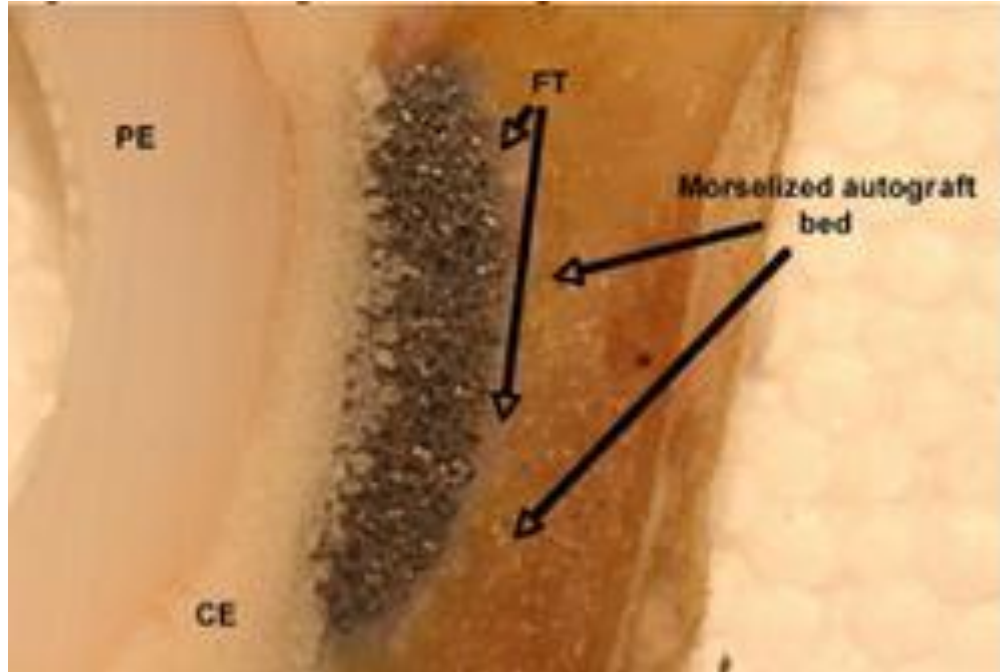


Trabecular Metal Revision Shell



Zimmer: *Trabecular Metal*

Other Applications:



Conclusions Active new bone formation was observed penetrating as much as 1-1.5 mm into the trabecular metal implant at 8 weeks following implantation. Over a longer period of time, with continued ingrowth and increasing strength, the provision of a stable mechanical environment is anticipated in response to the surgical techniques employed in this model

Zimmer: Zimmer Trabecular Metal Reverse Shoulder System

- Aids in the restoration of normal function for patients suffering from:
 - severe distortion of osseous anatomy (fractures)
 - and loss of rotator cuff function

Features:

- Trabecular Metal on the stem delivers a scaffold for biological ingrowth potential
- Screws allows for variable angulations to a maximum of 30° in all directions
- Cone geometry for initial stability and minimal bone removal



Zimmer: Inverse/Reverse System

Inverse/Reverse System offers many innovative features including:

- Option to convert to inverse/reverse without stem removal
- Designed for flexibility and stability by using either a press-fit or cemented stem
- Infinite variable settings of the humeral head
- Utilizes polyaxial locking screws, variable angulations to a maximum of 30° in all directions



DePuy:Delta CTA™

Reverse Shoulder Arthroplasty

- The Delta CTA™ Reverse Shoulder System was designed to provide a salvage solution for end stage cuff tear arthropathy patients who have poor biomechanics
- This system has been used in Europe for 15 years
- By changing the natural, anatomic center of rotation from the center of the humeral head to the base of the glenoid, the lever arm of the remaining active deltoid muscle bundle increases, providing the patient with a pain-free range of motion suitable for daily activities





DePuy:Delta CTA™

Reverse Shoulder Arthroplasty

Features:

- Medializes the humeral center of rotation
- Range of stem sizes
- 15 years of successful clinical use (European)

Advantages:

- Increases deltoid lever arm, restoring ROM
- Distal stem accurately sized to humerus.
- Proven motion, pain relief and stability when implanted by trained surgeons for the correct indications

DePuy Delta Xtend™ Reverse Shoulder System

Delta Xtend™ Reverse Shoulder System

The Delta Xtend™ system is a total semi-constrained shoulder arthroplasty. It reverses the normal relationship between the scapular and humeral components, moving the scapulo-humeral joint center of rotation medially and inferiorly. By doing this, it increases the deltoid lever arm as well as the deltoid tension therefore allowing the muscles of the deltoid group to compensate for rotator cuff deficiency. The Delta Xtend™ humeral stem is designed for cemented fixation. The glenoid component is cementless with four screws as primary fixation and HA coating for secondary fixation.



Encore Medical: Reverse® Shoulder Prosthesis, DJO/Surgical

Features:

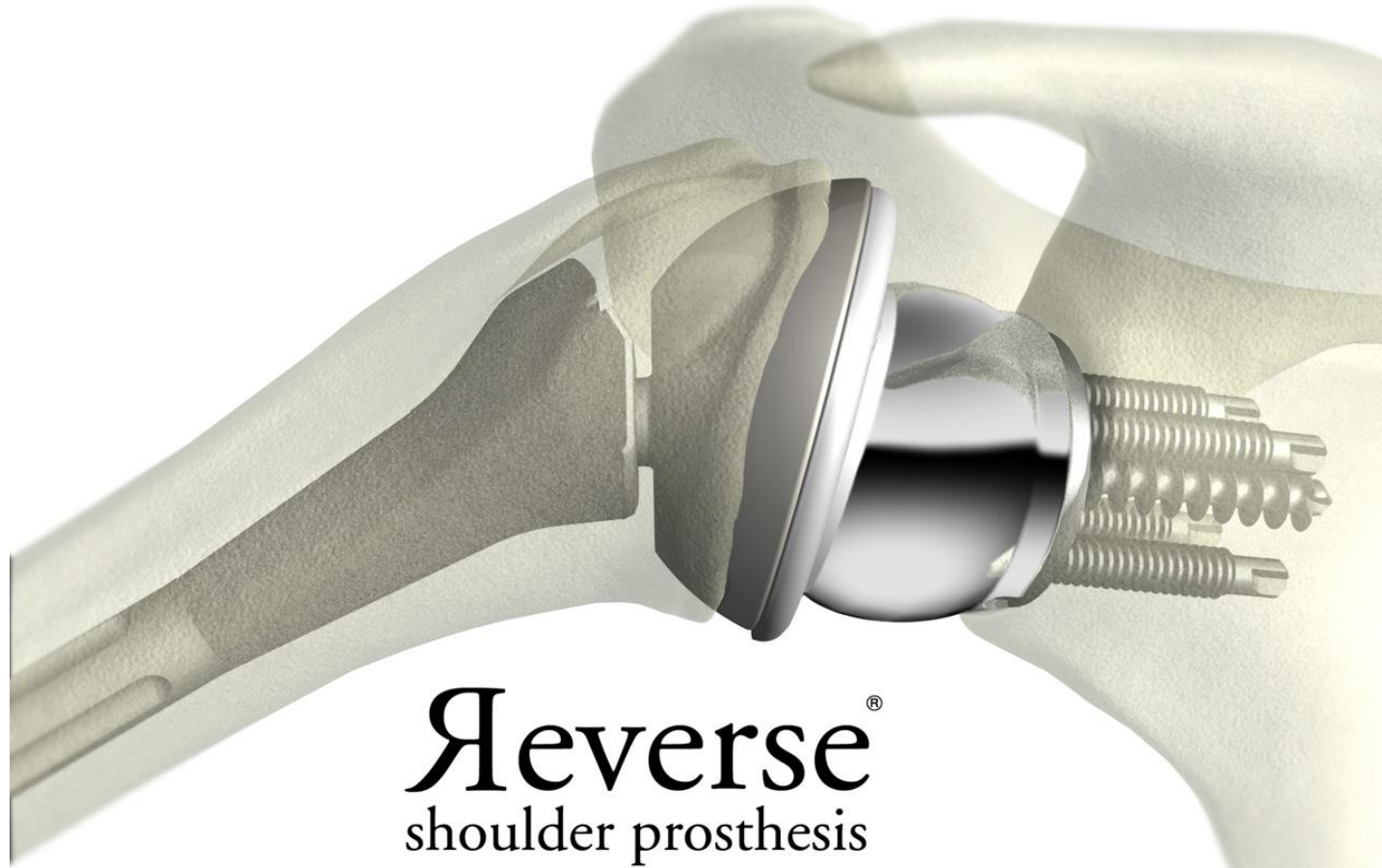
- In the reversed design, the forces in the joint are directed through the center of the glenosphere, converting the centrifugal (outward) forces into centripetal (inward) forces.
- This in turn creates inherent stability in the reversed design because of the congruency of the humeral socket and glenosphere.





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Encore Medical: Reverse® Shoulder Prosthesis



Reverse®
shoulder prosthesis



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Encore Medical: Reverse® Shoulder Prosthesis

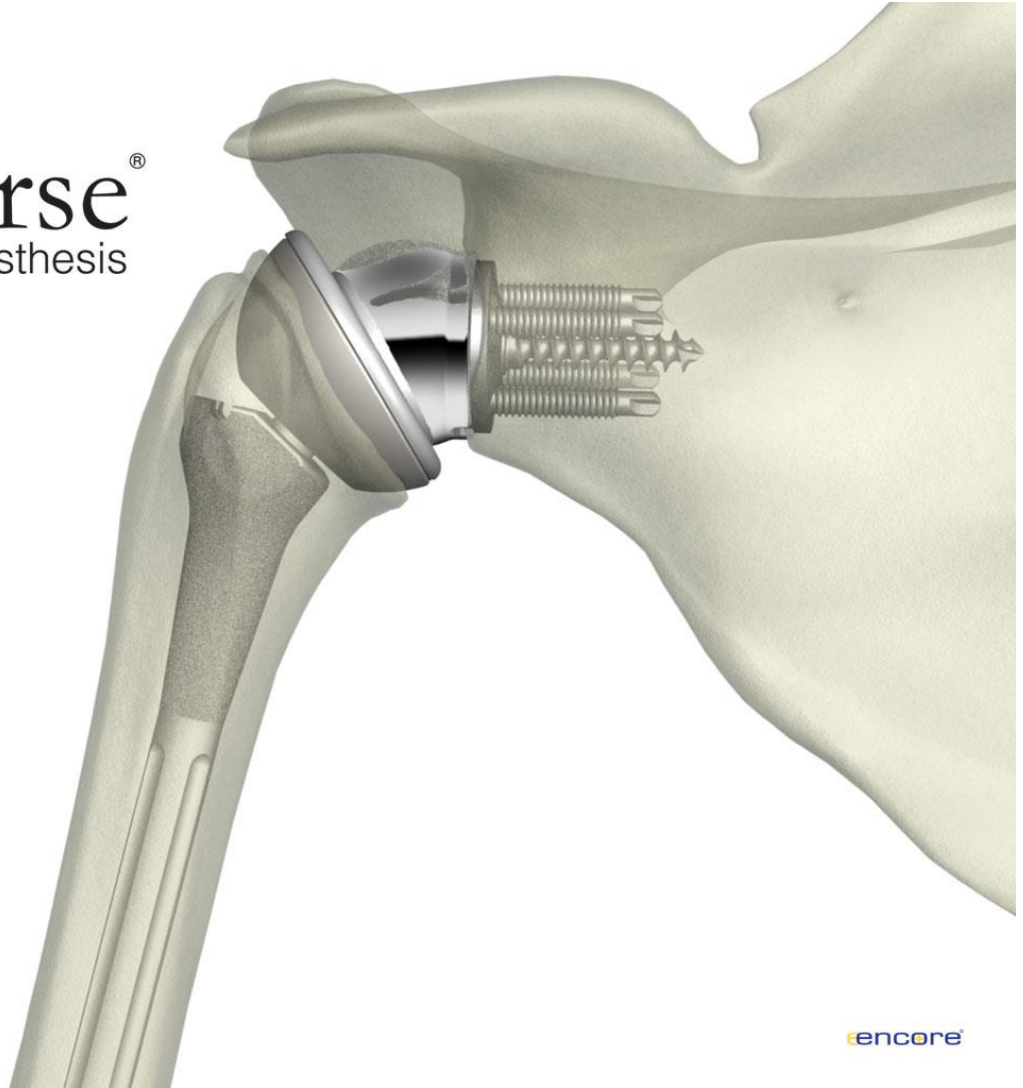




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Encore Medical: Reverse® Shoulder Prosthesis

Reverse®
shoulder prosthesis



encore®

Encore Medical: Reverse® Shoulder Prosthesis

Features:

- Cylindrical-shaped distal segment with cement flutes for optimal fixation
- Cemented application only
- Revision possible (tough since it is cemented)
- Titanium alloy humeral stem
- Titanium alloy cup with snap in polyethylene insert
- Titanium alloy baseplate
- Wrought cobalt chrome articulating head



Titanium alloy humera



Clinical Outcomes

Average total ASES scores improved 30.3 to 77.6

Average ASES pain scores improved from 15.6 to 40.9

Average SST scores improved 1.8 to 6.8

Blinded analysis of range of motion showed:

Average abduction improved 61° to 109.5°

Average flexion improved from 63.4° to 118°

Average external rotation improved from 13.4° to 28.16° (none of the patients in this study received a latissimus dorsi transfer)

53 patients rated their outcome as excellent (55%)

26 patients rated their outcome as good (27%)

11 patients were satisfied with their outcome (12%)

6 patients were unsatisfied with their outcome (6%)

Overall 7% complication rate (9 complications in 6 patients)

0 instances of scapular notching

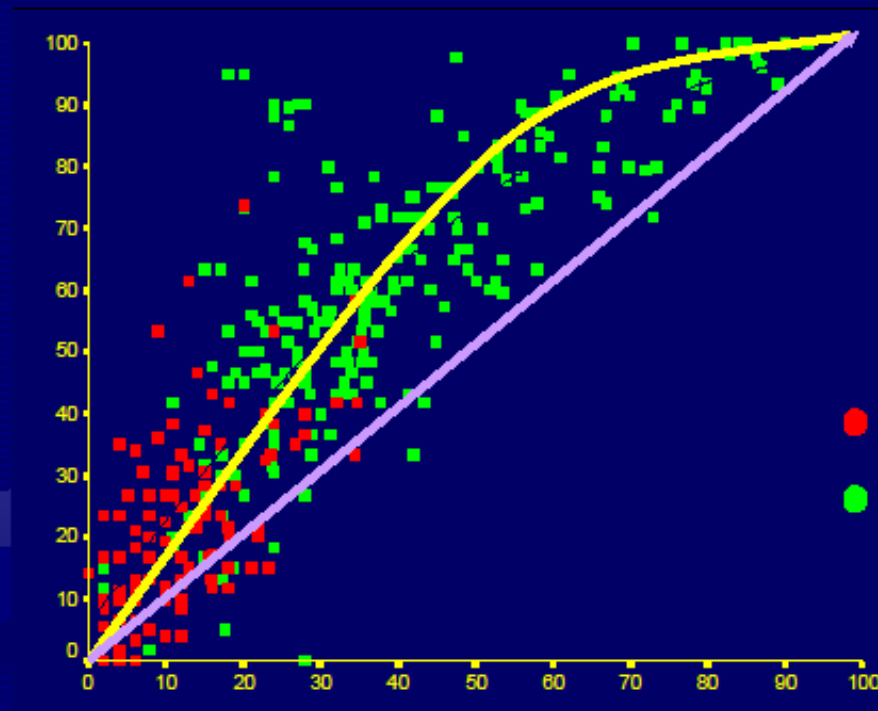
0 instances of scapular notching



Comparison of Outcome Scores

2001 n=204 shoulder arthroplasties

ASES
Score



CM Score

Partial Shoulder Replacement/Hemiarthroplasty

- When the normally smooth surfaces of the shoulder joint are severely damaged by arthritis or injury, shoulder replacement surgery is the most effective method for restoring comfort and function to the joint.
- When only the humeral side of the joint is worn out, a hemi-arthroplasty might be appropriate.
- After the non-prosthetic glenoid arthroplasty, the reamed glenoid surface must heal. This process may require up to a year to complete.
- Hospital stay is typically one day.



Post-op rehab:

- 1st 6 weeks, ROM only.
- After 6 weeks, introduce light strengthening.
- PROM exercises
- The specific limitations can be specified only by the surgeon who performed the procedure

Precautions:

- Avoiding repetitive heavy lifting
- Avoiding "jamming" activities such as hammering
- No lifting or pushing heavy objects



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Partial Shoulder Replacement/Hemiarthroplasty

Medscape® www.medscape.com





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Partial Shoulder Replacement/Hemiarthroplasty



Zimmer



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Partial Shoulder Replacement/Hemiarthroplasty





Partial Shoulder Replacement/Hemiarthroplasty





Partial Shoulder Replacement/Hemiarthroplasty



Osteocapsular arthroplasty

Osteocapsular arthroplasty:

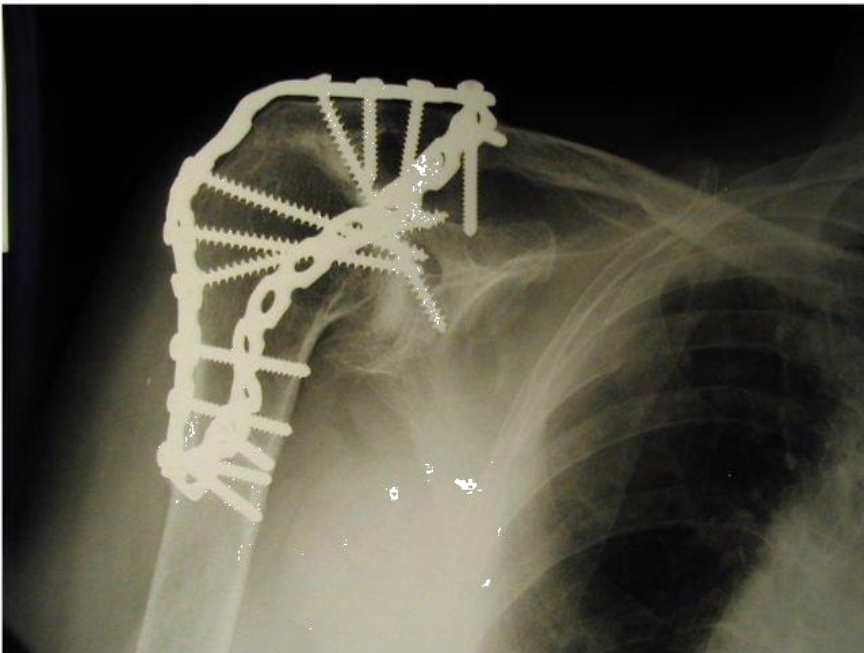
- During this procedure, the surgeon removes bone spurs (osteophytes) and reshapes and smooths the shoulder joint's surfaces.
- May be done arthroscopically.

Synovectomy

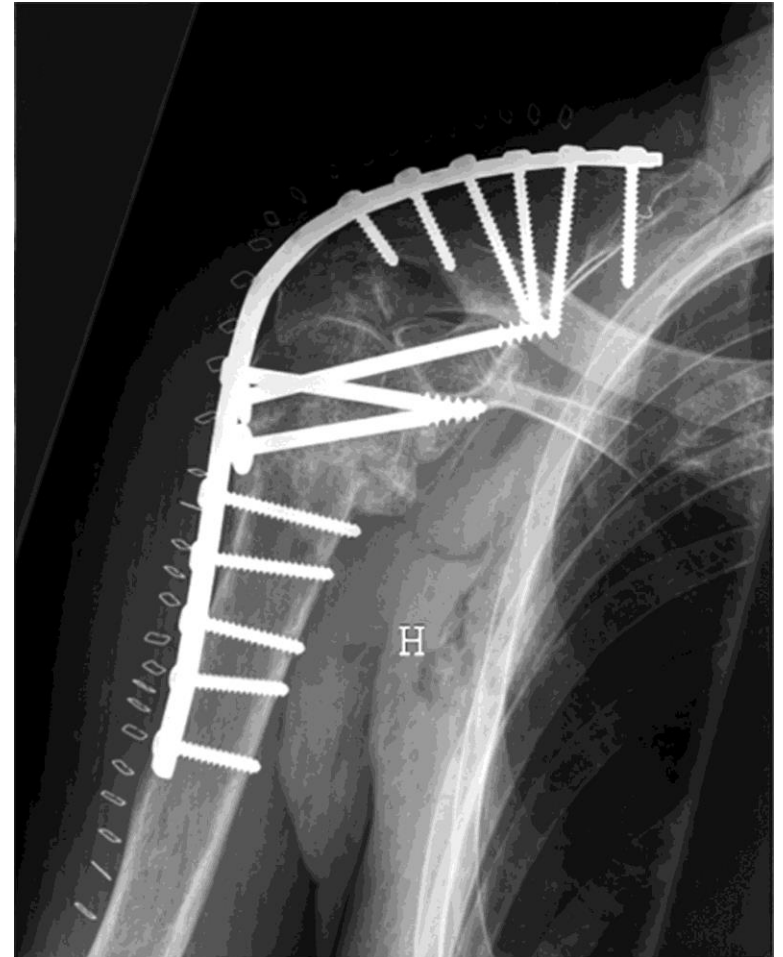
- Sometimes, the synovium surrounding your shoulder joint may become inflamed (i.e. RA) causing pain and stiffness.
- A synovectomy removes this inflamed synovium.
- The synovium can grow back and become inflamed again, but medications can usually prevent that from happening.
- If the bones in the shoulder joint aren't damaged, a synovectomy might be all that is needed to restore motion and reduce pain.
- Synovectomy are most often done via arthroscopic surgery.

Arthrodesis

- Also called joint fusion
- The glenohumeral joint is pinned together joint in one position.
- This procedure significantly reduces mobility of the shoulder.
- Significantly reduces pain. This is the main indication for this procedure.
- Another indication is the inability of the shoulder muscles to support and hold an artificial shoulder joint in place.



Shoulder Arthrodesis



Break!

The Hip

Let's take a look at the orthopedic solution available for hip disorders. We'll discuss the following hip procedures:

- Total Arthroplasty
- Hemi Arthroplasty
- Minimally Invasive Surgery
- Hip Resurfacing
- Fracture care: Pinning/DHS/Gamma nail

Total Hip Arthroplasty

- As we discussed earlier, this is one of the most common joint replacements in the US.

Indications:

- hip joint failure caused by osteoarthritis
- rheumatoid arthritis
- avascular necrosis
- traumatic arthritis
- certain hip fractures
- benign and malignant bone tumors
- ankylosing spondylitis

Total Hip Arthroplasty

Contra-indications:

- active local or systemic infection
- other medical conditions that substantially increase the risk of serious perioperative complications such as cardiac disease.

Factors to consider:

- Age
- bone stock
- asymmetric wear
- type and extent of soft tissue contractures
- Mental status

Total Hip Arthroplasty

Prognosis:

- The patient's anticipated outcome following a THR is to return to their previous functional, occupational and cognitive status using assistive device or adaptive equipment as appropriate within 6-8 weeks
- Choices of Implant Material:
 - Polyethylene
 - Metal
 - Ceramic

Total Hip Arthroplasty

Polyethylene

- Pro's
 - Increased durability
 - Increased performance
- Con's
 - Wear particles become a source of infection
 - This may lead to osteolysis, a "dissolving of the bone" which will require revision

Indication

- Less active, (older) patient.
- Preferably used with metal femoral head

Total Hip Arthroplasty

Metal on Metal

- Pro's
 - fewer osteolytic lesions
 - Slightly higher 20 year survival rate: 77% versus 73% (this study was based on the older implants)
- Con's
 - high frictional torque
 - Metal ion production
 - A 1998 study demonstrated increased cobalt and chromium levels in both blood and urine in patients with metal-on-metal articulations, raising concerns about potential toxicity and carcinogenicity
 - Follow up study found no significant increased risk of malignancies 15 years following metal-on-metal articulations

Total Hip Arthroplasty

Ceramic

Pro's

- Ceramics are quite hard and are scratch resistant
- These bearings have a very low coefficient of friction and are hydrophilic, which improves lubrication
- Less wear: 150-300 times less linear wear and 1700 times less volumetric wear than conventional metal-on-polyethylene articulations

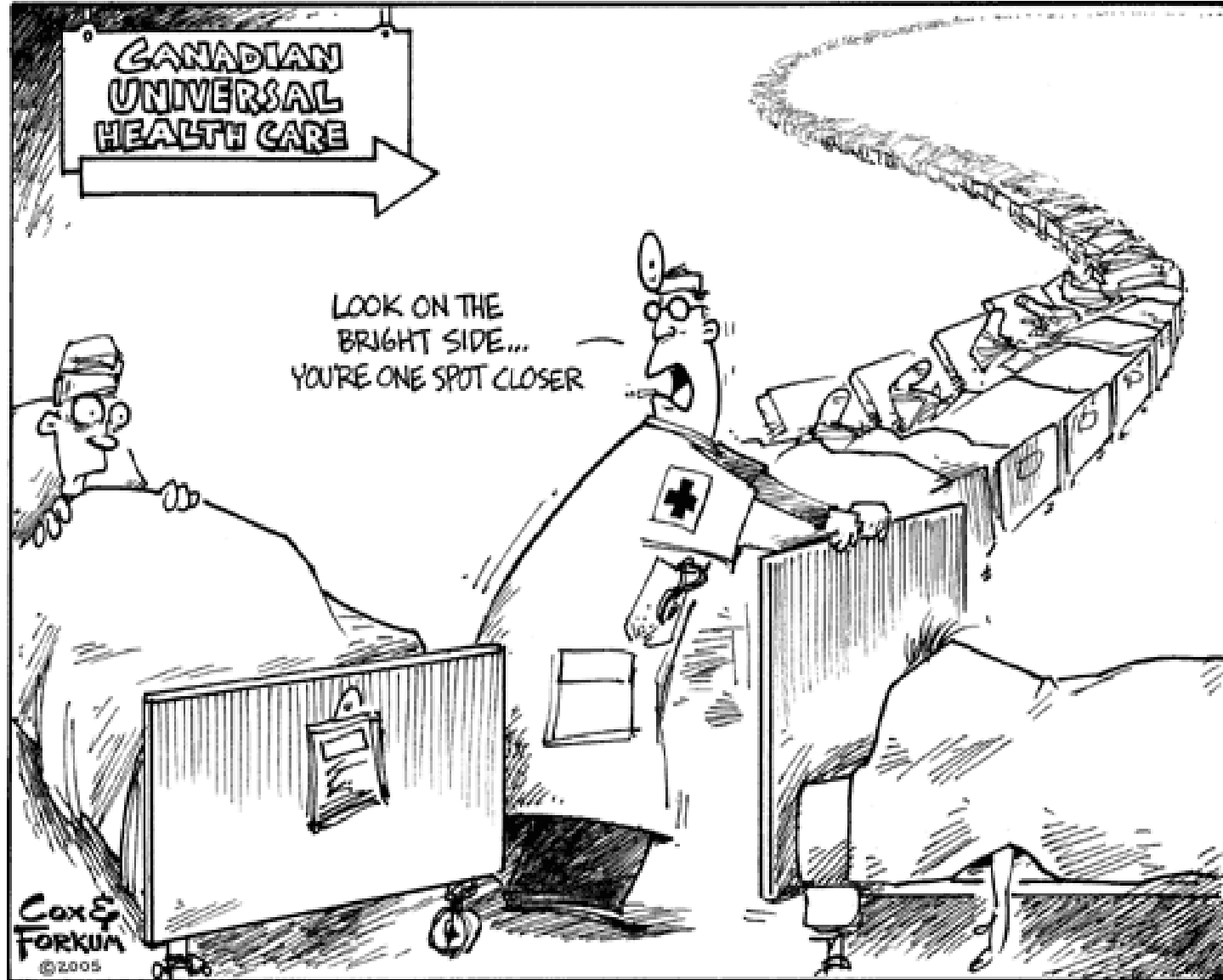
Con's

- Ceramic fractures (design flaws)
- Implant loosening (design flaws)
- Expensive





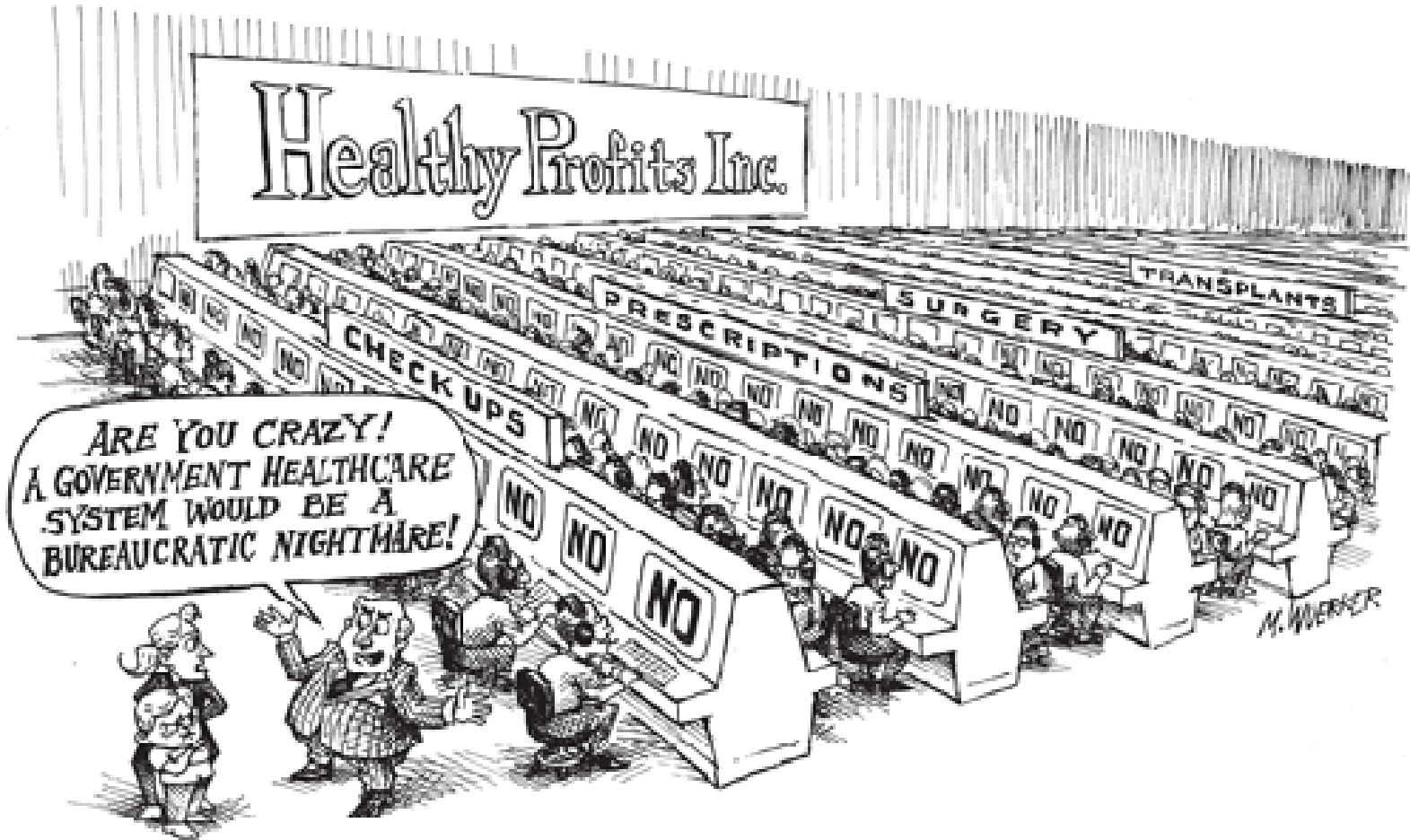
Total Hip Arthroplasty





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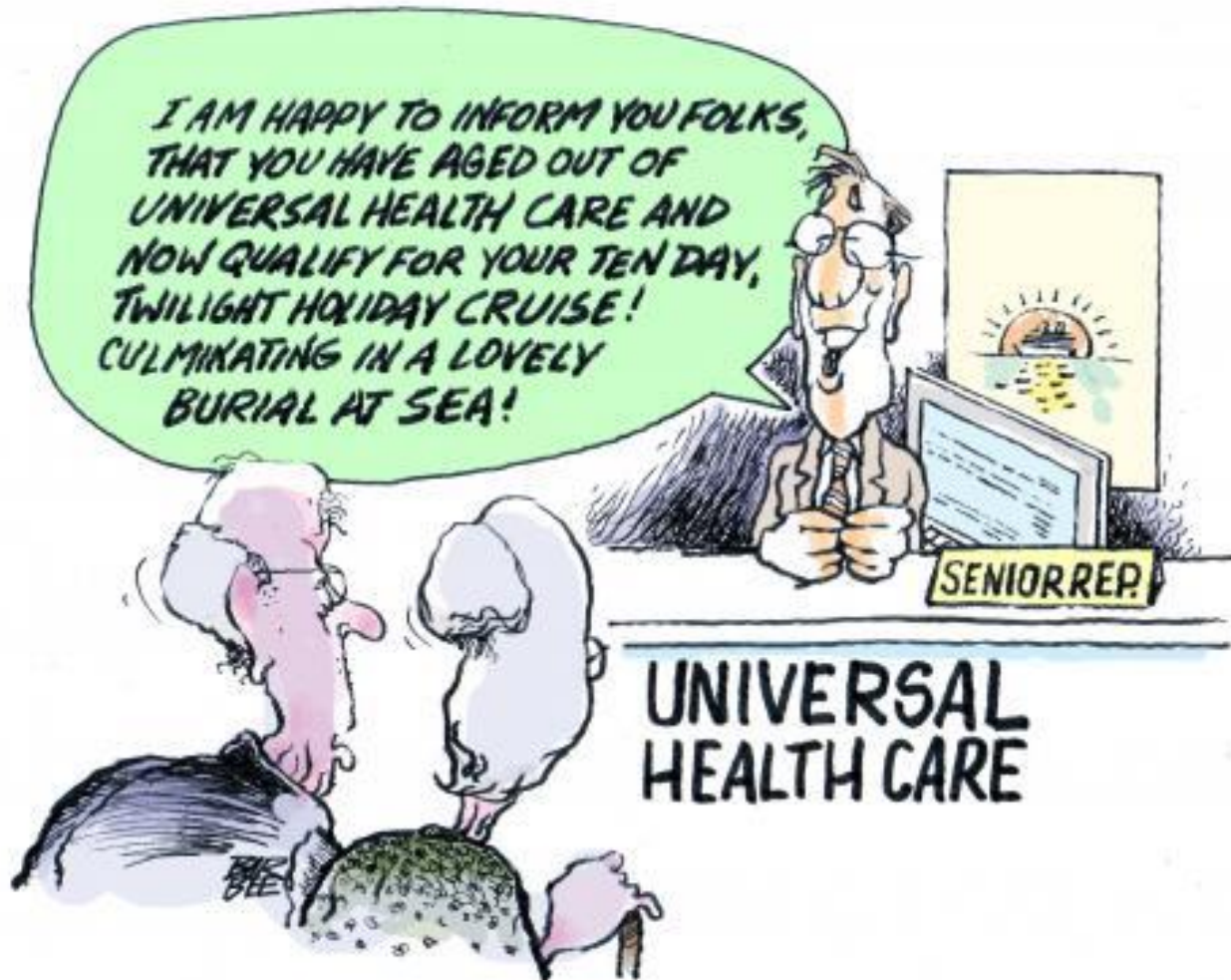
Universal Healthcare





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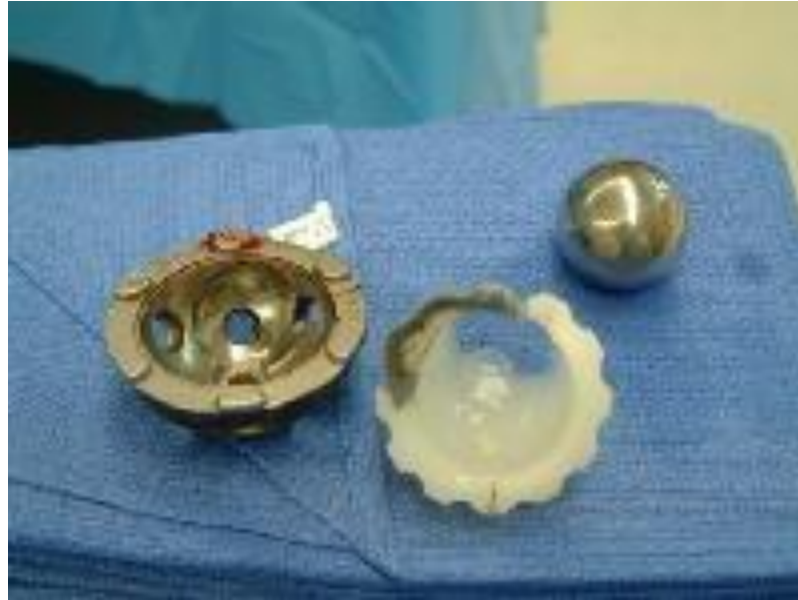
Universal Healthcare





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Total Hip Arthroplasty





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Total Hip Arthroplasty

The Charnley Hip (now by DePuy)

CHARNLEY®



The world's most successful hip implant

- The original design principles of CHARNLEY Hip System remain unchanged
- More than 40 years of constant development and clinical study have made CHARNLEY Hip System the benchmark by which all hip designs are assessed.
- Today's perception of THR as an almost routine procedure with high success rates owes much to the CHARNLEY Hip System's outstanding clinical record.



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Total Hip Arthroplasty The Charnley Hip System

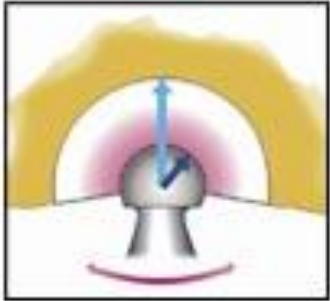


CHARNLEY®



- Proven, unrivalled clinical track record 1,2,3
- Up to 99% survivorship at 10 years 4
- Low frictional torque - reduces stress and wear
- Smaller, polished femoral head minimizes wear debris
- Secure cemented fixation - strong bone to cement interlock
- Refined, dependable surgical procedure

Total Hip Arthroplasty



Low frictional torque

- The torsion forces which can lead to implant loosening are minimized by the design of the CHARNLEY head and cup. The small, highly polished femoral head articulates in a thick acetabular cup, diffusing stress and reducing the risk of localized cement fracture.
- The head is precision manufactured to a finish consistently higher than ISO standards.
- The acetabular cup is manufactured from UHMWPe (Ultra high molecular weight polyethylene) This combines low friction properties with high wear resistance.

Reduced wear

- The small femoral head size has been demonstrated in a number of studies to generate less volumetric wear than larger heads.
- Debris generated by wear is a primary cause of osteolysis and resorption of bone, resulting in early implant loosening.
- The design and manufacture of the CHARNLEY femoral component minimizes this risk of failure.

Total Hip Arthroplasty

Cemented or Cementless Fixation?

Non-Cemented:

- rely on bone growth into porous or onto roughened surfaces for fixation
- less aseptic loosening on the acetabular side
- Typically less weight bearing initially.
- Used in the younger patient

Cemented:

- Quicker mobilization
- Used for the older patient

Total Hip Arthroplasty

Different approaches

Posterior/Lateral approach

- No combined motions of flex/Add/IR
- No hip flexion > 90 degrees
- No IR past neutral when hip in flexion
- No crossing of legs

Anterior/Medial approach

- No extension past neutral
- No bridging
- No prone lying
- No Ext/ER/
- Keep hip flexed in supine
- Develop tight hip flexors to increase anterior stability

Total Hip Arthroplasty

Anterior Approach

- The anterior surgical approach is typically done with patients lying on their back, through a small incision which allows the surgeon to avoid cutting of any muscles.
 - Quicker Return to Normal Activities
 - No Post-Operative Restrictions
 - Smaller Incision
 - No Muscle Cutting
 - Faster Recovery
 - Smaller change of leg length discrepancy
 - Patient will be able to sleep on their side much more comfortably.

Total Hip Arthroplasty

Anterior Approach

- Other benefits to the anterior approach in supine include:
 - The incision is in the front of the hip, allowing X-ray guidance in the operating room (as well as computerized navigation)
 - Both of these techniques allow for more accurate measurement of leg lengths at the time of surgery
 - With this additional, intra-operative information gained from the X-ray or the computer, there will be an excellent placement of the implants.

Total Hip Arthroplasty

Anterior Approach



Total Hip Arthroplasty

Anterior Approach

- The rehabilitation is faster because the muscles are not traumatized during the approach to the hip
- Patients are able to get up and walk with the use of a walker much easier and should progress to a cane with 2 to three weeks
- Patients are walking independently without the use of a cane typically by 4-5 weeks and then returning to their normal activities shortly thereafter
- This is in comparison to a posterior approach whereby patients are on walkers for almost the first 4 – 6 weeks, progress to cane for the next 3-4 weeks, then walk independently at about 10 weeks. Normal activities resume at about 3 months

Total Hip Arthroplasty

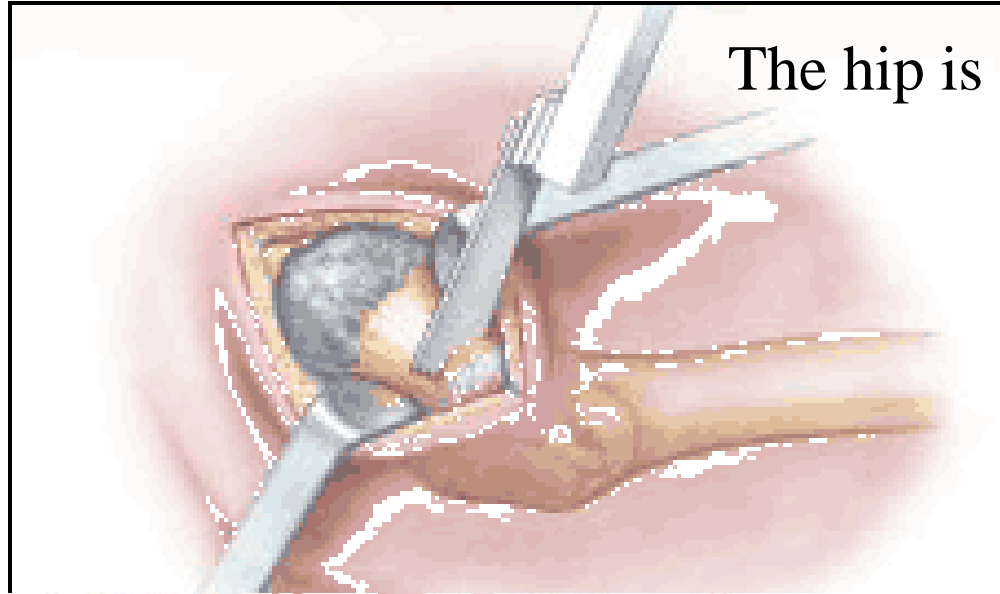
Anterior Approach

Why aren't all orthopedic surgeons using the anterior approach?

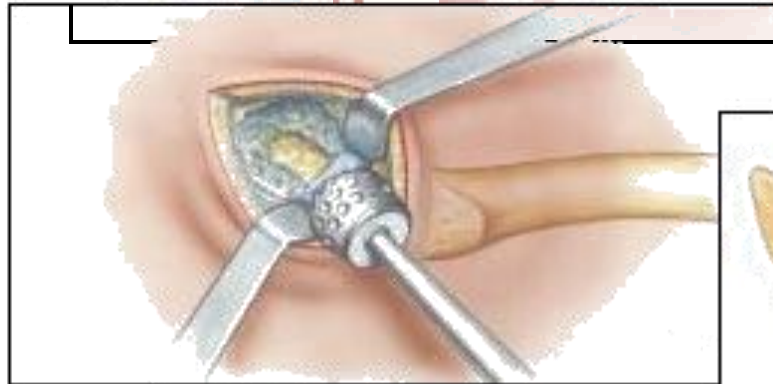
- Most orthopedic surgeons were trained to do hip replacement surgery through a posterior approach in their residencies
- The posterior approach works and has excellent results and some surgeons are reluctant to change.
- To learn the anterior approach means traveling to see other surgeons perform the operation, and practicing on cadavers. This takes time and money.
- You need a special Hanna table. Not all hospitals are willing to purchase a table that costs nearly \$100,000
- It takes a little longer to perform the operation through the anterior approach, but not significantly. It may take 15-60 minutes longer.



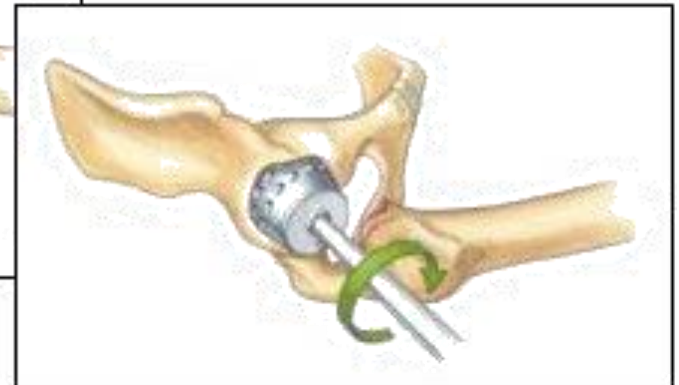
Total Hip Arthroplasty



The hip is exposed

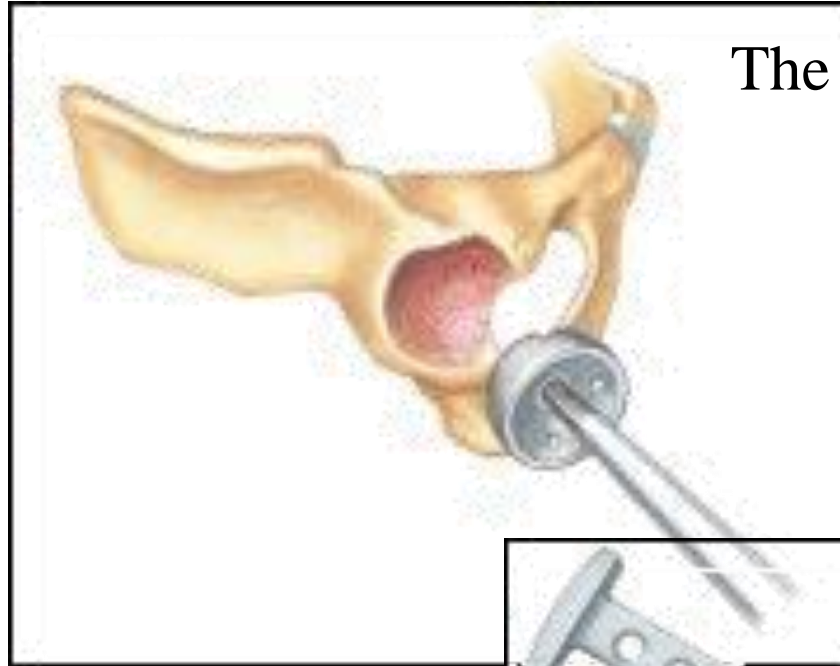


Acetabular Preparation

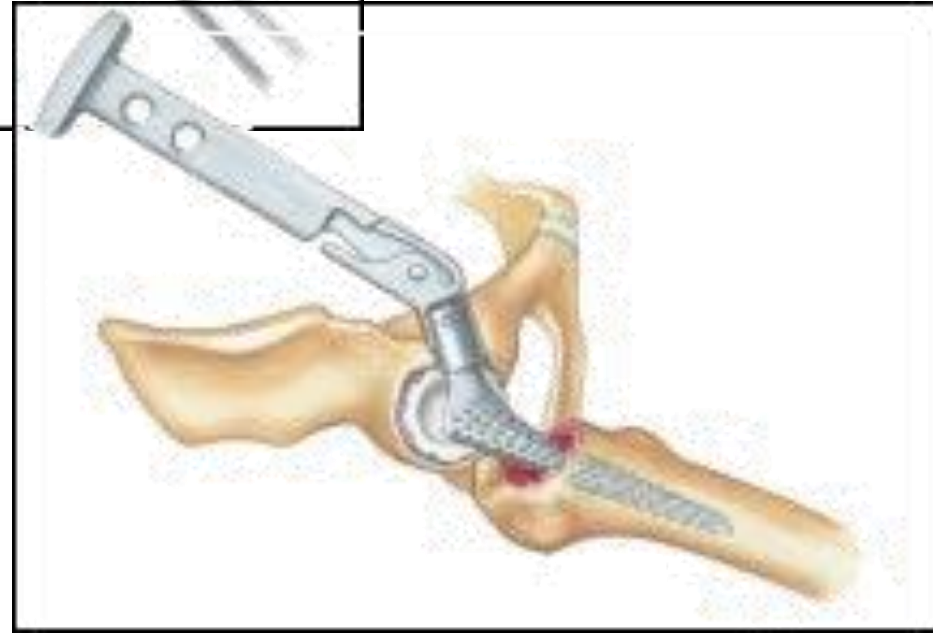




Total Hip Arthroplasty

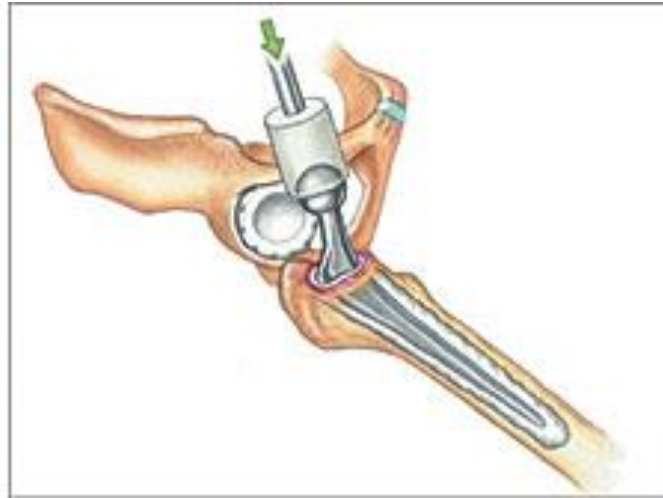
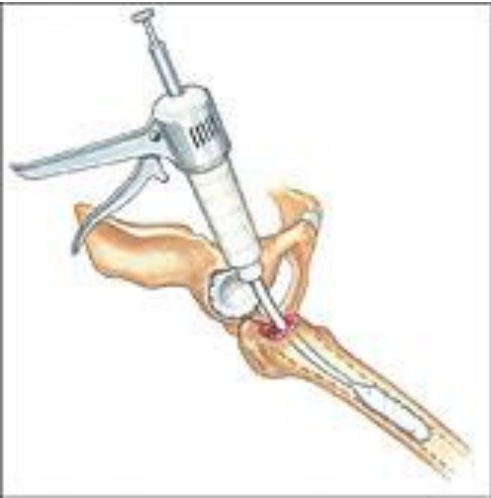


The Acetabular Prosthesis



Femoral Preparation

Total Hip Arthroplasty



The Femoral Prosthesis

The Final
Result





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Surgical Option for the hip, sorted by vendor

Zimmer

DePuy

Smith & Nephew

Biomet

Stryker

Wright Medical Technology

Zimmer:

Zimmer has 20+ Cemented and Cementless systems

- Apollo[®] Hip System

- Features:

- Acetabular Component Offers Optimum Head Coverage and Minimum Wear





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Zimmer® Continuum™ Acetabular System



CPT 12/14 Hip System

- Has been in use for 25 years
- Collarless. Polished design
- Low revision rate of 1.4 %
- Increased ROM



VerSys® Cemented Revision/Calcar

- Long stem
- Cemented
- Modular



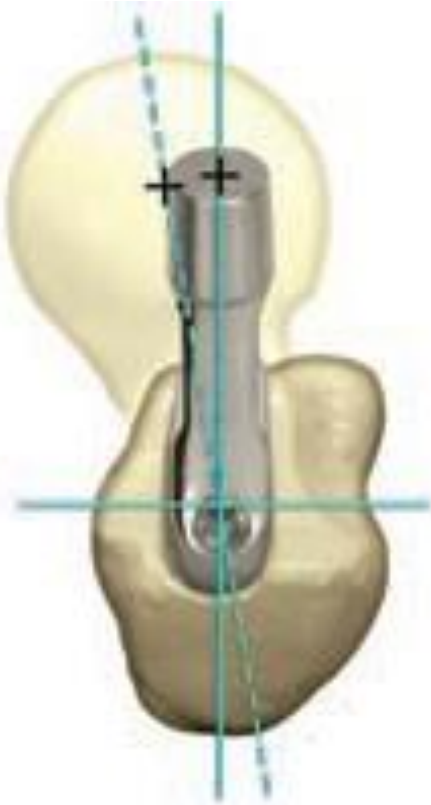
Improved Function and reduced dislocation risk:

- Proper offset
- Prevention of leg length discrepancy
- The *Zimmer* M/L Taper Hip Prosthesis with *Kinectiv* Technology allows surgeons to independently adjust leg length and offset intraoperatively after stem implantation to optimize each dimensional factor without affecting the other.
- The *Zimmer* M/L Taper Hip with *Kinectiv* Technology also allows independent version adjustments after stem implantation.



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Zimmer



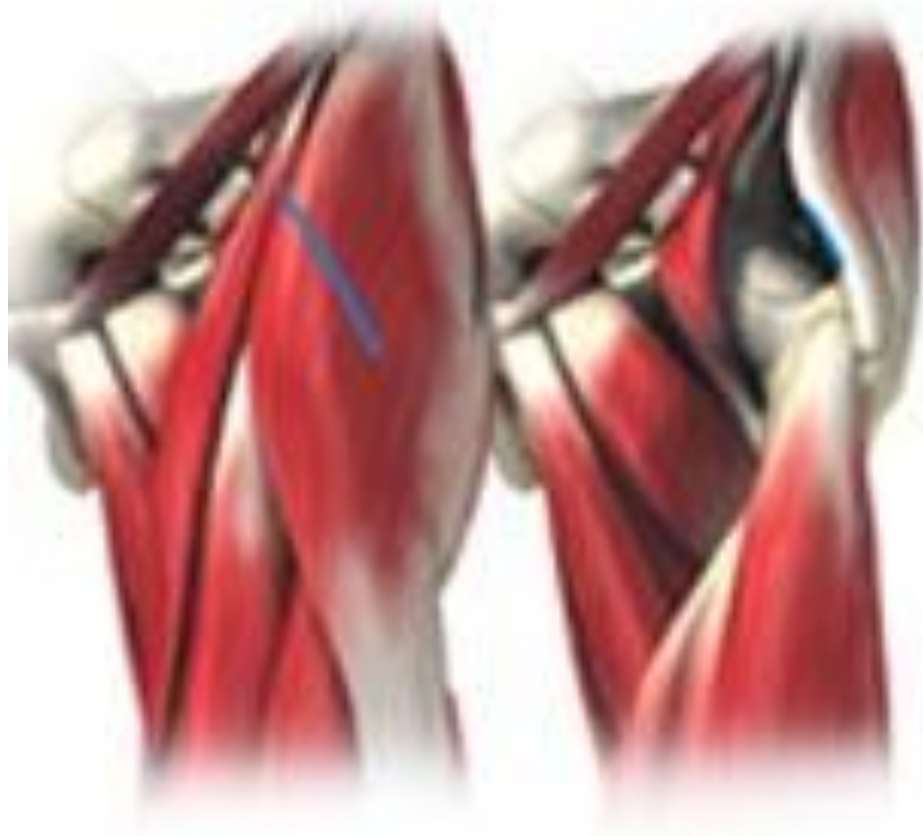
MIS Anterolateral Hip Procedure By Zimmer

- A single incision approach
- A muscle sparing approach intended not to cut muscles or tendons
- An anterolateral approach to the hip
- An approach with the patient in the lateral decubitus position
- Complete acetabular and femoral visualization
- Cut between the glutei and tensor fascia lata muscles directly to the hip capsule.
- This intermuscular interval through a small incision preserves muscle integrity so that rehabilitation can be rapid and the posterior capsule can remain intact, easing concerns about posterior dislocation



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MIS Anterolateral Hip Procedure By Zimmer



DePuy recall

- On August 26, 2010, after selling 93,000 of the defective products, DePuy finally released shocking information that shows that 13 percent of patients with the ASR hip implant have had to have the implant removed due to a failure.
- Based on this data, DePuy escalated its recall of the ASR hip implants and told hospitals and doctors to immediately stop implanting the devices and to return them to the company.
- Orthopedic specialists believe that DePuy's design of the acetabular cup is the reason for the failures. DePuy's acetabular cup is shallower than some other hip implants, and that may be the reason why DePuy's ASR system has such a high failure rate



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DePuy ASR Hip





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Smith & Nephew: Primary Femoral

- Modular





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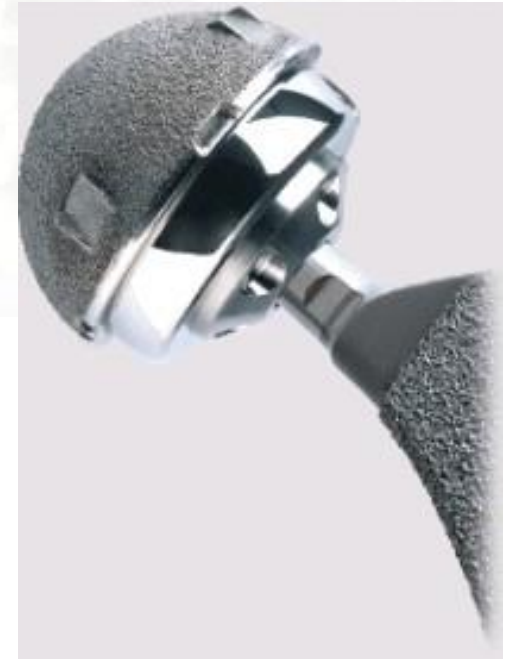
Biomet



“Biomet changed my life.”

Mary Lou Retton

Biomet Total Joint Replacement Recipient





Biomet's M2a-Magnum™ Hip

- Metal-On-Metal
 - giving this hip greater durability. The more active a person is, the more friction on the joint and the higher the risk of wear
 - For the younger and more active person
- Greater Motion, Stability and Flexibility
 - Large femoral head, providing greater range of motion (160 degrees) and greater resistance to dislocation compared to smaller heads
 - Only with a metal on metal device can you combine a large head with a small acetabulum



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Biomet's M2a-Magnum™ Hip

- Modular system
- Large articulation





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Biomet's M2a-Magnum™ Hip





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Stryker: Trident® Ceramic Hip System



Jack Nicklaus



• Trident® Ceramic Hip

Stryker: Trident® Ceramic Hip System

Features/Advantages:

- Potential to Wear Less, Last Longer
- The Trident® Ceramic Acetabular System is a unique design that features a patented titanium sleeve encapsulating the ceramic that is pre-assembled to the alumina ceramic at the factory. The titanium sleeve increases the material strength of the ceramic insert by 50% versus other ceramic inserts on the market.





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Stryker: Trident® Ceramic Hip System





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Wright's CONSERVE BFH Hip

www.JimmysNEWHip.com

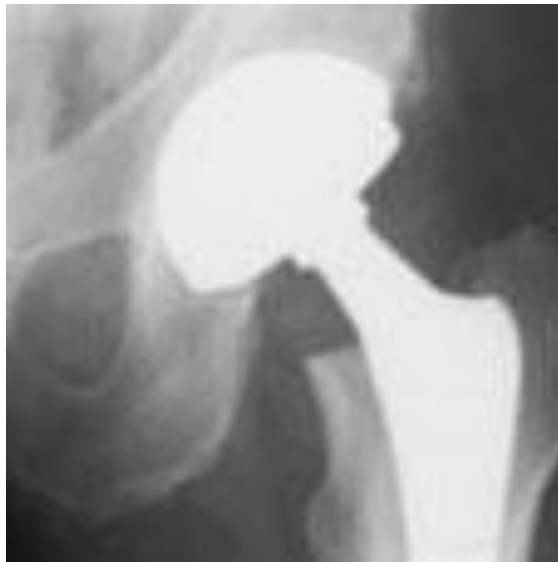
Don't let hip pain keep you from your active lifestyle. Get back in the game.



Wright's CONSERVE BFH Hip

Features/Advantages

- More stability through a larger femoral head
- Larger head also provides more mobility (172 vs. the regular 132)
- Metal on metal implant
- May be implanted through the MIS technique



Hemi Arthroplasty



- Only half of the hip joint is replaced, typically the femoral head
- Most common indication is a fracture of the femoral neck





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Complications





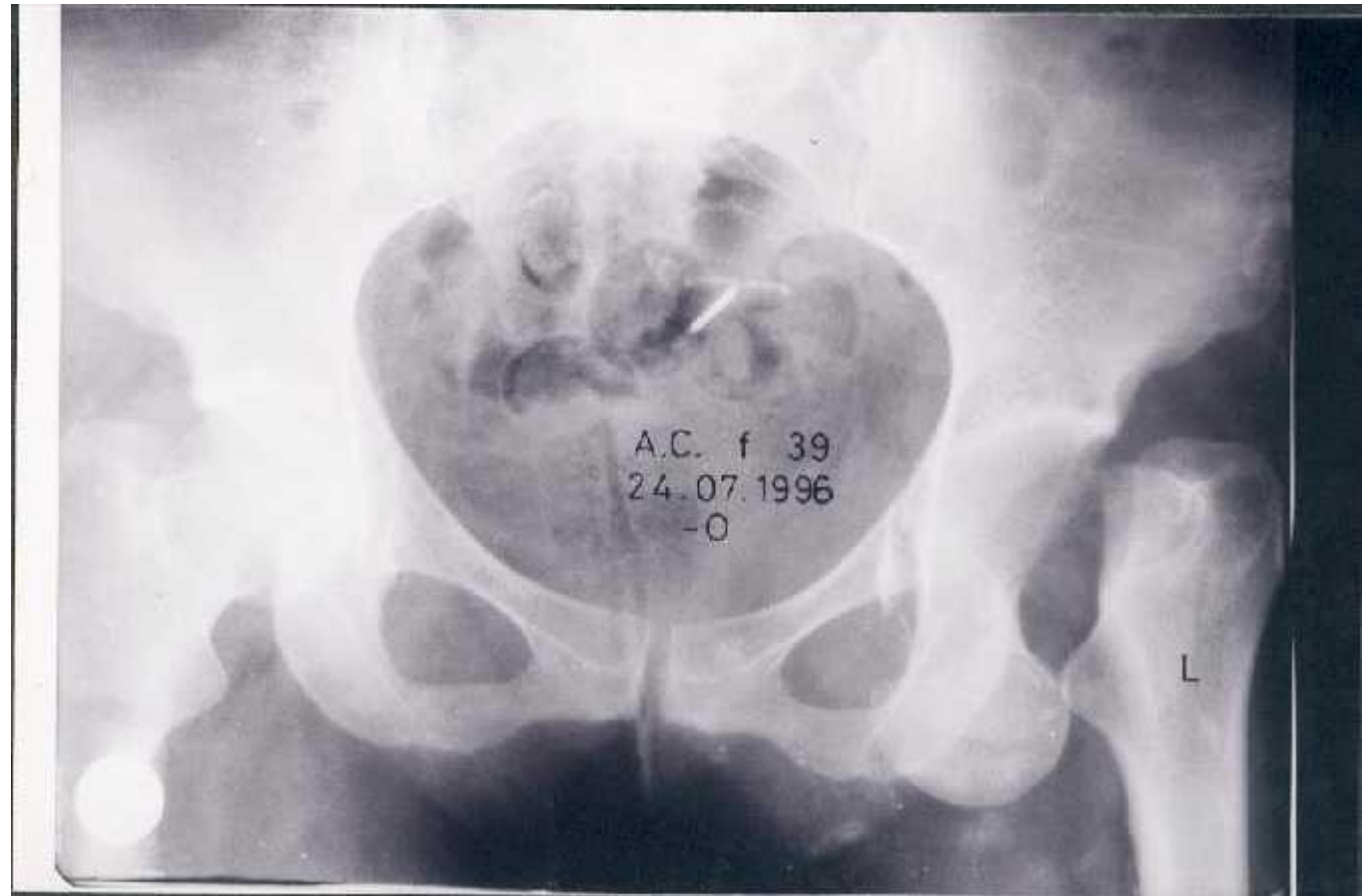
Complications





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Complications





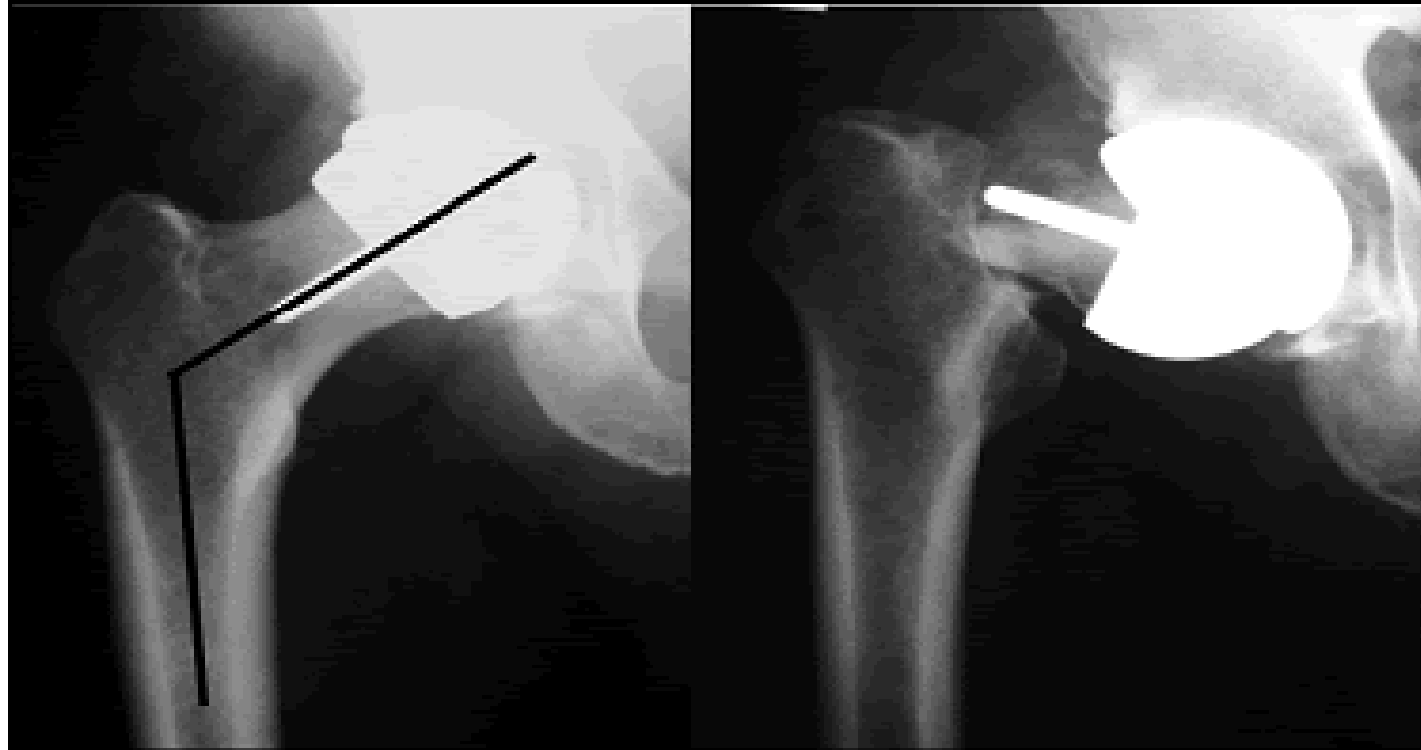
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Complications





Complications



Complications



Complications





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Complications





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Complications





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Complications



RA



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Complications



Dysplasia

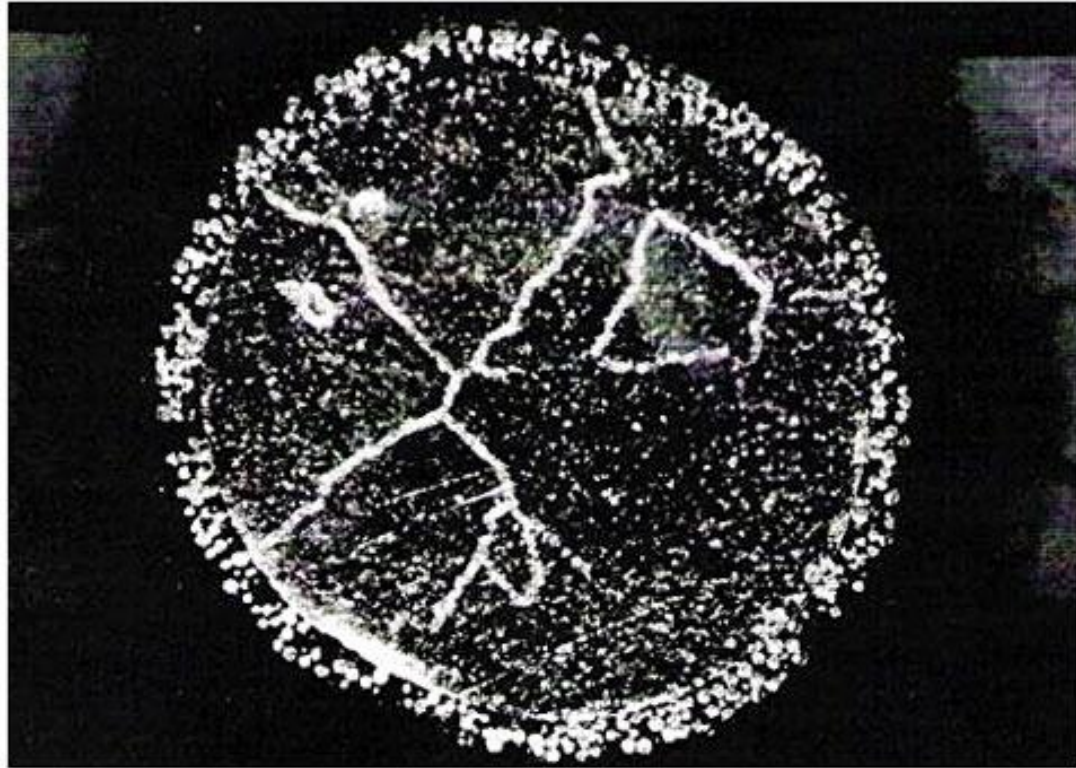


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Complications

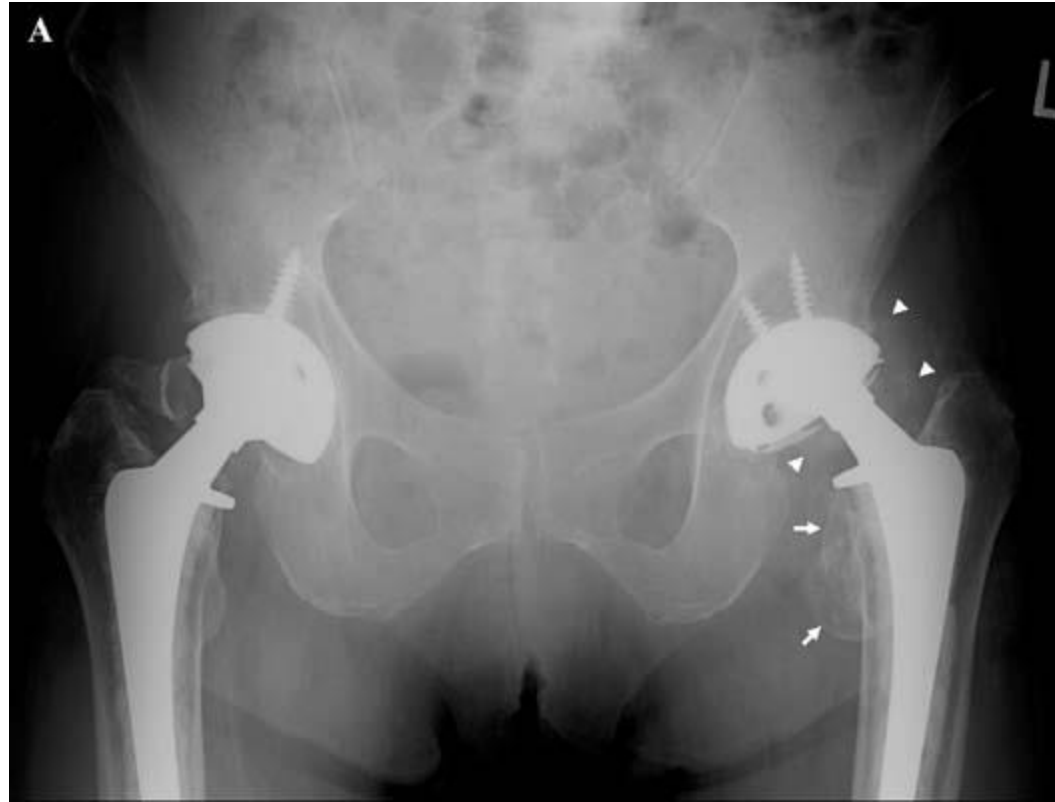


Complications



Cross section of a cast Cobalt-Chromium-Molybdenum implant at 7X magnification. The large grain size was considered a major weakness in the structure.

Complications



85-year-old female with metallosis of left total hip replacement. AP Radiograph of the pelvis shows eccentric position of femoral head within acetabular cup of left total hip replacement. The bubble sign (arrows) and cloud sign (arrowheads) are present in the periprosthetic region of the left hip joint. The right total hip replacement is intact, with incidental heterotopic ossification.

Complications

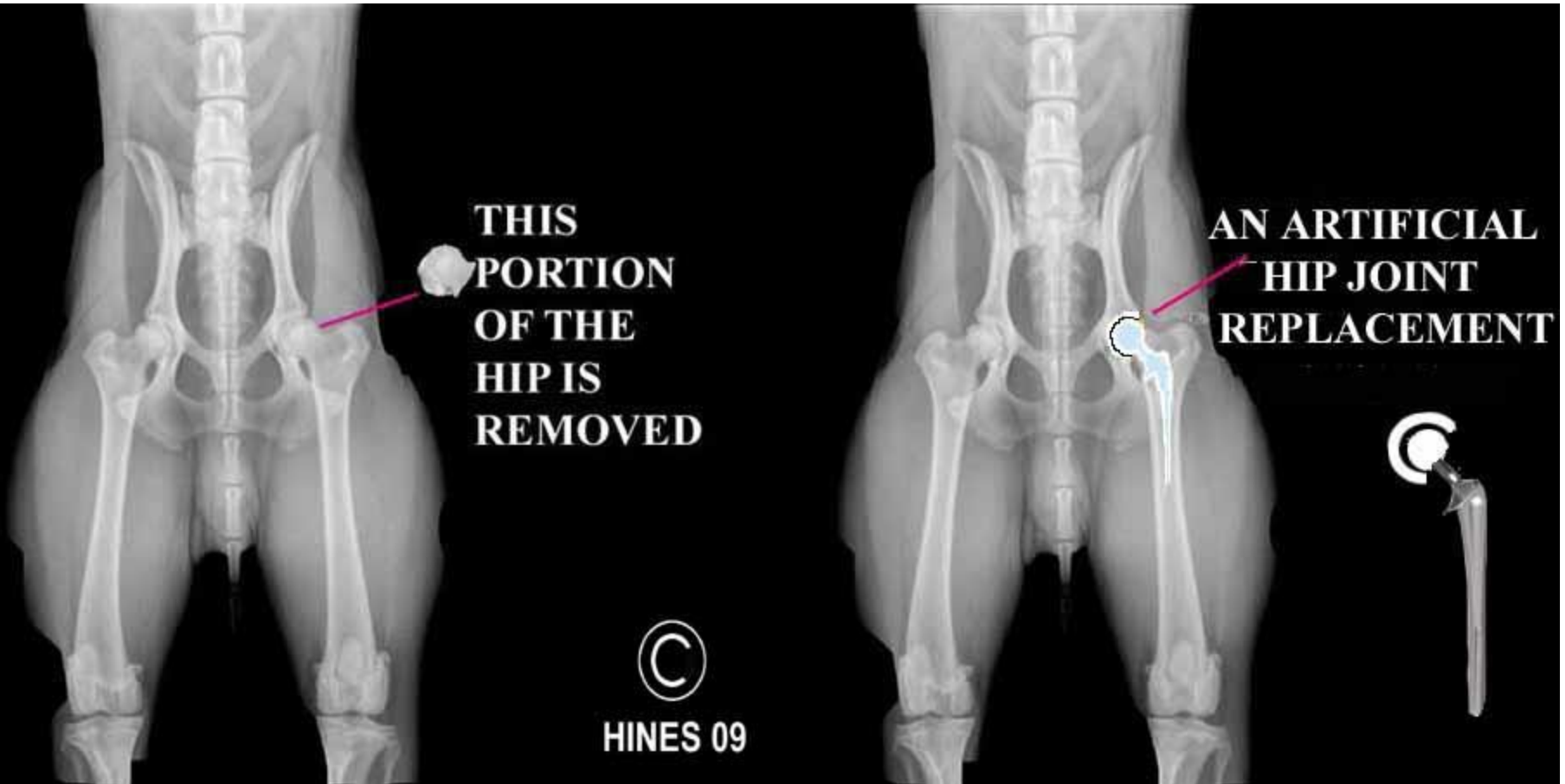


85-year-old female with metallosis of left total hip replacement. AP radiograph of the right hip shows eccentric position of the femoral head within the acetabular cup. The bubble sign (arrows) and cloud sign (arrowheads) are present in the periprosthetic region of the left hip joint.

Complications



Patient with loose cups and stems. Dark lines around the interface between the cement and bone indicate resorption and osteolysis



Prices are generally from \$4,000 to \$5,000. Approximately \$1,500 of this cost is for the implants. Following a successful total replacement of the ball and socket of the hip joint, limb function can return to 100 percent



Complications



Following revision with uncemented hip components there is good reconstitution of bone and good fixation of implants

Complications



Marked loosening of acetabular components in a young patient with inflammatory arthritis. Severe loss of bone is evident around the loose cups.

Complications



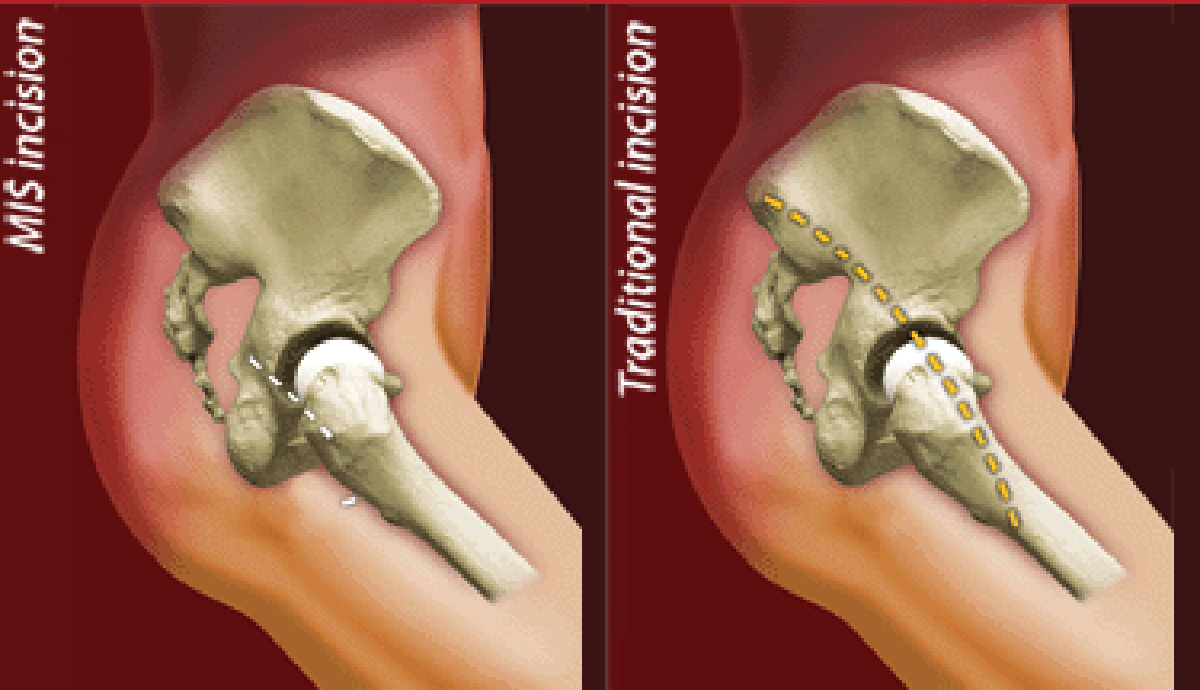
Hips reconstructed with specially designed acetabular components that allow incorporation of bone and bone grafts allowing excellent function



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Minimally Invasive Surgery

Smaller MIS Incision vs. Larger Traditional Incision



"With
**MIS
SURGERY**
I Only Had A Little Scar...
Yet What It Did Was
**MIND-
BOGGLING.**"

Minimally Invasive Surgery

- Smaller incision
- Surgeon will try to go around the musculature as much as possible
- Implant may be the same size, but the instruments are smaller
- Shorter LOS and faster recovery
- Poor visualization of the surgical field, especially with the knee.

Hip Resurfacing

Currently, only 2 vendors have FDA approval:

- Smith & Nephew's Birmingham Hip
- Stryker's Corin Group PLC's (LSE: CRG)
Cormet Hip Resurfacing System

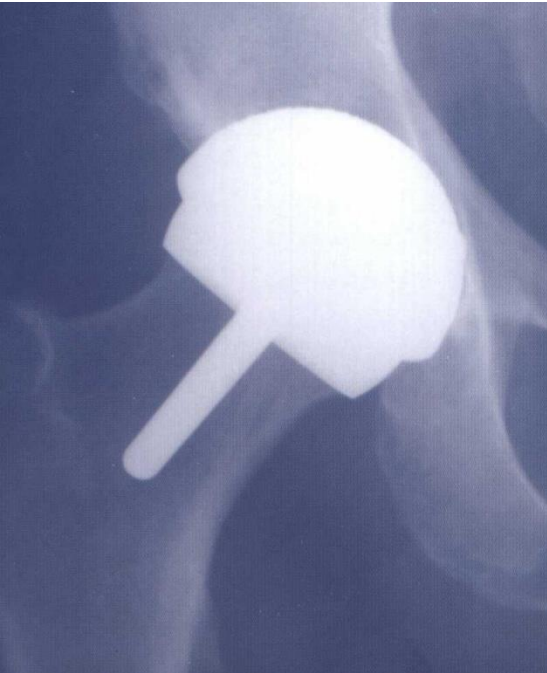
Advantages

- Femoral head is preserved
- Femoral canal is preserved
- No associated femoral bone loss with future revision

Concerns:

- No long-term track record
- Tough on surgeon
- Patient needs to have healthy bone stock

Smith & Nephew's Birmingham Hip



75,000 implants worldwide

Expensive implant, around \$10,000 (no competition)

No dislocation precautions

Excellent for the younger and more active patient



Smith & Nephew's Birmingham Hip

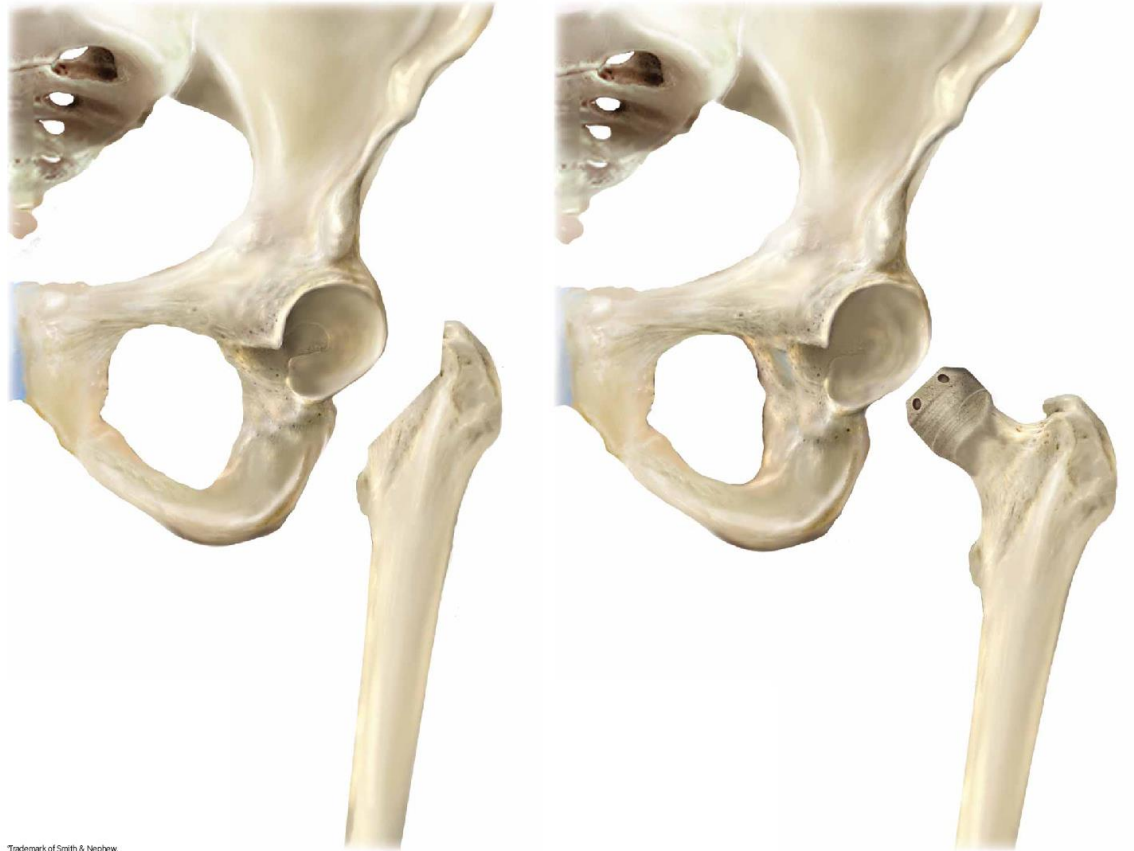
Stephen Raterman, MD
Florida Medical Clinic
813-979-0440
www.floridamedicalclinic.com

Total hip vs. BHR[®] System cuts



Smith & Nephew's Birmingham Hip

Total hip vs. BHR[®] System cuts

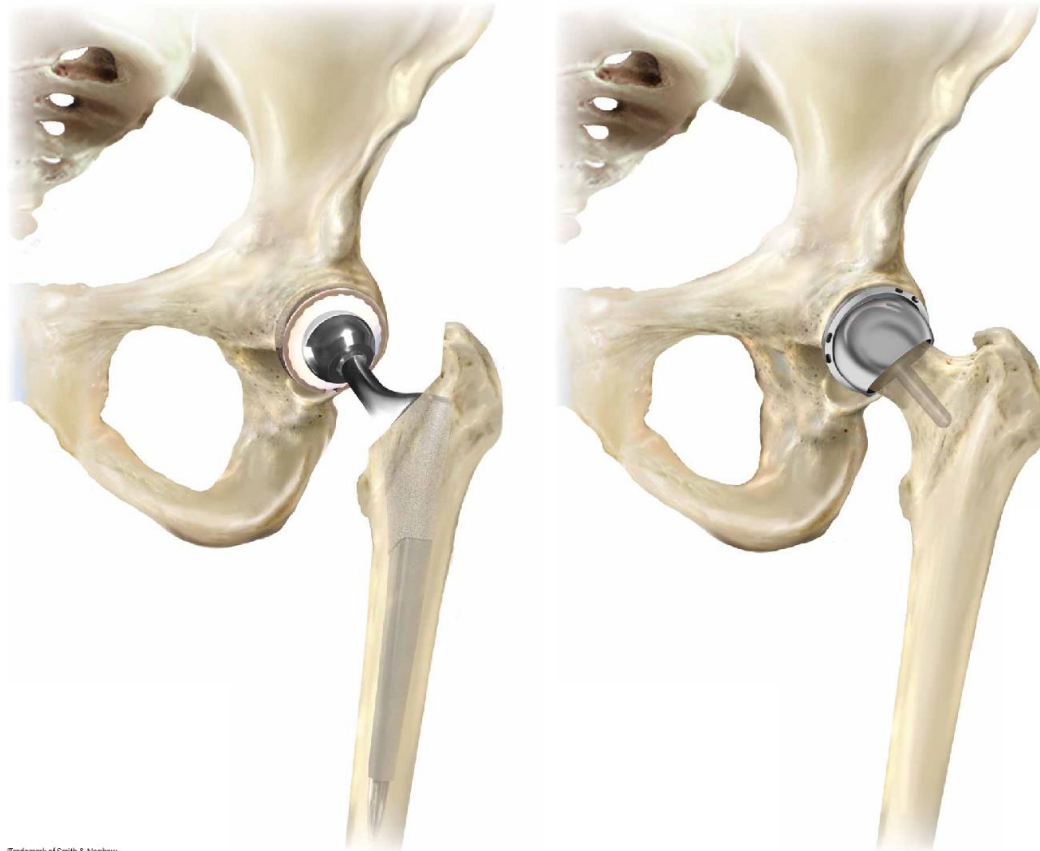




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Smith & Nephew's Birmingham Hip

Total hip vs. BHR[◇] System



Trademark of Smith & Nephew.



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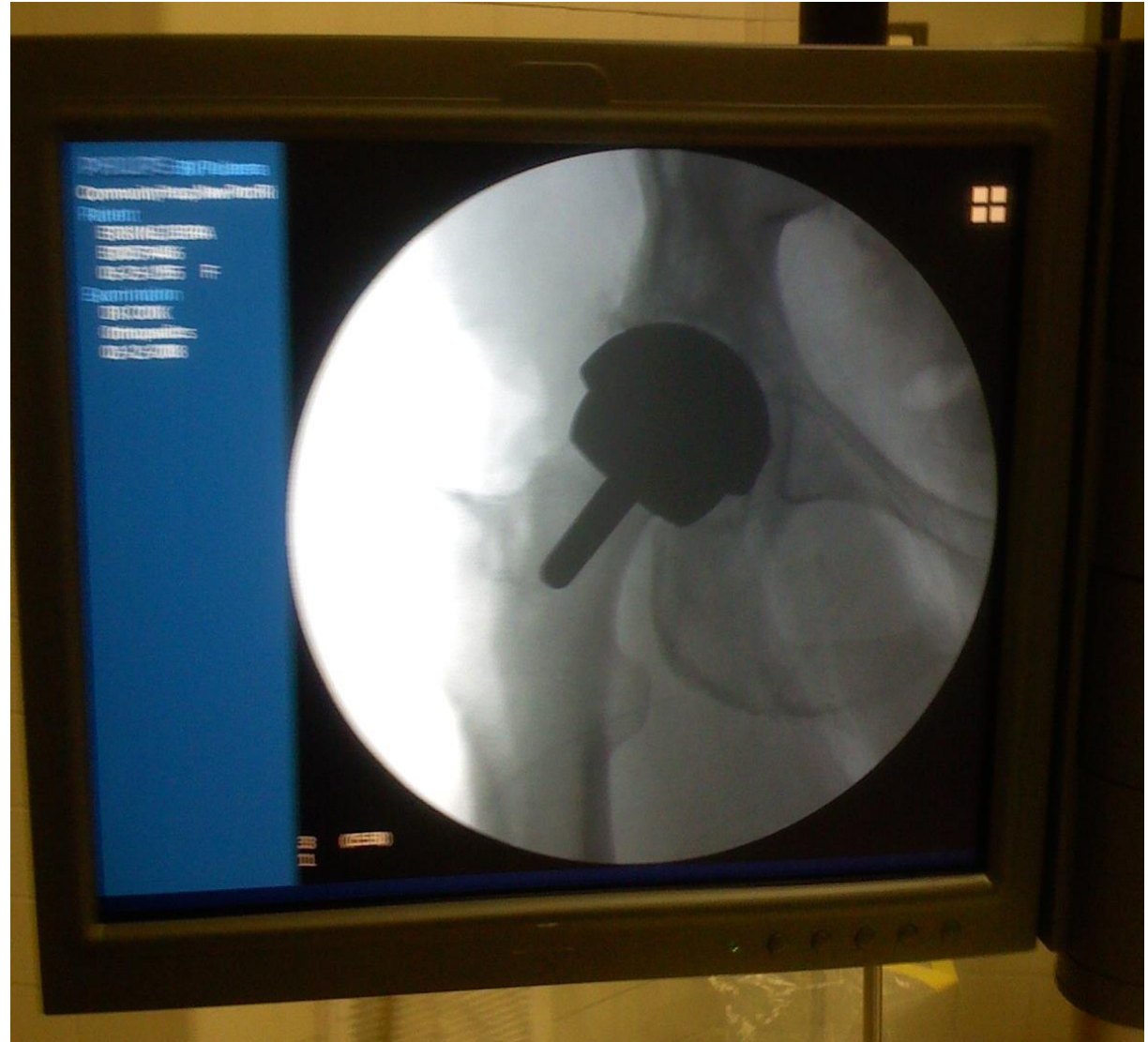
Smith & Nephew's Birmingham Hip





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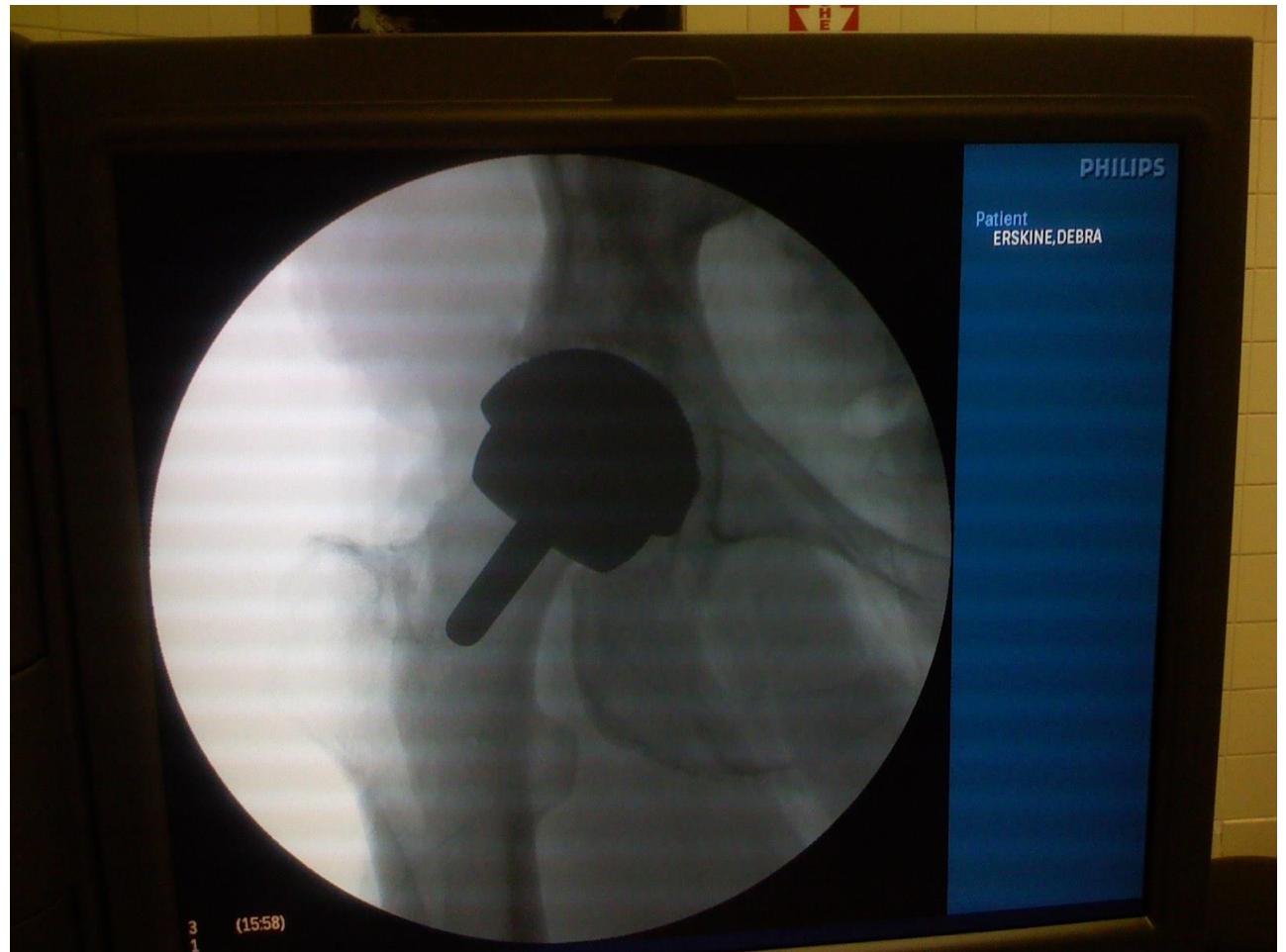
Smith & Nephew's Birmingham Hip





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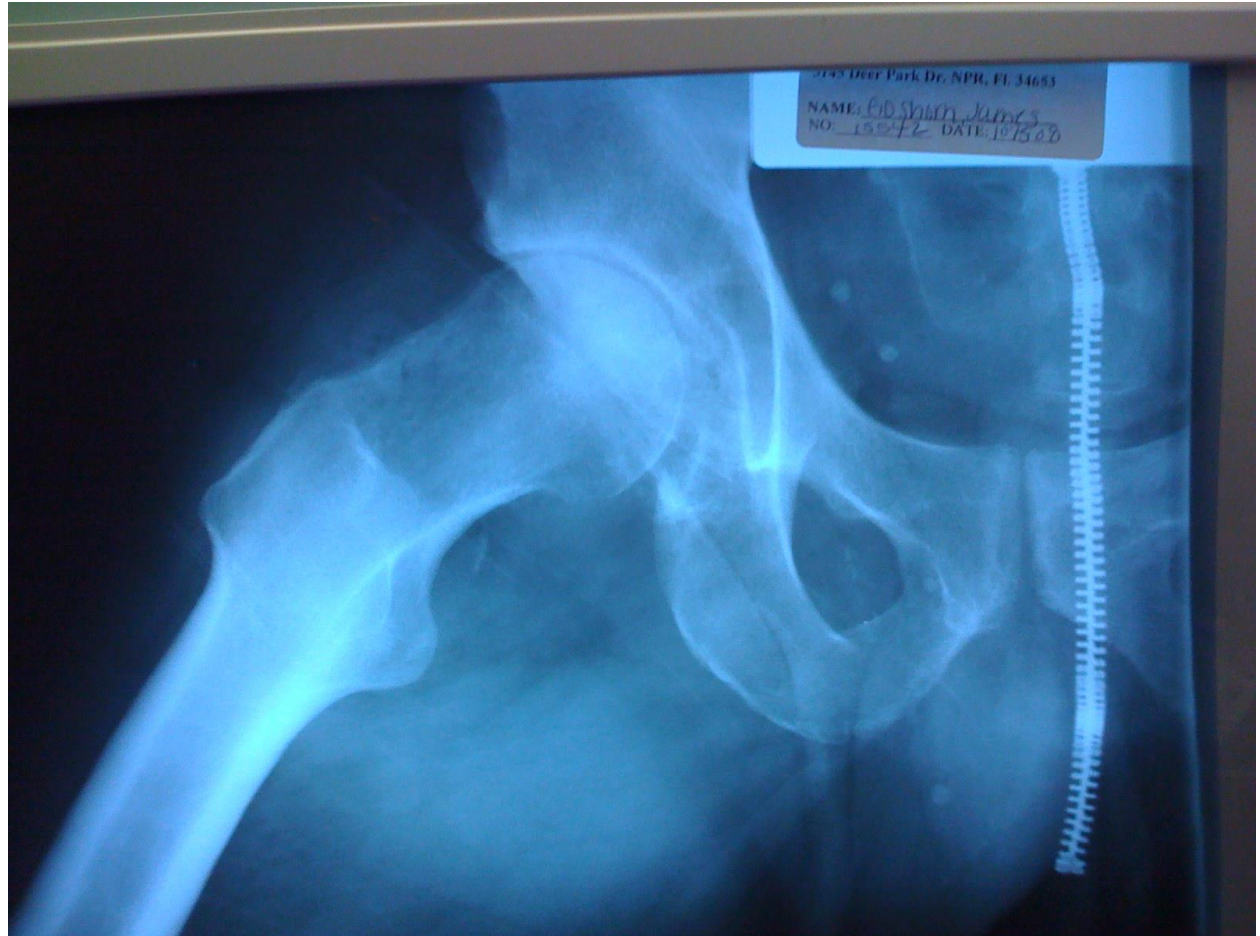
Smith & Nephew's Birmingham Hip





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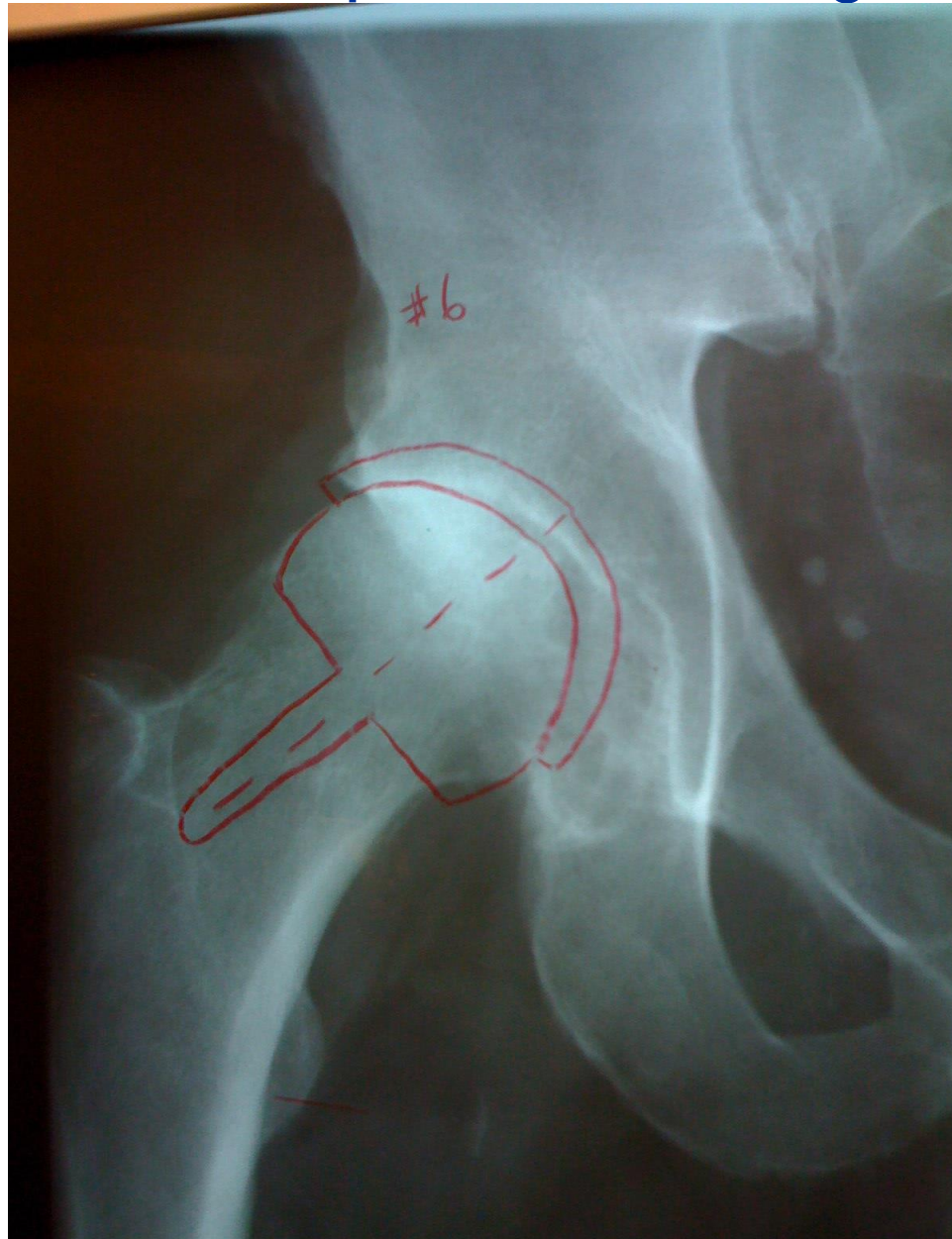
Smith & Nephew's Birmingham Hip





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Smith & Nephew's Birmingham Hip



A BHR should be as 'stable' as a normal hip.
This is true if the following criteria are met.

- 1. Native angles, inclination , offsets and all anatomical parameters have to be replicated.** If this is not done fully and only accuracy of say 80% is obtained - then the stability is likely to be approx in the region of 80% only.
- 2. The capsule should be repaired to capsule preferably as it restores the joint 'proprioception' (or position sense).** This would kick in the event of a potential dislocation as it would in a normal hip. If the capsule is repaired to bone , it is many times better than doing nothing but does not achieve the proximity to the stability of a normal hip.
- 3. Other factors that can potentially cause dislocation like impingement must be carefully addressed . The most common offender is the non -restoration of the head neck offset.** One must keep in mind that the BHR is the Ferrari of hips and the conventional THR is an old fiat.



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Durom™ Hip Resurfacing by Zimmer





Durom™ Hip Resurfacing by Zimmer

- The Durom Hip Resurfacing has been designed for use in young active patients who are likely to outlive a "conventional" hip prosthesis.
- Emphasis has been placed on a high quality bearing surface, preservation of bone stock and durable fixation of the components to the skeleton.
- Zimmer uses the Metasul bearing, which is a proven low wear, low-friction articulation for this implant.
- In the Metasul implant, the conventional plastic polyethylene insert has a cobalt chrome metal inlay. This helps minimize wear over time, potentially increasing the longevity of the implant.
- FDA approved.



Stryker's Corin Group PLC's Cormet Hip Resurfacing System



- Corin Medical, Ltd. makes the Cormet hip resurfacing implant. Stryker Corporation has an agreement to market Corin's Cormet hip resurfacing device in the United States.
- The Corin Cormet was approved for marketing in the United States by the FDA on July 3, 2007.
- 345 resurfacings were performed (294 patients, 51 bilaterals), no cases lost to follow-up, mean age at operation 52 years (21-74 years) & 65% were male.
- There were 11 failures and 3 non-implant related deaths.

Stryker's Corin Group PLC's (LSE: CRG) Cormet Hip Resurfacing System

- Metal on metal joint
- Large Femoral Head
- Bone conserving procedure
- Available 3rd quarter of 2007



Stryker's Corin Group

- Patient typically feel apprehensive after the surgery
- Make sure that you have been given full instructions about post-operative recovery.
- The post-operative regime, varies from surgeon to surgeon, so be sure to check and update your protocols
- Pt will be able to learn to climb stairs with crutches within a week.
- The patient will be to drive at about the six week post-operative check
- In three months most people are back at work, free of a cane or crutches and sleeping on the operated side.
- Improvement can continue for a year or more, depending on the patient's condition prior to surgery.

Rehab

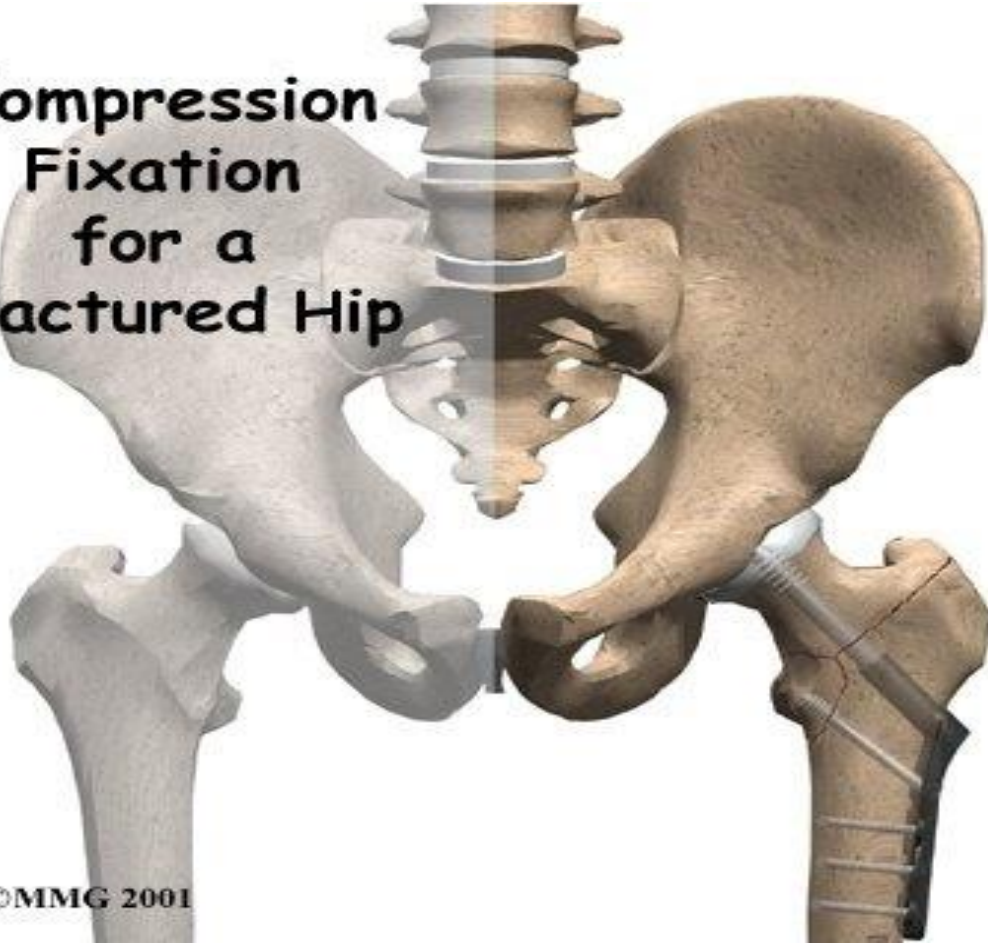
The following rehabilitation plan is intended simply as a general guideline for hip resurfacing patients which we hope will be helpful, but you must get specific instructions from the surgeon as to the appropriate rehabilitation regime he advises you to follow after your operation.

SEE HANDOUT

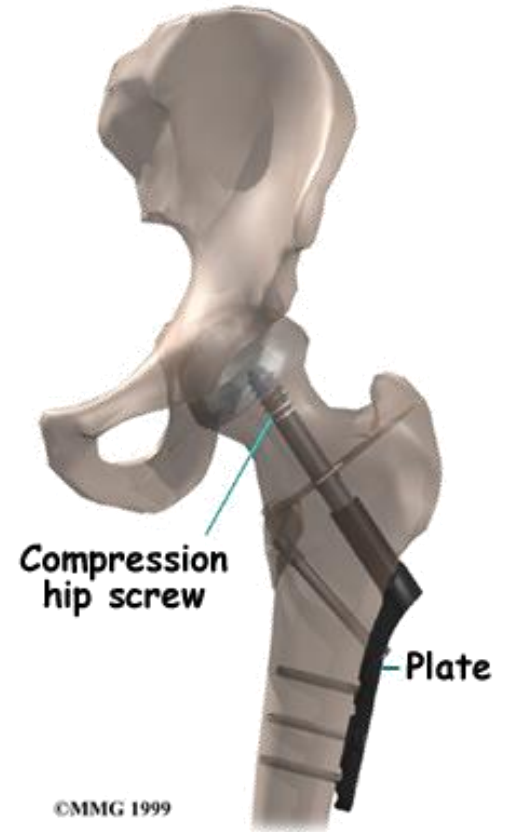


Hip Fracture Care

**Compression
Fixation
for a
Fractured Hip**



©MMG 2001



©MMG 1999

Fracture Care: The gamma nail

Indication:

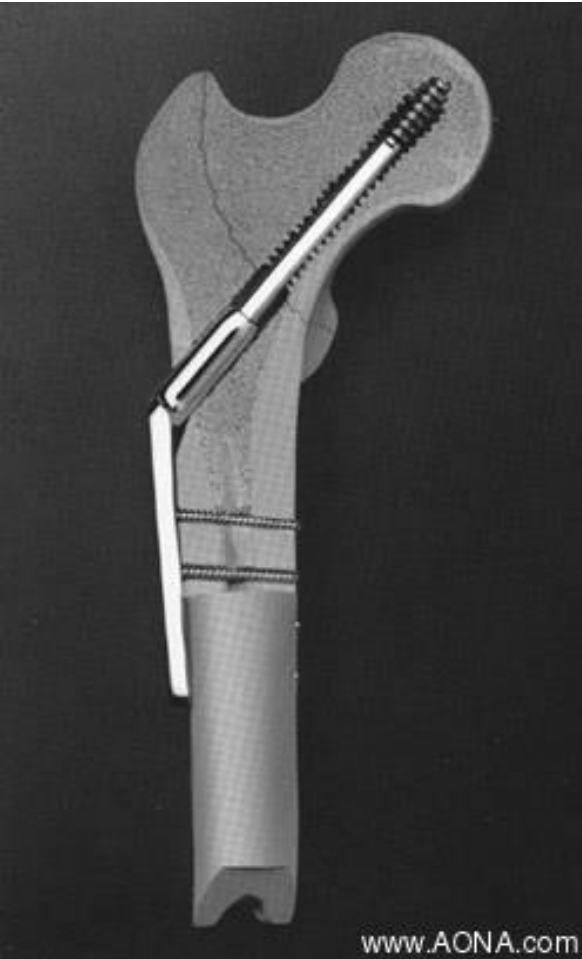
- subtrochanteric hip fx's
- Intertrochanteric fx's

Features:

- Allows for immediate WB
- Risk of distal fx
- Quick procedure (18min)



Fracture Care: Dynamic Hipscrew



- The Dynamic Hip Screw is designed to provide strong and stable internal fixation of a variety of intertrochanteric, subtrochanteric and basilar neck fractures, with minimal soft tissue irritation
- The Dynamic Hip Screw (DHS) is widely accepted in the treatment of intertrochanteric fractures of the proximal femur. The telescoping screw and plate allows collapse and impaction of the fracture leading to greater construct stability. The commonest mode of failure is cutting out of the screw from the femoral head, with a reported incidence of 2.25% to 12.6%. Fracture reduction and implant placement have both been shown to affect the rate of failure by cutting out. However, conflict exists in the literature as to the optimal reduction and screw placement to prevent failure.

Fracture Care: Dynamic Hipscrew



Principle:

- The goal of treating fractures in the trochanteric region is to restore the medial support in line with Shenton's arch.
- The function of the compression trabeculae is insured by a screw introduced into the femoral head and neck.
- The shaft of the screw slides in a tunnel which forms part of the side plate.
- This permits early loading with impaction of the fracture without danger of the screw perforating the femoral head.
- The design of the screw shaft and the tunnel prevent rotation of the head fragment.
- This device does not function as a load-bearing but as a load-sharing implant. Load transmission occurs mostly through bone.

The Variable Hip Screw (VHS)



- The VHS® Variable-Angle CHS System takes the time proven technology of hip fixation to the millennium.
- Optimal implant-to-patient fit. No longer is the surgeon limited by the pre-established intraoperative constraints of a fixed neck-shaft angle device
- The VHS® System allows for compression and valgus reduction of the fracture after fixation is achieved
 - Promotes reduced O.R. Time
 - Uncompromising Surgical Latitude

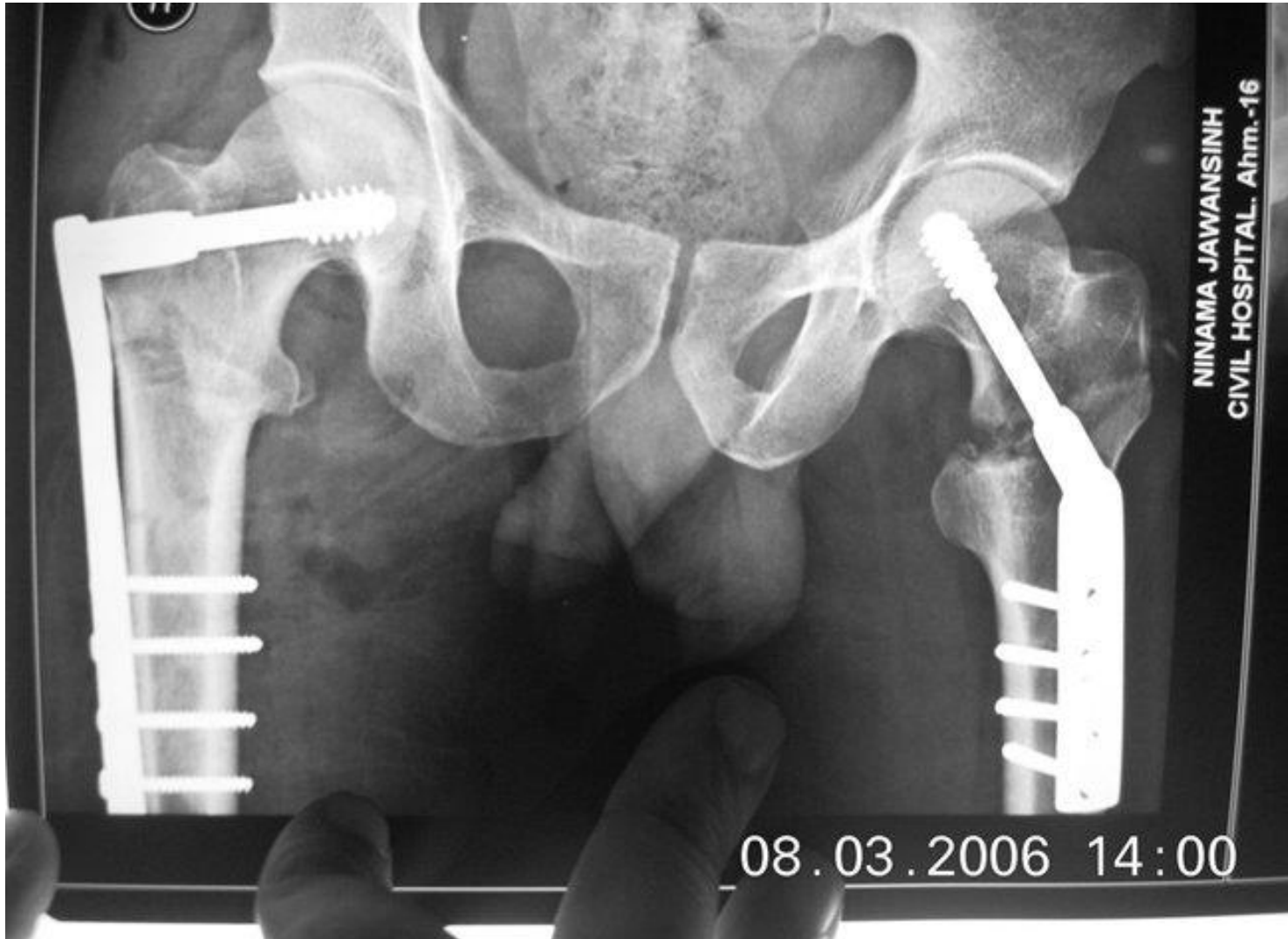


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Complications



DHS vs. VHS



The Knee

Here we'll take a close look at orthopedic technologies currently knee disorders.

We'll discuss the following knee procedures

- Arthroscopy
- Total Knee Arthroplasty
- Genderknee
- Minimally Invasive Surgery
- Partial Knee Arthroplasty

Joint Cartilage

Cartilage

- Cartilage is usually found in close association with bone in the body
- It is a type of connective tissue which is tough, semi-transparent, elastic and flexible
- The matrix or ground substance of cartilage consists mainly of glyco-protein material, chondroitin
- The cartilage cells (chondrocytes) lie scattered in the matrix
- Cartilage is covered by a dense fibrous membrane, the perichondrium
- No nerves or blood vessels occur in cartilage.

Joint Cartilage

Hyaline Cartilage

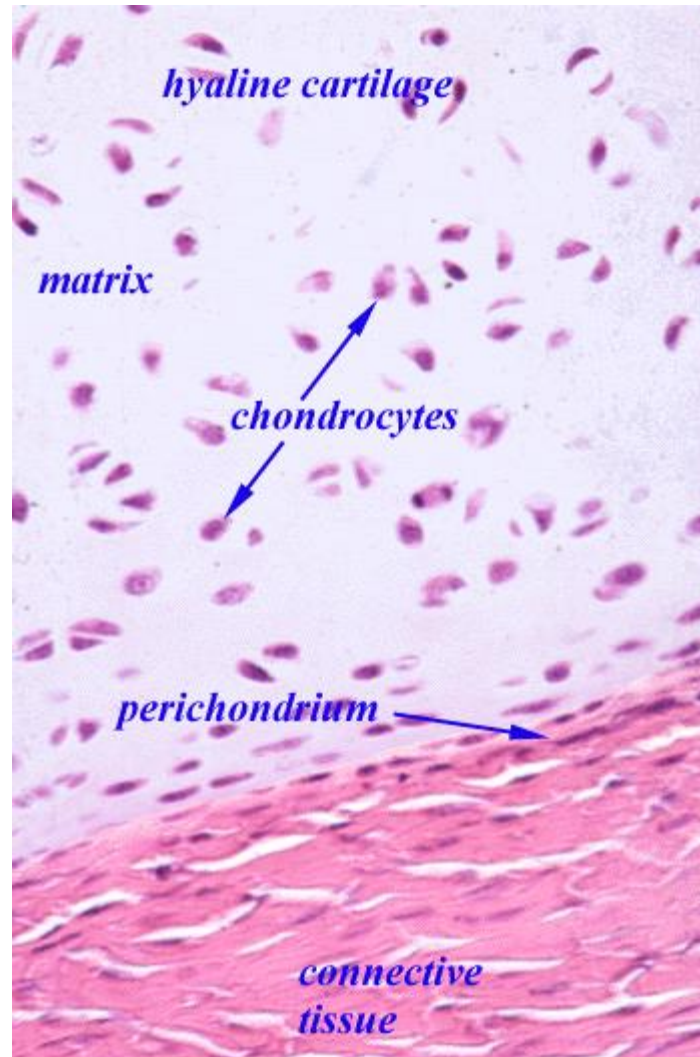
- Hyaline cartilage is semi-transparent and appears bluish-white in color
- It is extremely strong, but very flexible and elastic

Functions:

- Reduces friction at joints.
- Allow for movement
- Growth: Hyaline cartilage is responsible for the longitudinal growth of bone in the neck regions of the long bones.

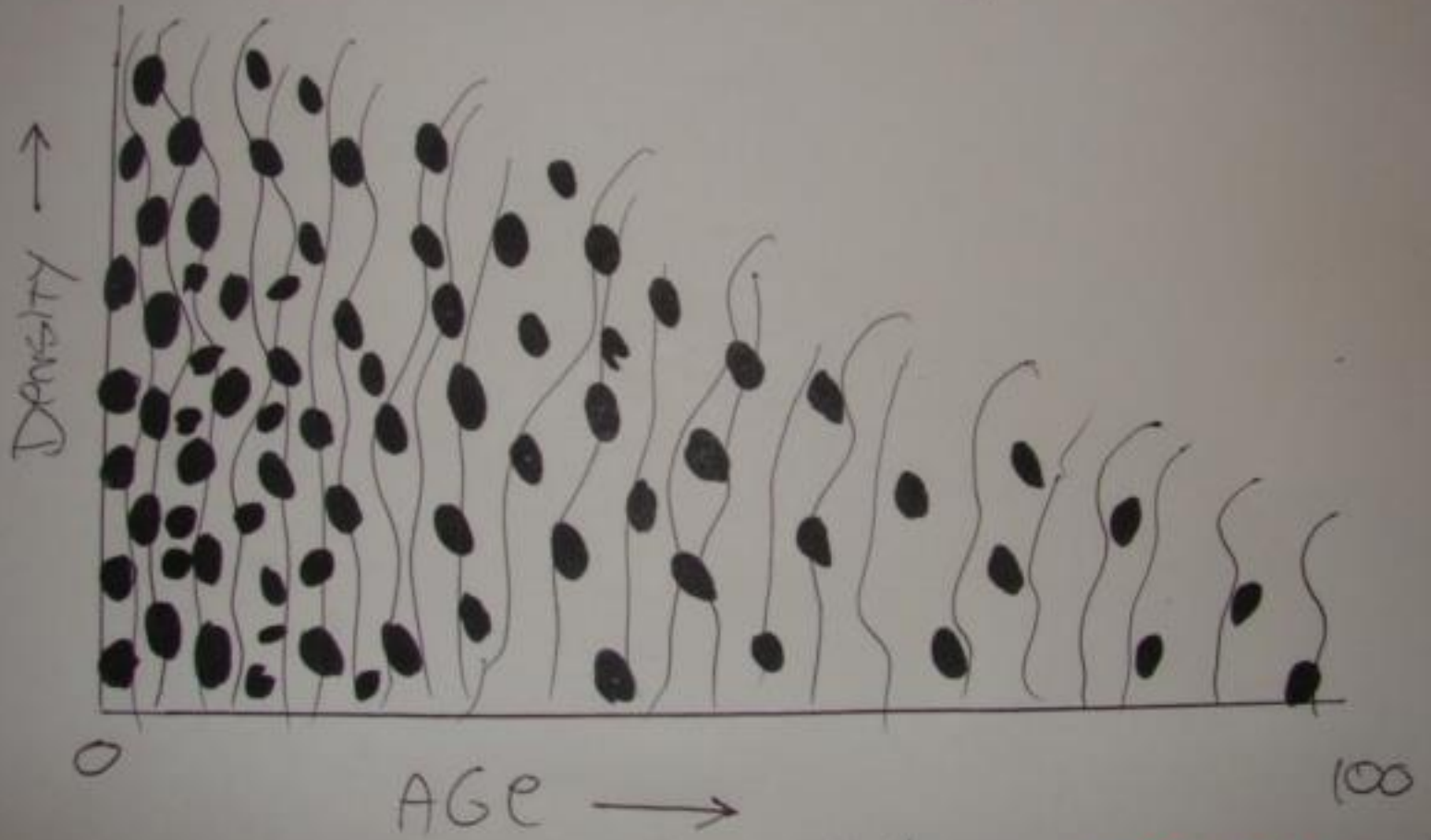


Joint Cartilage





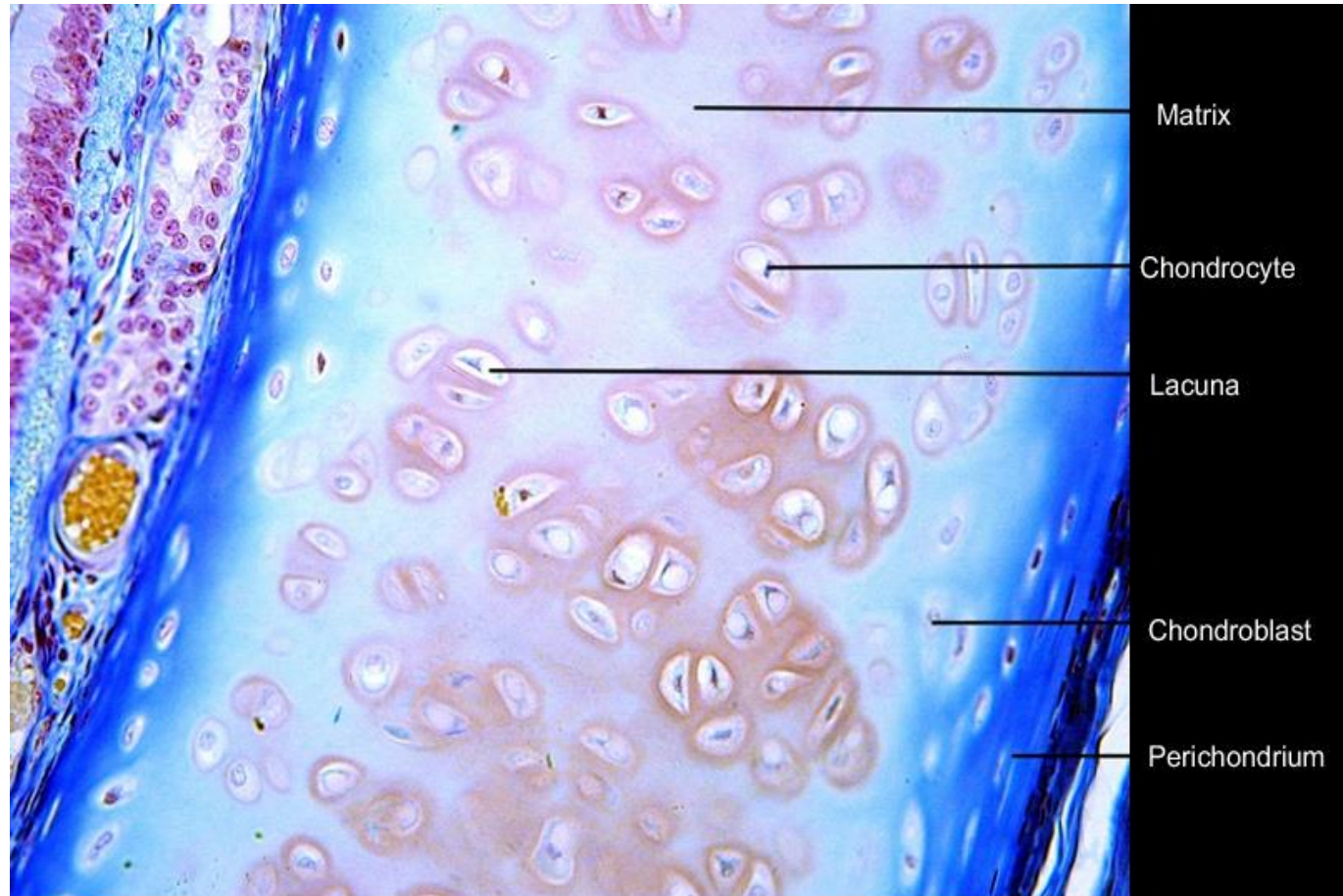
See Weed Comparison



● CHONDROCYTES: Produce All the components of cartilage



Joint Cartilage



Hyaline Cartilage (400x)

This cartilage type is found on the ends of articulating bones, in the nose, trachea, bronchi, costal cartilage, on the ends of articulating bones, and it makes up the embryological skeleton.

Joint Cartilage

GAG: Glycosaminoglycans

- Has a high molecular weight lending itself to high viscosity and excellent lubrication within the body.

Proteoglycans:

- Hyaline cartilage is the most abundant cartilage in the body. It serves to add structure and flexible support. The proteoglycans within the hyaline cartilage are shaped like a bottle brush, with hyaluronic acid making up the backbone of the brush. Without the strength of the backbone, the proteoglycan falls apart, leaving the cartilage to deteriorate.

Joint Cartilage

Synovial Fluid:

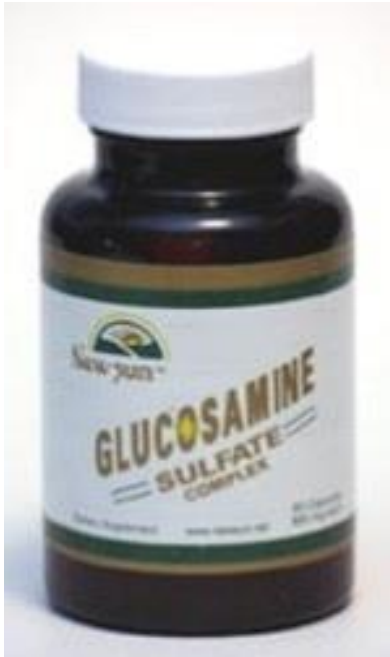
- The cartilage is avascular, as it contains no blood vessels. It is unable to be fed its needed supply of nutrients by the blood. It must be fed by the synovial fluid.
- The synovial fluid is produced within the synovial membrane and secreted to the extracellular space.
- Its main function is to act as a lubricant for the joints as it sits within the joint cavities.
- It also provides nutrients to the joints and the surrounding cartilage, as well as removes the metabolic waste produced by the cartilage.
- The most predominant glycosaminoglycan found within the synovial fluid is hyaluronic acid.

Joint Cartilage

Hyaluronic Acid:

- Without the appropriate levels of hyaluronic acid, the synovial fluid loses its ability to perform, thereby leaving the joints unprotected and the cartilage undernourished.
- Also found in the combs of roosters and makes for the injectable hyaluronic acid.

Glucosamine & Chondroitin Sulfate



- Glucosamine sulfate is a form of amino sugar that is believed to play a role in cartilage formation and repair
- Chondroitin sulfate is part of a large protein molecule (proteoglycan) that gives cartilage elasticity.
- chondroitin sulfate is a complex carbohydrate that helps cartilage retain water
- As we age, glucosamine declines in concentration in the joint.
- They are both extracted from animal tissue: glucosamine from crab, lobster or shrimp shells; and chondroitin sulfate from animal cartilage, such as tracheas or shark cartilage.



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Complications





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Complications



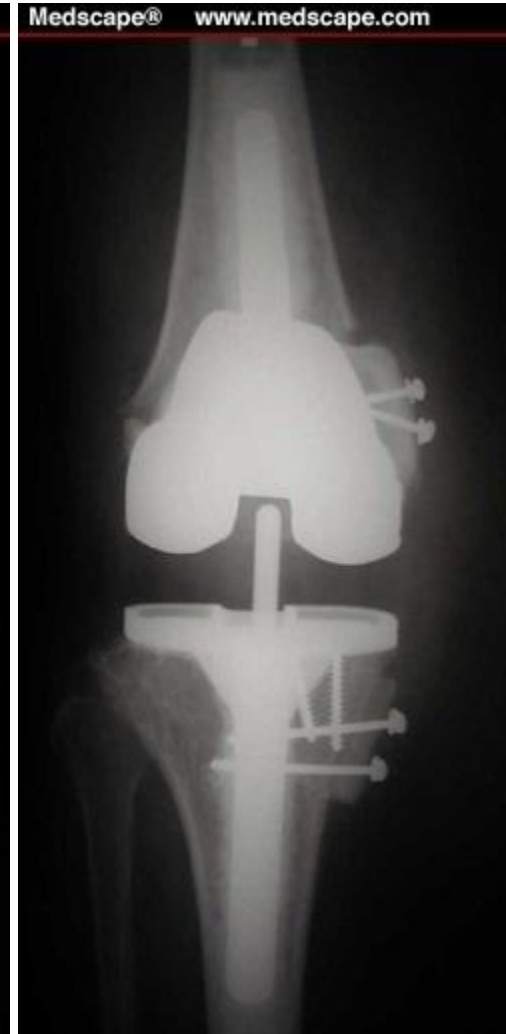
Normal knee



Osteoarthritic
knee



Complications





Complications





Complications



Complications



Knee Arthroscopy

- Knee arthroscopy is surgical procedure in which a small camera is used to examine tissues inside the knee joint. Additional instruments may be inserted to repair the knee.
- Typically, there are three small incisions:
 - One for the instrument
 - One for the camera
 - One for the drain
 - The camera is attached to a video monitor, which the surgeon uses to see inside the knee. In some facilities, the patient can choose to watch the surgery on the monitor as well.

Knee Arthroscopy

- a local or regional anesthetic is administered, to numb the affected area. Sometimes general anesthesia might be indicated
- saline is pumped during in under pressure to expand the joint and to help control bleeding the procedure
- Commonly used instruments include
 - a blunt hook to pull on various tissues
 - a shaver to remove damaged or unwanted soft tissues
 - a burr to remove bone (osteotomy)

Knee Arthroscopy

- A heat probe may also be used to remove inflammation (synovitis) in the joint

Indications:

- A torn meniscus (either repair or remove)
- Mild arthritis
- Loose bodies (small pieces of broken cartilage) in the knee joint
- A torn or damaged anterior cruciate or posterior cruciate ligament
- Inflamed or damaged lining of the joint (synovium)
- Misalignment of the knee cap (patella)

Knee Arthroscopy

Risks:

- Allergic reactions to medications
- Problems breathing (with general anesthesia)
- Bleeding in the joint (hemarthrosis)
- Infection
- Damage to the cartilage, meniscus, or ligaments in the knee
- Failure of the surgery to relieve symptoms
- Knee stiffness

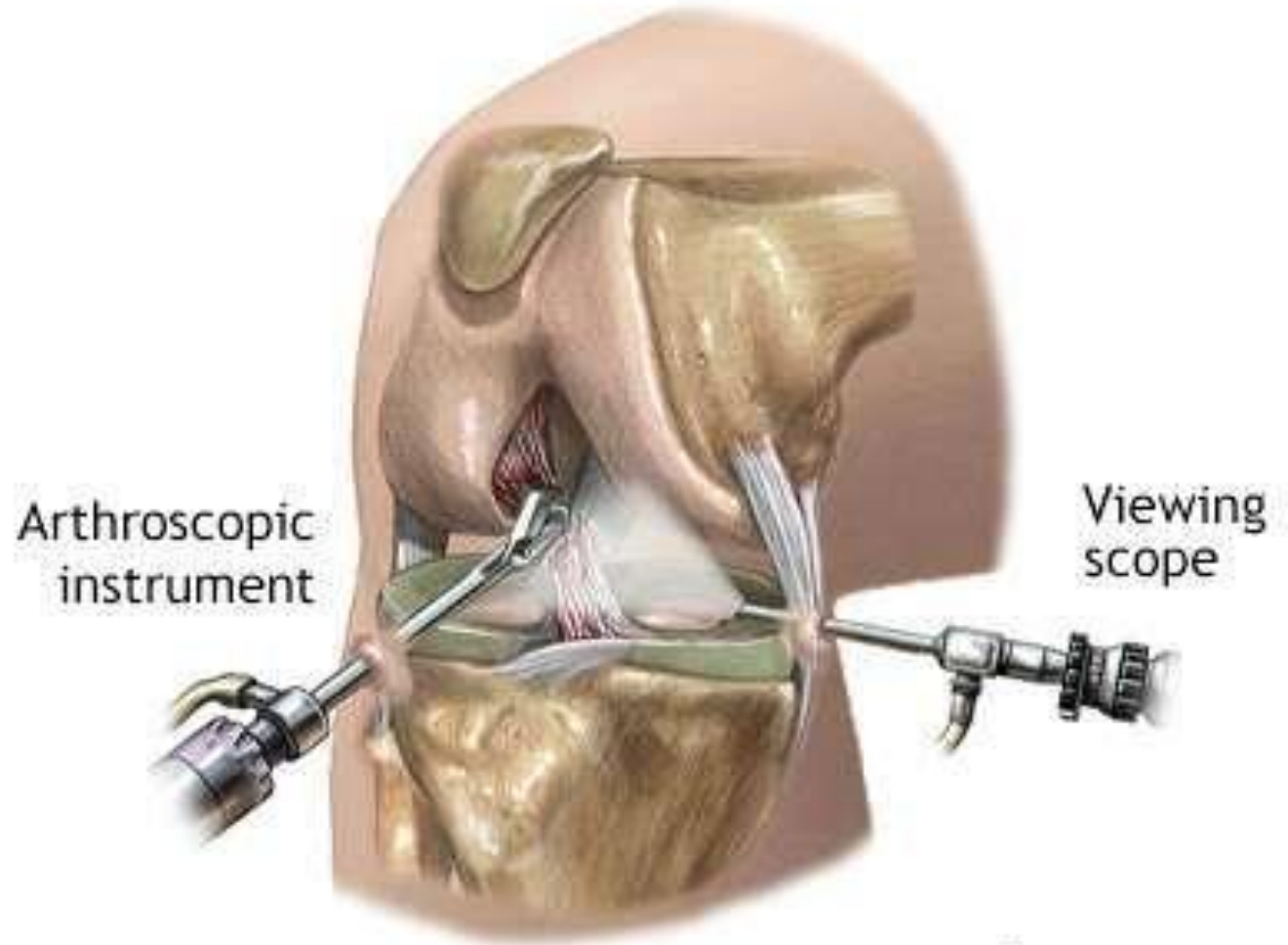
Knee Arthroscopy

Expectations after surgery

- Less pain and stiffness
- The presence of arthritis dramatically reduces the effectiveness of arthroscopy and up to 50% of patients may not improve post-operatively
- Arthroscopic or arthroscopic-assisted surgery done to repair the meniscus or reconstruct ligaments in the knee is much more complicated with prolonged recovery and more variable results
- For a simple meniscal cleaning (debridement), recovery is usually quite rapid



Knee Arthroscopy



Knee Arthroscopy

Post-op Rehab.

- Generally, an aggressive rehab approach can be taken
- No major precautions or contra-indications are present and ROM and strength can be progressed as tolerated
- One primary goal following surgery is to gain full passive knee extension
- Neuro-muscular quad control, is the key to facilitate a normal gait pattern
- Initially, focus should be on increasing VMO tone
Exercises should be geared toward quad strengthening in a pain-free range. Until swelling is minimal and the patient has a normal gait, prolonged standing and walking activities should be limited

Knee Arthroscopy

- Exercises should be geared toward quad strengthening in a pain-free range. Until swelling is minimal and the patient has a normal gait, prolonged standing and walking activities should be limited
- Patellar mobilizations and scar massage are both necessary to regain full ROM.
- Advancement of exercises and activities is based on quad tone
- Always communicate with the surgeon about the protocol

Total Knee Arthroplasty

- As stated earlier, the Total Knee Arthroplasty has been around for 50 years. A lot has changed since the initial surgeries
- We will look at the different types of knees currently available.

Indications:

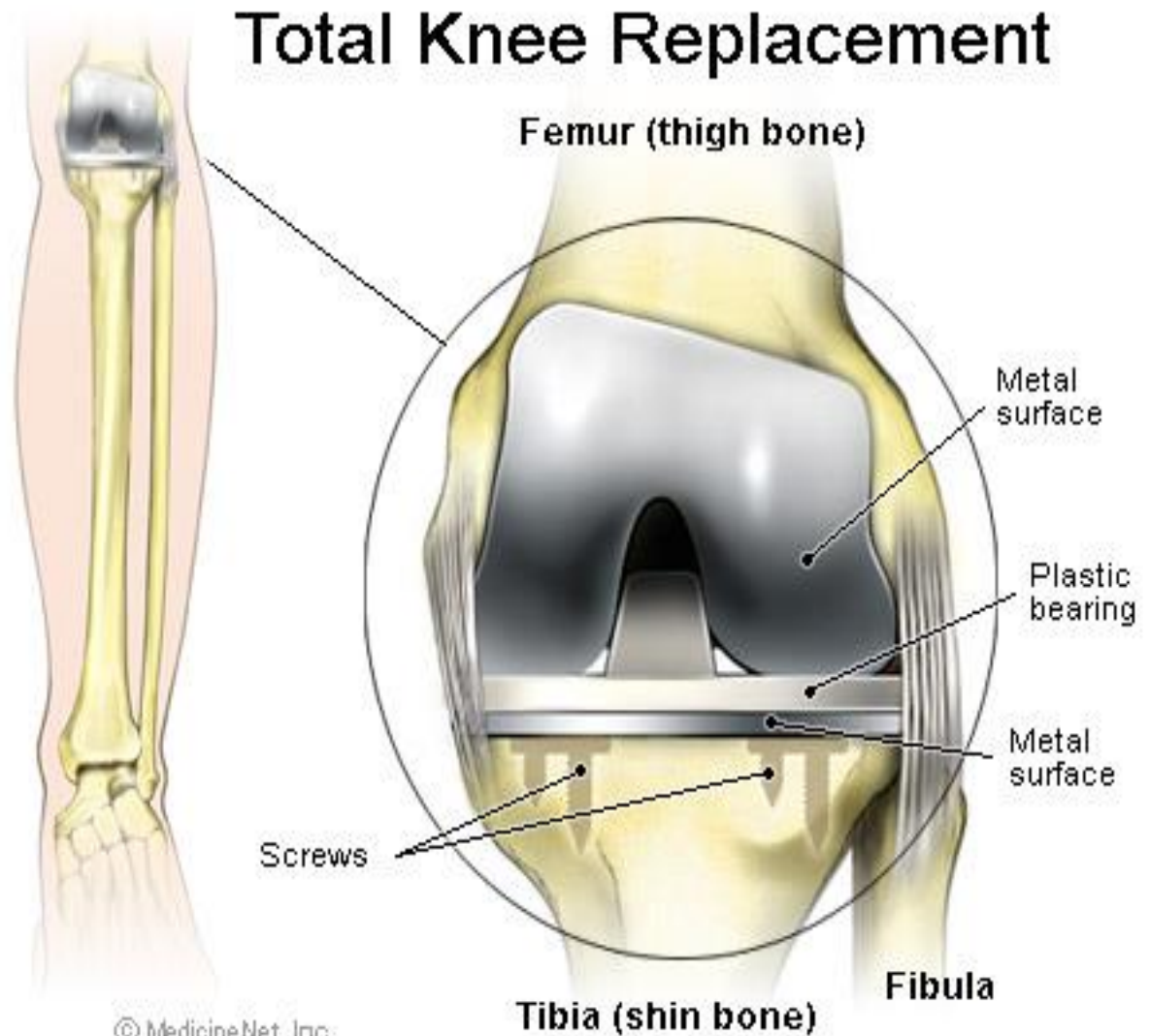
- Osteoarthritis: Wear and tear of the joint
- Rheumatoid Arthritis: Inflammation of the synovium
- Traumatic Arthritis
- Correction of varus, valgus, or posttraumatic deformity

Total Knee Arthroplasty

Typical symptoms, patients present with prior to a TKA:

- Severe knee pain that limiting ADL activities
- Moderate or severe knee pain while resting
- Chronic knee inflammation and swelling that doesn't improve with rest or medications
- Knee deformity--a bowing in or out of your knee
- Knee stiffness

Total Knee Arthroplasty





- Anesthesia
- Preparation and draping
- Tourniquet
- Incision, exposure of the joint
- Dislocation of the patella laterally to get to the joint.
- Preparing of the femoral surface using templates
- Preparing of the tibial surface using templates
- Use of trials to accurately measure correct implant size
- Implants go in

Total Knee Arthroplasty: Sequence of events

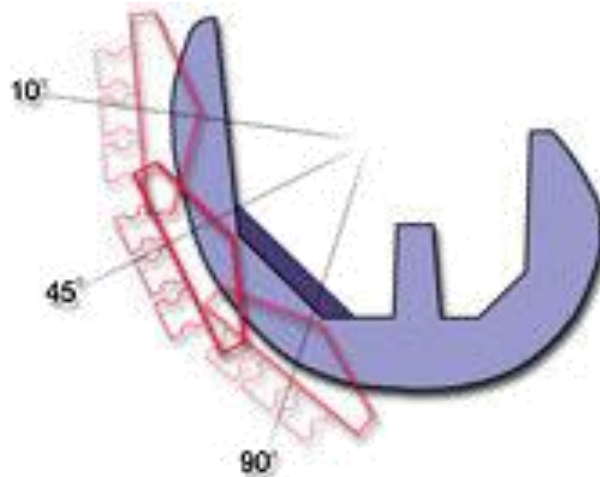
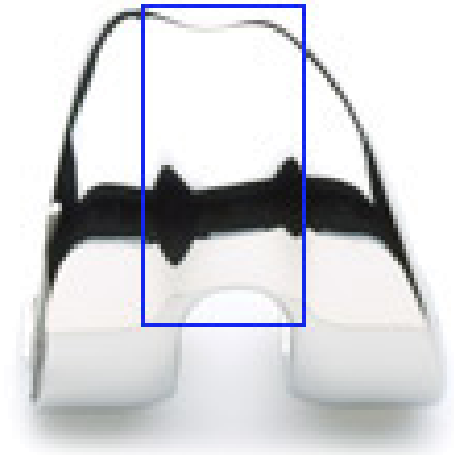
- Knee cap gets replaced
- Closure of synovium and fascia after the drain and pain pump are inserted.
- Closure of skin
- Total surgeon time: 45-60 minutes
- Total OR time for the patient: 120 minutes

Total Knee Arthroplasty

- The posterior cruciate ligament is a tissue that normally stabilizes each side of the knee joint so that the lower leg cannot slide backward in relation to the thigh bone.
- In total knee replacement surgery, this ligament is either retained, sacrificed, or substituted by a polyethylene post. Each of these various designs of total knee replacement has its benefits and risks



Total Knee Arthroplasty: Alignment



Joint alignment follows the same principals as aligning your tires: if joints are out of alignment, one side is going to wear down → Varus/Valgus

Total Knee Arthroplasty: Alignment

Alignment is crucial. If the knee joint is not aligned correctly during total knee replacement:

- Decreased ROM
- Patellar wear: The patella acts as a delicate balancing point for the muscles that propel the knee in motion. If it's out of balance, it won't be able to leverage the same degree of movement, and the added stress can eventually wear it down.
- Instability: If the implant doesn't fit correctly it will become unstable

Total Knee Arthroplasty: Bone Preservation

- Bone is living tissue and like most living things, needs stimulation to stay healthy.
- A challenge in knee implant design is not to let the implant do all the work. If the implant overly shields the bone from stress (“stress-shielding”), bone can be resorbed or broken down by the body, resulting in bone loss for the patient. Think about Wolff’s Law
- On the other hand, if the bone is required to take on too much stress, abnormal growth can occur – called “adaptive remodeling.”

Total Knee Arthroplasty: Stability

- 99% of the surgeons will sacrifice the ACL
 - It is too damaged
 - It gets in the way during the surgery
- To compensate for the ACL, the knee implant includes a tibial insert to provide stability
- The decision whether or not to sacrifice the PCL is more subjective, depending upon surgeon philosophy, functionality, etc
- Some surgeons want to retain as much of the natural anatomy as possible. Others feel that a partially damaged ligament (as is usually the case) is unpredictable after surgery

Total Knee Arthroplasty: Stability

If the PCL is sacrificed, it must be substituted

- Some implants offer varying degrees of stability in its knee implant designs to compensate for deficient ligaments
- minimum thickness for patients with good quality ligaments to the posterior stabilized design (bottom left) to provide the most stability for patients whose PCL's have been sacrificed.





Total Knee Arthroplasty: ROM

- Goal is always to gain as much ROM as possible (93 degrees AROM for ADL's)
- CPM; yes or no?
- Various types of implants with various ROM

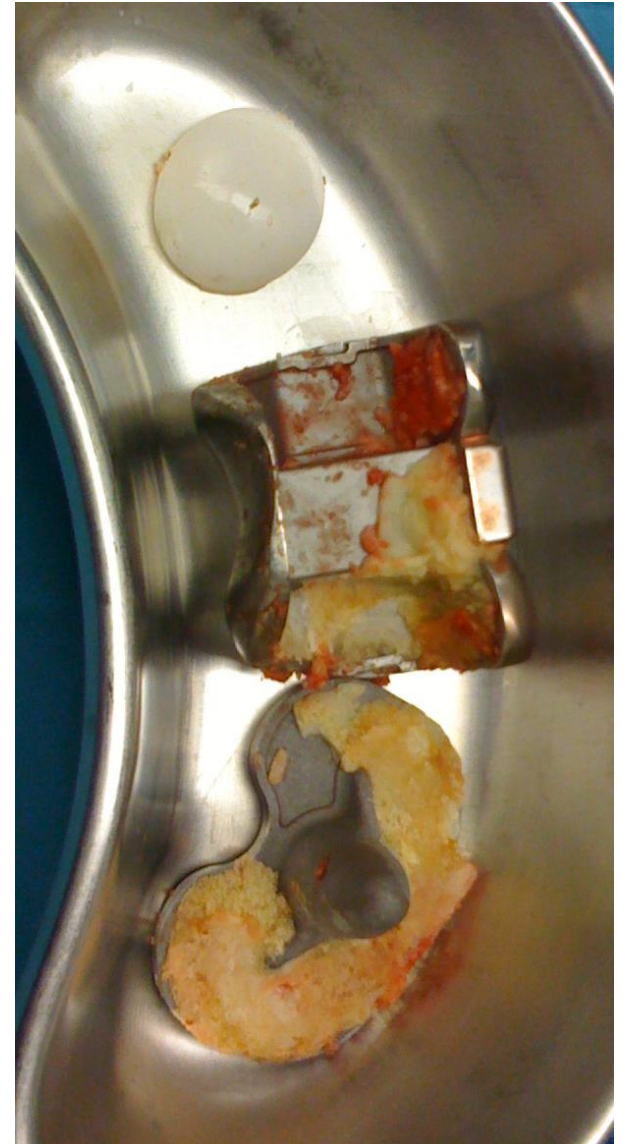
Total Knee Arthroplasty: Lifespan

- The longevity of a prosthetic knee varies from patient to patient.
- It depends on many factors
 - a patient's physical condition
 - activity level
 - body weight
 - the surgical technique.
- A prosthetic joint is not as strong or durable as a natural, healthy joint, and there is no guarantee that a prosthetic joint will last the rest of a patient's life. All prosthetic knees may need to be revised (replaced) at some point



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Total Knee Arthroplasty: Lifespan





The Knee: Total Arthroplasty options, sorted by vendor

- DePuy
- Biomet
- Stryker
- Smith & Nephew
- Zimmer

DePuy: P.F.C.® Sigma™ RP Knee System

- This is the world's leading mobile-bearing knee



- Are typically cemented

- The sweptback "keel" design provides rotational stability and facilitates placement of the implant into the prepared proximal tibial plateau.

- The "peripheral rib" stem design is identical to the time-tested LCS tray

- Cobalt chrome to reduce wear (it's more polished than Titanium)

Biomet: AGC® Total Knee System

Design Rationale: Tibio-femoral articulation allows for full interchangeability between femoral and tibial components. The AGC® Knee offers a one-piece molded tibial component with a durable cobalt chrome femoral component as well as modular capability, for increased sizing





Biomet: AGC® Total Knee System

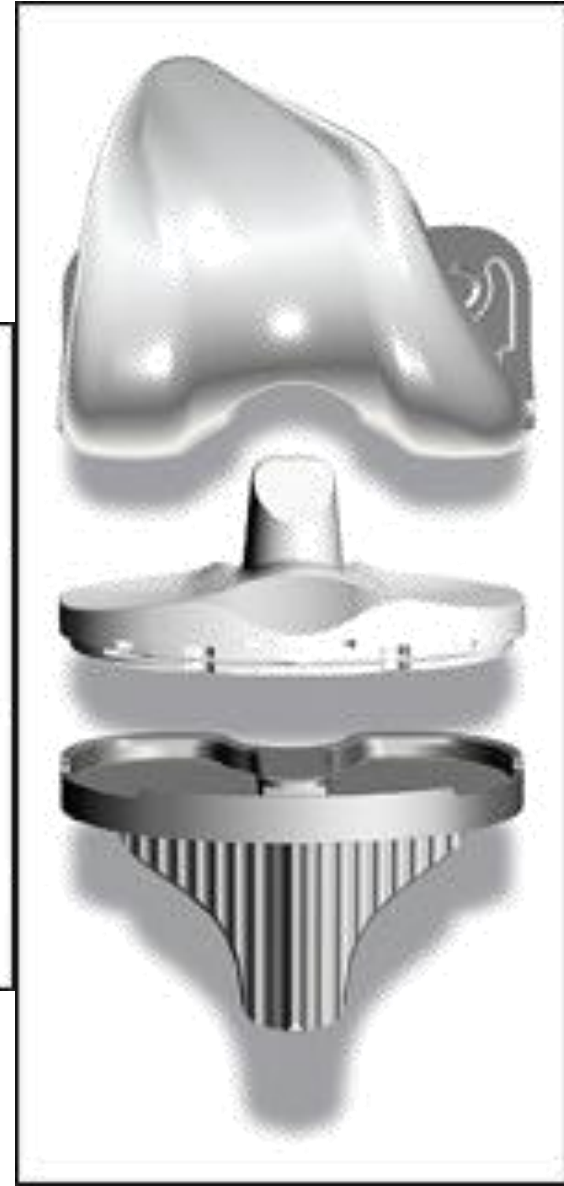
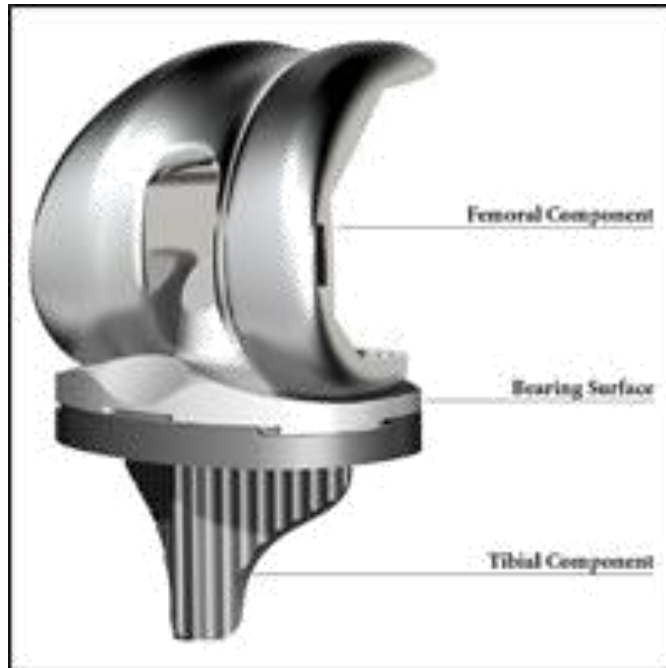
History: Has been implanted since 1983 with 98% survivorship at 15 years..

- Components are available in a variety of designs and size ranges intended for both primary and revision applications
- Cruciate Retaining
- Posterior Stabilized



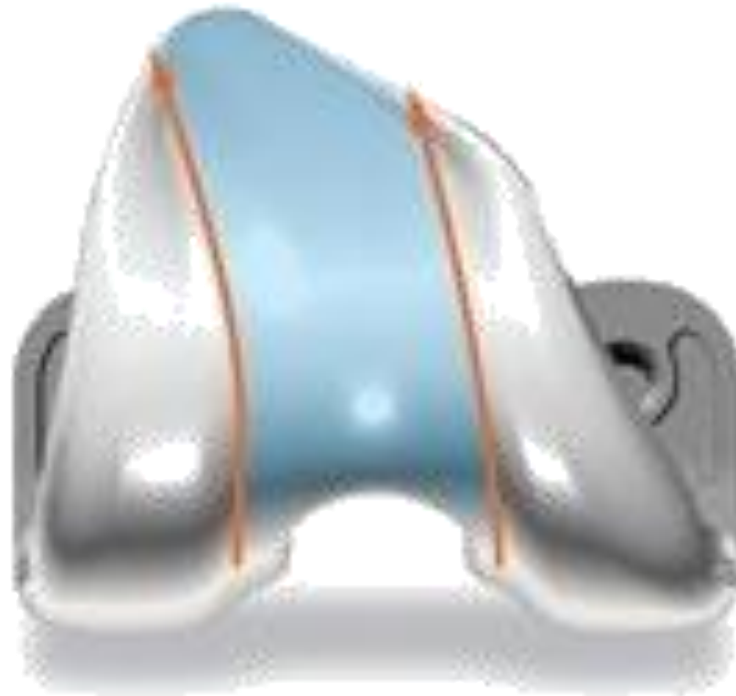
Stryker: The Triathlon® MIS Total Knee Arthroplasty

- Increased Motion
- Better Fit
- Reduced Wear



Increased motion:

- High Flexion Knee System Designed for Mobility with Stability Through 150 Degrees of Motion
- The deep flexion features of the components are designed to maximize rotation in deep flexion without sacrificing stability
- Studies have shown that patients achieve 12-15% increase in motion after one year



Anatomic Patellofemoral Track

The Triathlon® Knee patellofemoral track has the industry's lowest revision rate (0.3%) to date to this knee system.

Stryker: The Triathlon® MIS Total Knee Arthroplasty

Better fit:

- Designed with a wide range of sizing options, based on the anatomical differences of men and women
- The unique 7-degree anterior flange design of the Triathlon® Knee System is designed to provide the flexibility to downsize the femoral component while avoiding the incidence of notching



Reduced Wear

- The durability of knee implants is dependent on clinical factors such as patient weight, age, activity, as well as on the bearing material in conjunction with the appropriate balance of conformity and constraint
- Very stable joint through the Rotary Arc design, yes allowing for full ROM of up to 150 degrees. This Arc design reduces rotatory stress and increases surface contact, reducing wear.

Smith & Nephew

Recall!:Oxinium Genesis II and Profix II implants

Reason: They did not bond properly

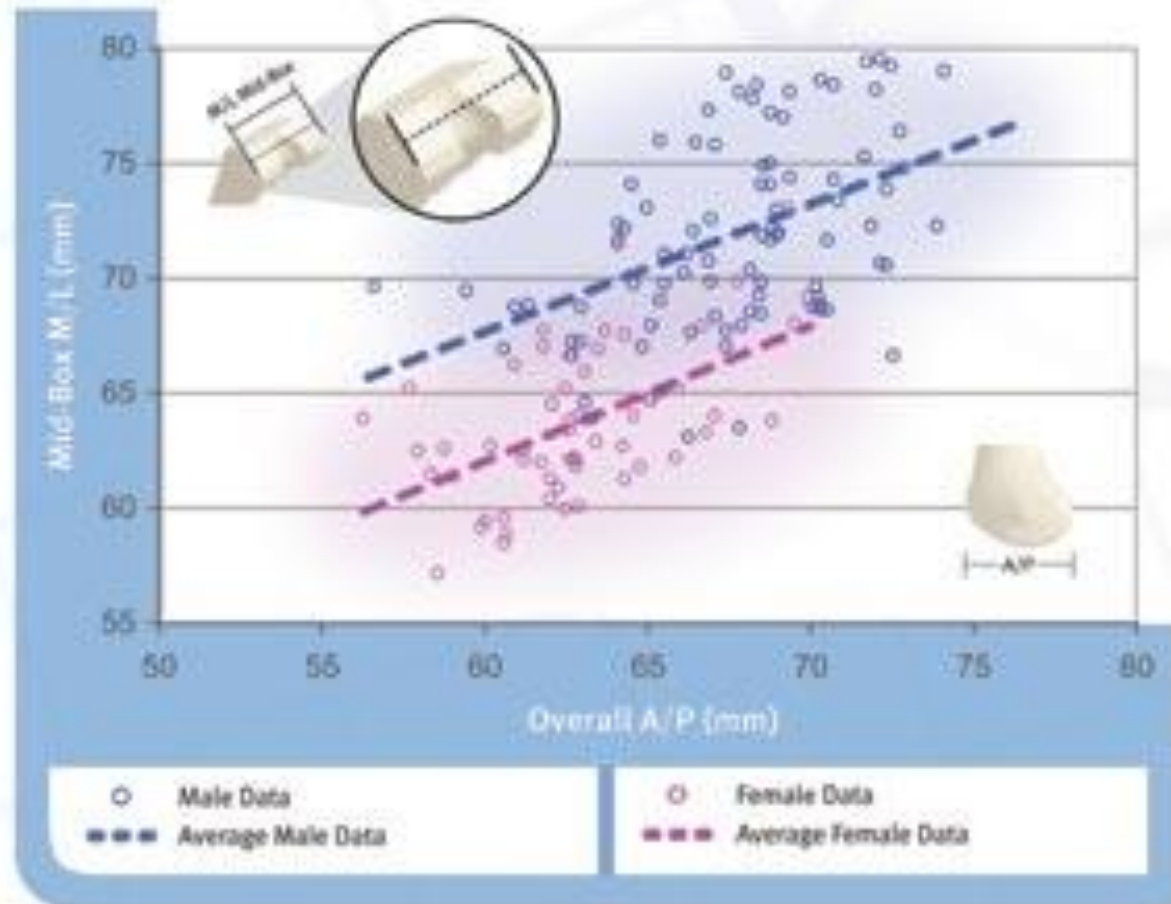
Results:

- Lawsuits
- Revisions
- Bad rep for the whole industry

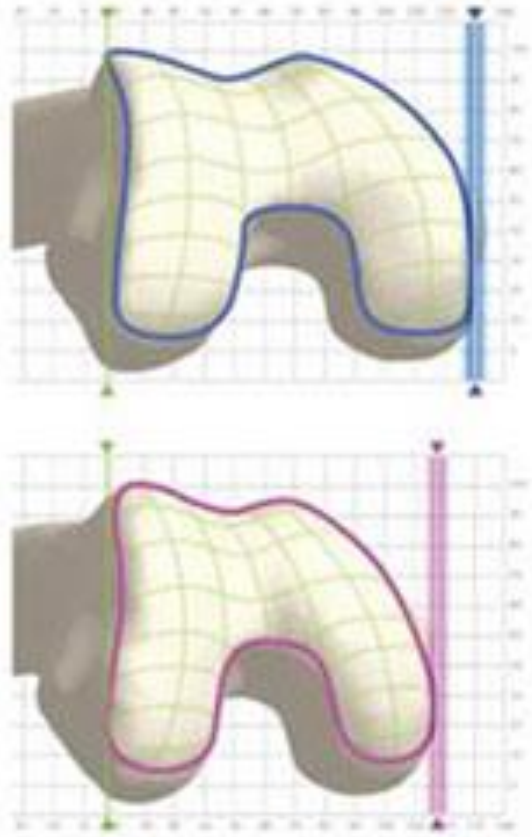


- Wear testing has indicated that OXINIUM total knee implants demonstrate the scratch and wear resistance necessary to be long lasting
- The smooth, hard surface of an OXINIUM total knee implant is the result of a process that allows oxygen to absorb into zirconium metal, which changes only its surface from metal to ceramic
- The ceramic surface makes OXINIUM implants 4,900 times more abrasion resistant than cobalt chrome and reduces friction between the implant and plastic surface

Mid-box M/L vs. overall A/P

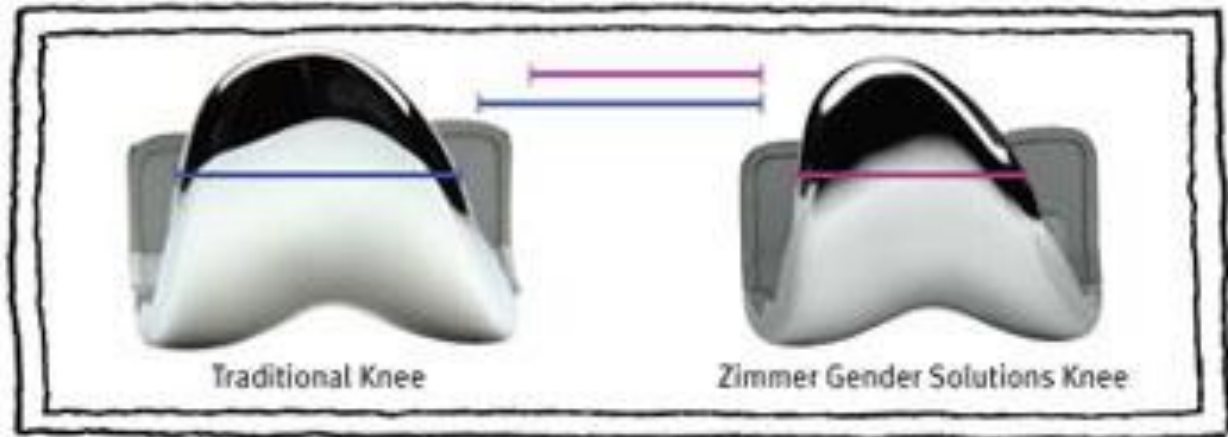


Zimmer:Zimmer[®] Gender Solutions[™] NexGen[®] High-Flex Knee



- More and better sizing of the implant, reducing overhang
- Better Q angle

Zimmer:Zimmer[®] Gender Solutions[™] NexGen[®] High-Flex Knee



Minimally Invasive Surgery

- Quad sparing: Much faster recovery since the quadriceps muscle is spared
- Smaller, less conspicuous incision – 3 to 5 inches vs. 8 to 12 inches
- Less tissue trauma – the quadriceps tendon and muscles are avoided, rather than cut or manipulated
- Shorter total rehabilitation
- Less blood loss
- Less pain
- Shorter hospital stay
- Not always good visualization of the joint



Partial Knee Arthroplasty

Review Anatomy

Advantages:

- less tissue damage and therefore recovery is faster
- LOS is 1-2 days
- Immediate ROM improvement
- Medial more common than Lateral
- The design of the most common type of total knee replacement uses a mobile bearing which relies on the medial collateral ligament to keep it in place. This gives rise to one of the more common complications of partial knee replacement, which is dislocation of this bearing



Partial Knee Arthroplasty

- Partial knee replacement of only the lateral compartment is possible, but more commonly uses a bearing that is not mobile.
- Mobile bearings in a lateral partial knee replacement are more likely to dislocate
- Patellofemoral partial knee replacement.
- Currently only one vendor has a a partial that replaces the patellofemoral joint as well.

Stryker: EIUS® UKR and the AVON™ PFJ

- Stryker has a separate PKR and a separate PFJ
- Arthritis in the PFJ increases the revision rate of a PKR by 40%



PFJ



PKR

Biomet: Oxford® Partial Knee System



- Claimed to be “The only true mobile meniscal bearing knee system approved for use in the U.S”
- Minimally invasive
- Resurfacing technique with no large femoral bone cuts
- Restore the anatomic joint line
- Preserve bone stock
- Minimum replacement of the damaged cartilage surfaces
- Preserve ligaments, opposite compartment, and patello-femoral joint providing natural motion and a more normal feeling knee
- Much cheaper for the hospital



Smith & Nephew Journey Deuce Knee System

- The JOURNEY DEUCE Knee System is a new, innovative solution that may give nearly 70% of all patients receiving a total knee replacement a more minimally invasive, bone and ligament preserving treatment alternative.
- The implant is called the "DEUCE" because it replaces only the two areas of the knee most commonly affected by osteoarthritis while keeping the third area intact.
- Retention of ACL/PCL
- 155 degrees of flexion



Benefits:

- ACL and PCL sparing
- Less bone removal than a traditional TKA
- Can be done with an MIS technique
- Expected rehabilitation times similar to a uni-compartmental knee
- Expected blood loss similar to a uni-compartmental knee
- Expected kinematics similar to a uni-compartmental knee



Unicompartmental Spacer



a uni-spacer -- a metal disc that is shaped like an articular condyle and is placed between the sclerotic bone to unload the diseased compartment

There's been some initial enthusiasm over this, but studies have been conflicting. The designer reported an increase in function in 71% of his patients, but 21% needed to be revised within two years. In another study, 32 of 34 patients still had pain with ambulation, and there was no statistically significant improvement in functional or pain scores pre- and post-operative.



Ankle Replacement

- Now another aging joint is fast becoming a candidate for replacement. This year, **4,400 patients** are expected to undergo surgery to replace arthritic or injured ankles with artificial joints made of metal alloys and lightweight plastic, according to industry estimates
- Ankle replacement has been around for **three decades**, but it has been slow to catch on. Problems with early devices left surgeons and patients wary.
- The operation is complex, and many foot and ankle surgeons lack experience. While **Medicare pays for ankle replacement, many private insurers do not.**

Ankle Replacement

- An estimated 50,000 people a year experience end-stage ankle arthritis, in which the ankle cartilage has worn away completely, causing painful bone-on-bone contact and some level of disability.



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Ankle Replacement

Bone plate secured



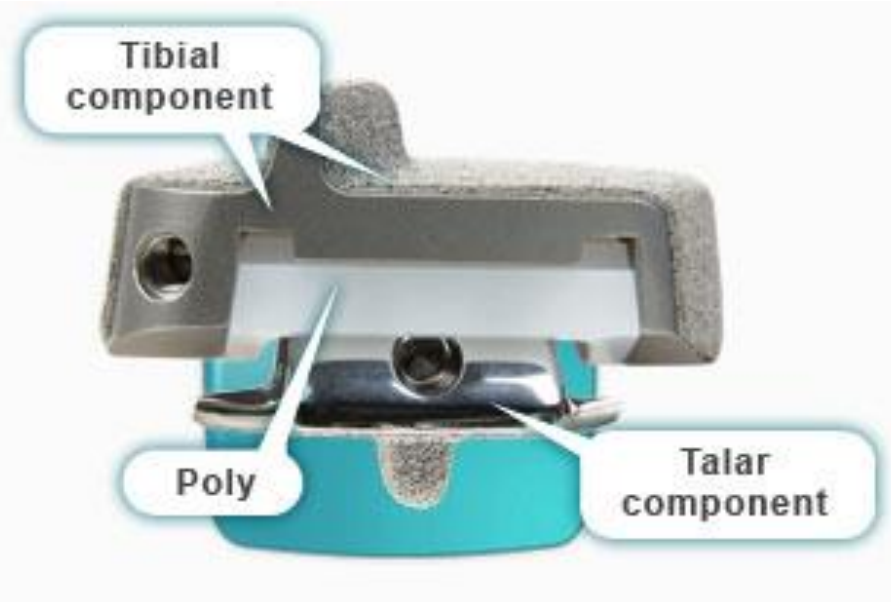
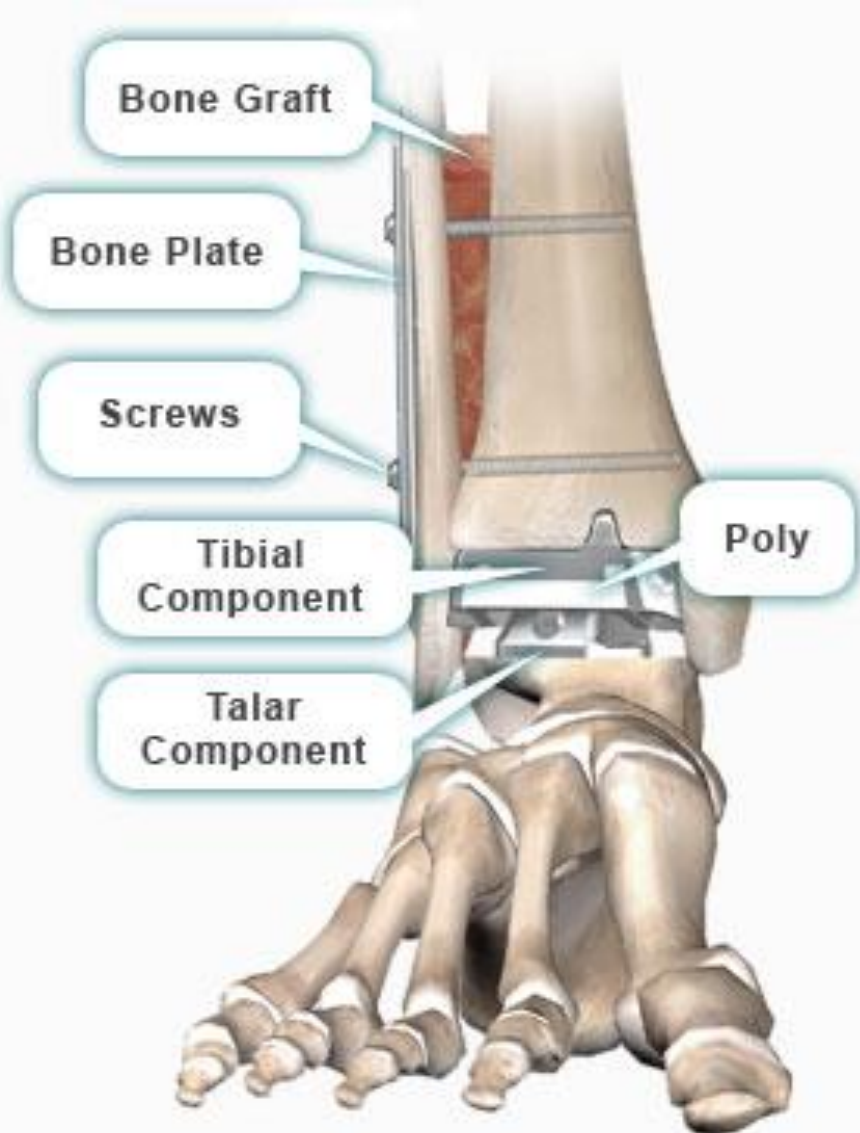
Ankle Replacement

- Until lately, such patients have had only one surgical option: **ankle fusion surgery**, in which the worn-out part of the joint is removed and the bones are permanently locked together with screws and plates.
- The procedure usually **relieves pain**, but the patient **loses mobility** in the ankle, leading to changes in gait and, ultimately, additional wear and tear and **arthritic pain in other parts of the ankle**.
- About **25,000 ankle fusions** were performed in the United States last year.

Ankle Replacement

- The ideal patient is around **60 years old** and of **normal weight**, although doctors consider older patients, depending on their health. People with **diabetes** may not be good candidates because they may risk complications as a result of poor blood circulation.
- The new models require that less bone be removed, so the bone to which the device is affixed is stronger.
- In addition, instruments used to guide surgeons in aligning the artificial joint have improved.
- 90 percent of ankle replacements were still in place after an average of eight and a half years.

Ankle Replacement



DePuy Agility

Ankle Replacement

Fourth Generation Outcomes:

- No patient reported severe pain after recovery.
- 55% of patients reported having no pain at all after recovery.
- 95% of patients studied said they would choose to receive the implant again.
- 96% of patients said they would recommend the surgery to a friend.
- 79% of patients reported that they were “extremely satisfied” with their total ankle implants.

Computer Assisted Navigation

- As recent as three years ago, several implant manufacturers started to develop and implement navigation systems.
- This new technology was and still is mainly applied to the TKA's and THA's.
- It was mainly developed to increase the accuracy of the alignment and implantation of the parts

Computer Assisted Navigation

- The increase in time ranged from 5–34 minutes per case.
- Here is BCBS Technology Evaluation Center's review: It cannot be determined whether any improvement is attainable outside the investigational setting since the evidence is not sufficient to permit conclusions on the effect of computer-assisted navigation on health outcomes.
- For the above reasons, the use of computer-assisted navigation for total knee arthroplasty **does not** meet the TEC criteria.

Computer Assisted Navigation





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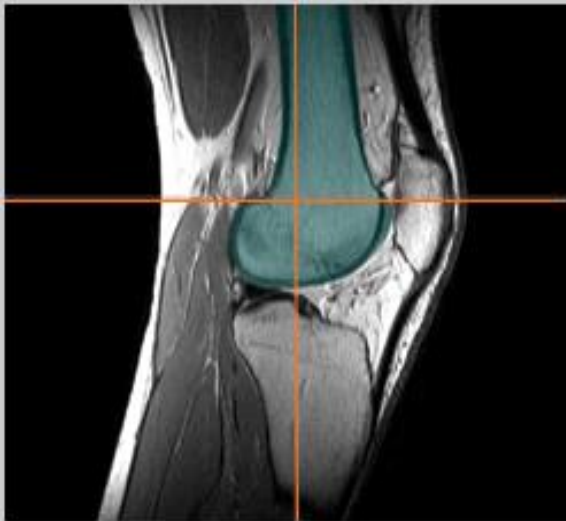
CAN by Zimmer



Pre-op Planner - Simple. Efficient, Control.

Customized Cutting Blocks

Smith & Nephew :VISIONAIRE



Customized Cutting Blocks

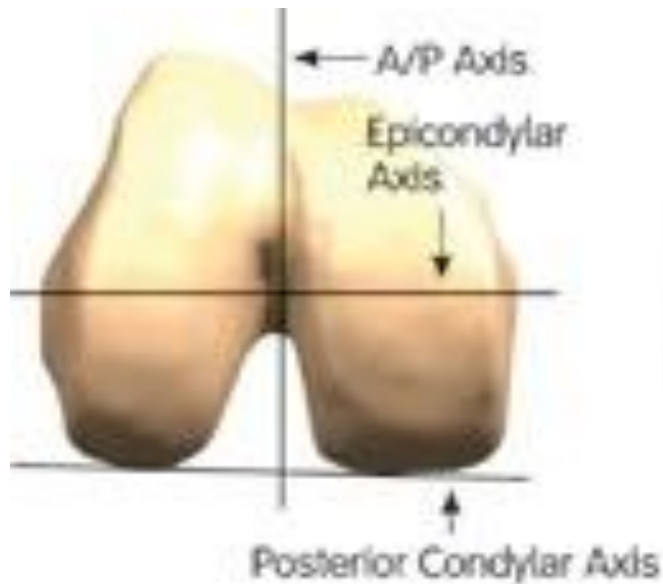
Benefits:

- Greater OR Efficiency
- Cost reduction by reducing instrumentation
- Reduced patient complications: Patient specific alignment may lead to better patient outcomes and lowered risk of complications such as DVT due to lack of violation of the IM canal
- Quicker OR, less anesthesia

Customized Cutting Blocks

Benefits:

- Better positioning and sizing.

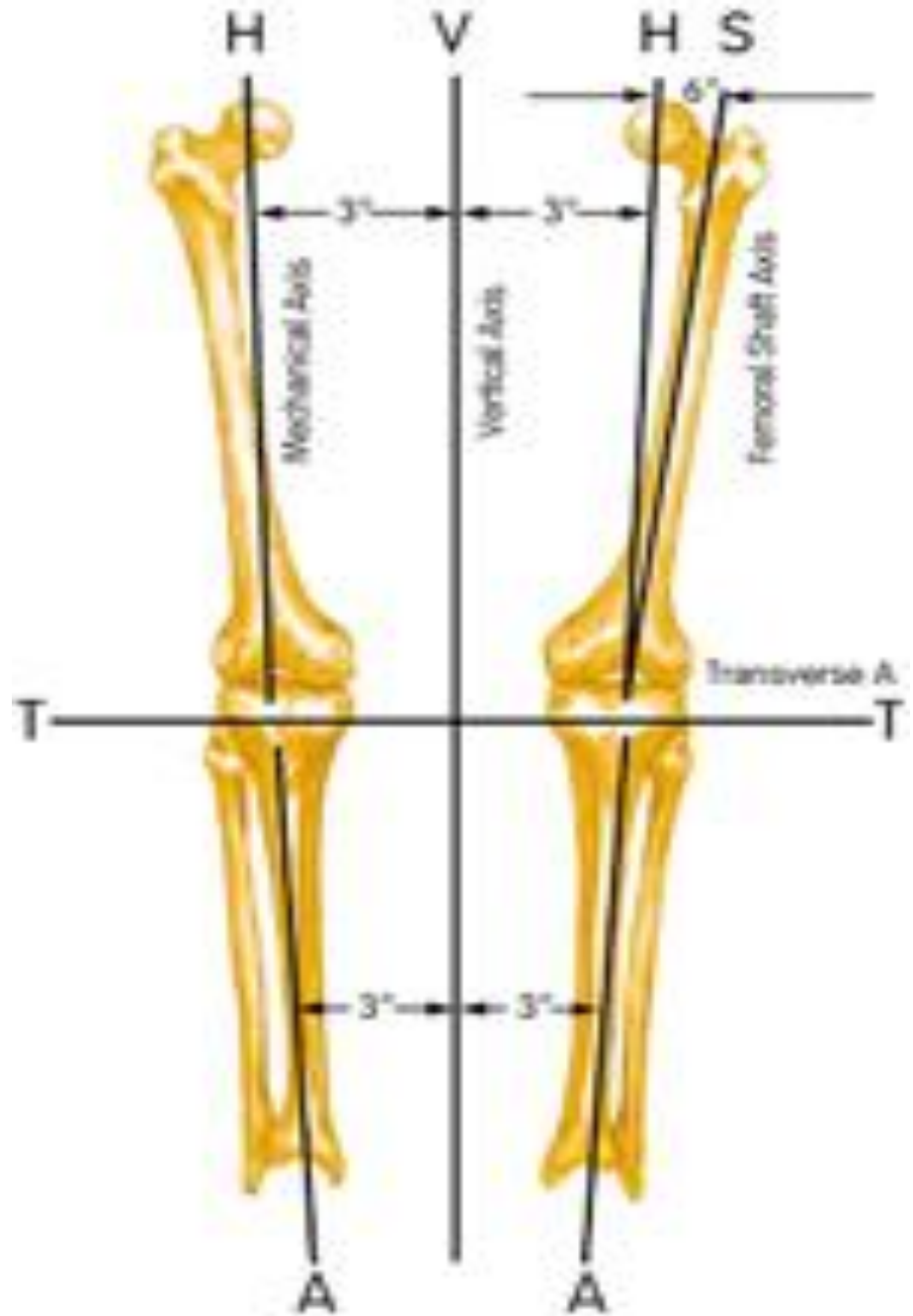


This technology achieves accurate rotational and A-P position. All of the commonly-referred anatomical landmarks (AP axis, epicondylar axis) are analyzed pre-operatively, allowing for the proper positioning of the implant for each individual.



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Customized Cutting Blocks



Customized Cutting Blocks

Concerns:

- Pre-surgery MRI required
 - Who pays for this
 - Unnecessary radiation
- More expensive
- Just an additional revenue stream for the implant industry



Functional outcomes and how They are affected by these new implant technologies

- All the orthopedic implants we just discussed are tools to help improve the functional outcomes of these surgeries
- Any implant company now has a vested interest in making sure their functional outcomes are excellent, especially in an era of direct marketing, where many customers are looking for high and quick functional outcomes.
- Many patients are educating themselves about the functional outcomes of the surgery and the implant used and will do their research before they elect to have the procedure done



Functional outcomes and how they are affected by these new implant technologies

- One other factor we can't overlook is the fact that the average age of a recipient of an elective implant procedure is trending to be younger and more active, demanding a faster return to a more active lifestyle
- And with the baby boomers retiring, the pressure is on the manufacturers, surgeons and us therapists, to meet these expectations
- Manufacturers in the meantime are complaining that the introduction of new technology is very time consuming and expensive and blame the FDA for that. But with the recent disasters at the FDA (Merck Vioxx), freshly in mind, they are not looking to shorten the approval process.



Functional outcomes and how they are affected by these new implant technologies

- Other important factors that may influence the functional outcome of the procedure include the hospital setting, education and anesthesia to name a few. We will talk about these later on
- Factors that play an important role in better functional outcomes, influenced by the manufacturer include:
 - Reduced wear of the implant device
 - Technology that allows for increased WB
 - Technology that allows for less tissue damage and therefore increased healing time
 - Technology that allows for better mechanic, allowing for better, more functional ROM, faster.



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Functional outcomes and how they are affected by these new implant technologies

- Another example would be implants that allow for a better fit.
- The development of many modular systems is an excellent example of this. Instead of adjusting the joint or bones to the implant device, surgeons can now adjust the implant device to the patient.



Functional outcomes and how they are affected by these new implant technologies

Let's look at a few studies.

- Robert L. Kane, MD et al produced a list of potential prognostic factors, including:
 - including co-morbidities
 - radiographic evidence of joint destruction
 - bone loss
 - integrity of the extensor mechanism
 - range of motion
 - Alignment
 - tibiofemoral angle
 - ligament integrity
 - as well as the characteristics of the operating surgeon, such as procedure volume and experience.



Functional outcomes and how they are affected by these new implant technologies

- Conditt MA et al show in their 2004 study that those receiving a cruciate-sacrificing, posterior-stabilized (PS) TKA design have greater functional limitations in squatting, kneeling, and gardening suggesting that with the specific implant used in this study, substitution for the PCL with a spine and cam mechanism may not fully restore the functional capacity of the intact PCL, particularly in high-demand activities that involve deep flexion. But keep in mind that these patient are demanding more mobility.



Functional outcomes and how they are affected by these new implant technologies

- Another study, done by R W Nutton et al, found that patellar resurfacing had no impact on the functional outcomes, measured up to 18 months after the TKA
- In about 90 percent of patients undergoing TKA, there appears to be rapid and substantial improvement in the patient's pain, functional status, and overall health-related quality of life
- 85 percent of TKA patients are satisfied with the results of surgery
- One of the most important factors leading to successful TKR is proper (correct/patient selection) surgical technique; the rate of complications in some studies that utilized national administrative databases was inversely related to both surgeons' and hospitals' volume of operations per year



Functional outcomes and how they are affected by these new implant technologies

- Rates of prosthesis failure requiring revision increase with duration of follow-up after surgery from about 10 percent at 10 years to about 20 percent at 20 years
- Factors associated with shortened time to prosthesis failure include:
 - age younger than 55 years
 - male gender
 - diagnosis of OA
 - Obesity
 - Presence of comorbid conditions
- It is hypothesized that the higher rate of prosthesis failure observed in young obese men with OA is related to higher levels of physical activity after TKR in this population



Functional outcomes and how they are affected by these new implant technologies

Some tools often used for functional outcome include:

- Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC): 24 questions
- The New Zealand Priority Criteria for Major Joint Replacement
- The Knee Society Score (KSS)
- The Hospital for Special Surgery (HSS). Developed by the Rehab department of this facility in 1983



Functional outcomes and how they are affected by these new implant technologies

- Australian Orthopedic Association (AOA) Registry data showed a significantly higher 5-year revision rate for HR than for THA in a large number of patients, 90% of whom were younger than 65 years of age
- Individual study revision rates ranged from 0.3% to 5% for most studies, with an overall THA revision rate of 2.7%.
- Femoral bone neck fracture accounted for nearly 25% of HR revisions, but its risk can be reduced by patient selection criteria (e.g., adequate bone density, no obesity or prior hip surgery) and experienced surgical technique



Functional outcomes and how they are affected by these new implant technologies

- Dianne Bryant et al showed in their 2005 study that at a minimum of two years of follow-up, total shoulder arthroplasty provided better functional outcome than hemiarthroplasty for patients with osteoarthritis of the shoulder
- Since continuous degeneration of the glenoid after hemiarthroplasty or glenoid loosening after total shoulder arthroplasty may affect the eventual outcome, longer-term (five to ten-year) results are necessary to determine whether these findings remain consistent over time
- At 20 years, the survival rate is 84% for TSA and 74% for HHR

New Anesthesia Technologies

- General vs Local/Epidural / IV Sedation
- Studies have shown that the number 1 concern that patients have before undergoing the elective procedure is their pain management.
- Trend is to go more towards nerve blocks to help reduce LOS and maybe even convert IP surgeries to OP procedures.

General Anesthesia

Purpose:

- pain relief (analgesia)
- blocking memory of the procedure (amnesia)
- producing unconsciousness
- inhibiting normal body reflexes to make surgery safe and easier to perform
- relaxing the muscles of the body

General Anesthesia

- Agents used for general anesthesia may be either gases or volatile liquids that are vaporized and inhaled with oxygen, or drugs delivered intravenously.
- A combination of inhaled anesthetic gases and intravenous drugs are usually delivered during general anesthesia; this practice is called balanced anesthesia and is used because it takes advantage of the beneficial effects of each anesthetic agent to reach surgical anesthesia.
- If necessary, the extent of the anesthesia produced by inhaling a general anesthetic can be rapidly modified by adjusting the concentration of the anesthetic in the oxygen that is breathed by the patient. **Spine Cases**

General Anesthesia

Precautions:

- Very low but may include
 - heart attack
 - Stroke
 - brain damage
 - Death

Side effects

- Headache
- vision problems, including blurred or double vision
- shivering or trembling
- muscle pain
- dizziness, lightheadedness, or faintness
- drowsiness
- mood or mental changes
- nausea or vomiting
- sore throat
- nightmares or unusual dreams

- All of these limit post-op rehab

Local Anesthesia

Intravenous opioids.

- These are more effective in abdominal surgeries
- Also have common side effects including
 - Nausea
 - Sedation
 - Confusion

Regional Anesthesia

- Spinal Blocks
- Epidural blocks
- Axially brachial plexus blocks
- Femoral nerve blocks

Local Anesthesia

- Currently, spinal anesthesia is the anesthetic technique of choice for sx. Of the LE.
- Also, post-op pain relief from epidural anesthesia is superior to pain relief from IV opioids (i.e. PCA pump)
- TKA is one of the most painful orthopedic procedures
- Studies have shown that intra-operative and post-operative epidural anesthesia result in early rehab after TKA
- Also, epidural ropivacaine combined with morphine provided improved pain relief in comparison to the PCA

Local Nerve Blocks

- Another study showed that continuous femoral block plus a sciatic nerve block caused less nausea and no pain compared to the epidural
- Single shot versus catheter nerve block
- Bedside femoral block has been found to be a useful adjuncts to other pain methods.

Intra-articular painpump

- An intra-articular pain pump catheter is usually placed into the joint by the surgeon during the shoulder procedures. The small flexible tube remains in the joint for several days to deliver pain medication, usually a combination of bupivacaine and epinephrine, to the shoulder.
- A study that just came out on 7/26/07 found that pain pumps used in shoulder surgery linked to cartilage damage. Postarthroscopic Glenohumeral Chondrolysis
- The study looked at 152 patients who had undergone arthroscopic shoulder surgeries. Twelve of the patients developed PAGCL. All of the patients who developed the condition had received pain pumps during their surgeries

Intra-articular pain pump

- A commonly used pain pump is the Stryker pain pump. It comes in several sizes and is inserted into the joint and subcutaneously prior to closure of the wound
- It can only be used once, since refill needs to occur in a sterile area (such as the OR), making refilling too expensive
- Patients typically use it for up to 48 hours
- The cost to the facility is around \$200

Stryker pain pump

Benefits:

- Non-Narcotic – Provides patients with a non-narcotic solution to post-operative pain management
- Digital Status – Digital screen provides device status without any disruptive alarms or noises
- Unrestricted Movement – Device does not restrict patient mobility during post-operative activity and rehabilitation
- Patient Interaction – Bolus feature allows for patients to play an active role in their pain management
- Programmable – Programming capabilities allow for physicians to customize each pump to needs of the patient




Stryker pain pump

- Versatile – Versatility of programming allows for facilities to stock one pump for numerous applications
- Disposable – Disposable devices alleviate the patient's need to return any capital item
- No Extra Staff Required – No additional staff is needed to clean, stock, and reassemble PCA components

Re-introduction of Functional Activities

When does Rehab start?

- Prehab
 - Prehab for injury prevention
 - Prehab for faster surgical recovery
 - People who go into surgery in a good physical condition, will do better
 - Exercise Improves Early Functional Recovery After Total Hip Arthroplasty 
 - The amount of pain felt after surgery may be lower in people who are in better physical shape
- Day of surgery
- POD 1

Joint Care Center:

- Hotel Environment
- Educational poster boards
- Educational DVD's (also at the surgeon's office)
- Concierge
- Private rooms
- Gourmet meals
- Coach program
- Exercise class
- Better nursing ratio
- Same post-op protocols

Re-introduction of Functional Activities

- Coach Program with overnight accommodation
- Dining room
- Guests, not patients
- PT will evaluate pt's POD if possible
- Pt will wear regular clothes
- Cappuccino bar
- Internet access
- Daily Knee Knotes
- Daily Hip Tips



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Joint Care Center @ Community Hospital





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Joint Care Center @ Community Hospital



CPM's, how effective are they?

Let's look at some studies:

- Effectiveness of Continuous Passive Motion and Conventional Physical Therapy After Total Knee Arthroplasty: A Randomized Clinical Trial. 
- CONTINUOUS PASSIVE MOTION AFTER PRIMARY TOTAL KNEE ARTHROPLASTY 
- Home continuous passive motion machine versus professional physical therapy following total knee replacement 
- Efficacy of continuous passive motion following total knee arthroplasty: a metaanalysis 
- CONTINUOUS PASSIVE MOTION FOLLOWING TOTAL KNEE ARTHROPLASTY: A REVIEW OF OUTCOMES WHEN REHABILITATION PROTOCOLS PERMIT EARLY MOBILIZATION. R.Grella 

WB status

- Always confirm the WB status with the surgeon when in doubt. If you are not sure, assume NWB
- Depends on the following factors:
 - Stability of reduction/implant
 - Bone
 - Method of fixation
- Cement allows immediate weight bearing but has associated risk of intraoperative fat embolism and hypotension because it is injected under pressure. Might also crack if air got inside the cement.
- In the OR, this cement should be mixed in a vacuum to eliminate this.

WB status

- Research has shown the following:
 - in 596 Geriatric Hip Fracture Patients with FWB in which 473 were available for 1 year follow-up
 - 16 patients or 3.4 % needed additional hip surgery owing to failure of fixation, nonunion, osteonecrosis, or prosthetic dislocation\
 - 2.9 - 5.3% depending on location of fracture needed a revision because of loosening of fixation



The effect of partial or full weight bearing ambulation after cementless total hip arthroplasty

Harri Hip Score

See below for a link to an very helpful, online tool to calculate this score:

http://exper.ural.ru/trauma/harris_e.phtml

Orthopedic Surgery Complications

Common complications include:

- Infection
- Dislocation
- DVT

Infection

- The use of perioperative antibiotics and other operating room procedures reduces deep wound infections after knee surgery to less than 1 percent.
- Although data also support the use of antibiotic impregnated bone cement as an additional means of reducing the deep-wound infection rate, concern regarding the availability, cost, and genesis of antibiotic resistant strains of bacteria has tempered the enthusiasm for this strategy.
- Some data also support the use of ultraclean-air operating rooms and whole-body exhaust-ventilated suits worn by the operating room team to reduce infection rates.
- However, these operating room procedures have not been universally adopted primarily because of the uncertainty of their impact
- Infection within the first year will be blamed on the surgery

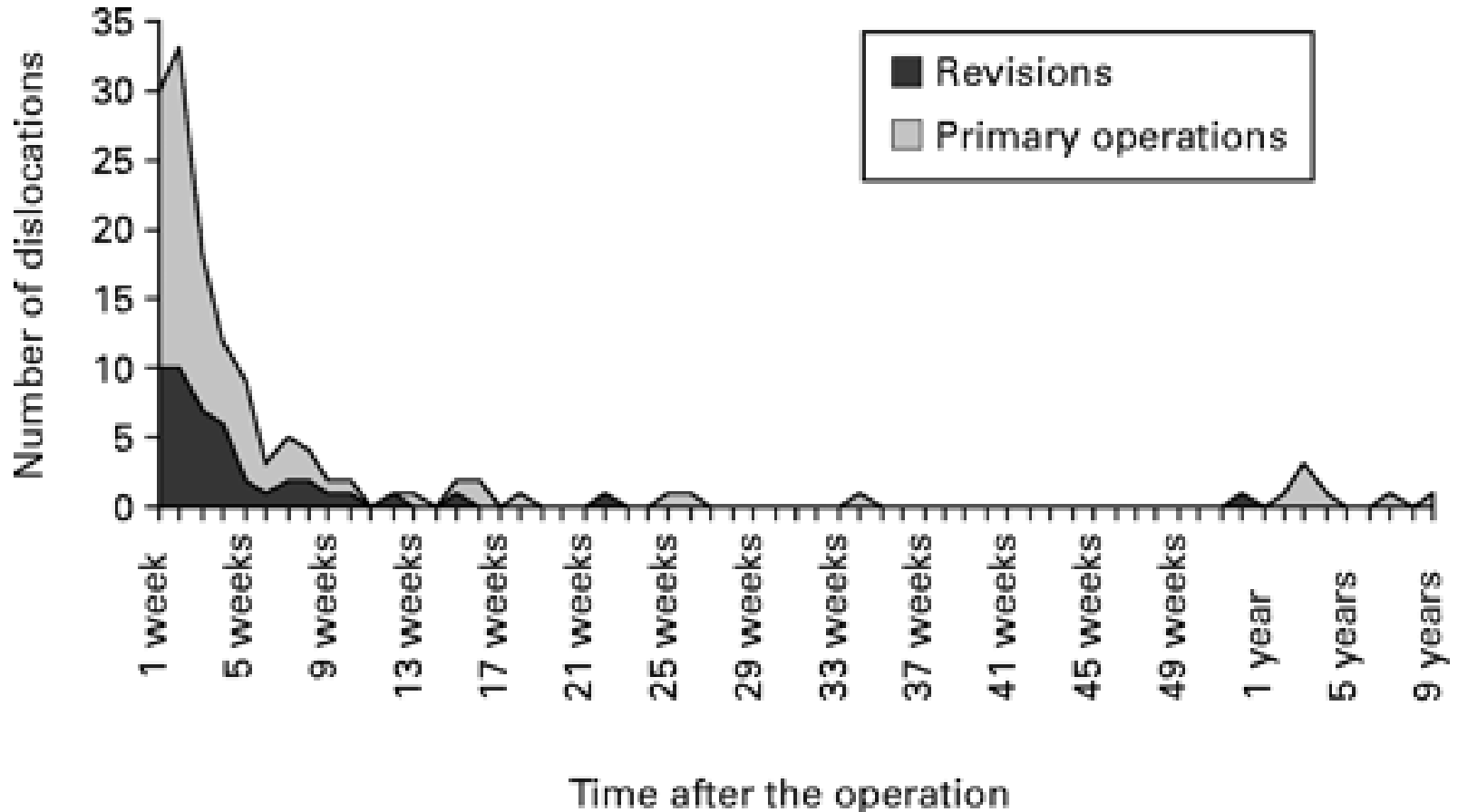
Joint dislocation

The Hip joint is the most common one

- Post-operative dislocation remains a common, major complication after total hip replacement (THR) with an overall incidence of 2% to 3% but ranging from 1% to almost 10% after primary THR
- Anatomy plays a major role, but can be better dealt with the newer implants, especially when using modular implants.
- Using a posterolateral approach for implantation of the prosthesis, Lewinnek et al proposed a radiological safe range of the position of the cup as anteversion of 15° (SD 10°) and abduction of 40° (SD 10°), although this was based on only nine dislocations. They found a rate of dislocation of 1.5% within this range, although outside this the rate was 6.1%.



Joint dislocation

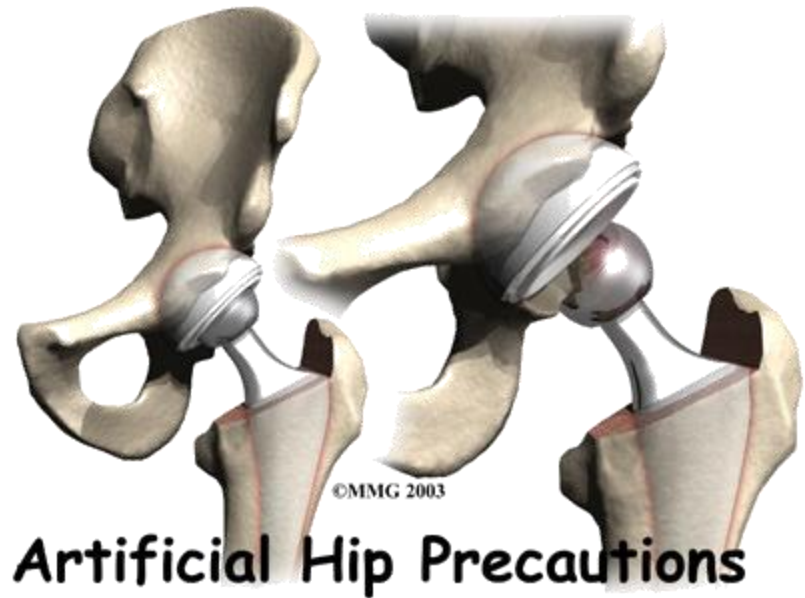


- Most dislocations (119, 78%) occurred within 12 weeks of surgery

Joint dislocation

Hip precautions:

See handout



DVT/Embolism

- Each year approximately 200,000 Americans undergo total hip replacement surgery. Statistics reveal that between 400 and 800 people develop a fatal pulmonary embolism in the first three months following this procedure.
- A pulmonary embolism is a blood clot which forms in a leg vein, breaks off, and travels to the lungs.

DVT/Emboli

- **Overweight patients with a BMI of 25 or more were 2 1/2 times as likely to be hospitalized for blood clots than the control group.**
- **Pneumatic compression was of most benefit to patients of average weight. Pneumatic compression (an external device consisting of inflatable cuffs for the purpose of massaging and compressing the legs to prevent blood from pooling in the veins and an increased risk of clot formation) did not reduce the risk of blood clots in overweight patients.**
- **Patients of normal weight who used pneumatic compression were 30 percent as likely to be rehospitalized for blood clots as patients not treated with pneumatic compression.**
- **Patients of all weight categories who were treated with anticoagulant drug therapy after going home were only 60 percent as likely to have symptomatic clots as those patients not receiving the therapy**

Importance of Education

- Patients outcome increase when they have a better understanding of the procedure and a better understanding of the expectations afterwards.
- Education needs to be **CONSISTENT** and repeated throughout the process. I.e what they hear at the surgeons office needs to be the same as what they hear at pre-admission, pre-op or post-op, upon discharge and at the rehab center they might go to afterwards.

Importance of Education

- The concept of effective clinician-patient communication is a necessity, not an option.
- According to the Bayer Institute for Health Care Communication, a clinician's role in communicating effectively with patients can be broken down into a process that includes the following communication tasks: engagement, empathy, education and enlistment.

Importance of Education

Engagement

- Engagement is a connection between the clinician and patient
- Barriers to engagement by the clinician include the failure to introduce oneself, inquisition-type questioning, and interruption of the patient's story
- "You don't get a second chance to make a first impression."
- Express your interest in the patient as well as the medical problems they bring to the table
- The outcomes of successful engagement are rewarding. For example, the quantity and quality of the diagnostic information available will improve. The groundwork for a successful relationship will have been laid. Additionally, the patient will have a sense of partnership with the clinician, which will facilitate adherence to a treatment regimen

Importance of Education

Empathy/Compassion

- Empathy is sincere—and successful—when a patient acknowledges that he or she has been seen, heard, and accepted as a person
- This seems like a simple concept, yet the effective use of empathy presents common dilemmas for clinicians
- Clinicians tend to fall back on "comfortable" medical language that creates a barrier to empathy
- Some clinicians feel that empathizing with a patient will require more time than they have to give.
- For example, introductions could be made to the fully clothed patient in the waiting room
- Acceptance requires acknowledging the patient's thoughts and feelings while reserving judgment. It also allows for self-disclosure, when appropriate

Importance of Education

Education

- Education has taken place when the cognitive, behavioral, and effective needs of the patient are addressed.
- Research shows that clinicians overestimate the time spent in the education of their patients by nine times!
- Poor education of patients is clearly a product of poor communication skills on the part of the clinician.
- To effectively communicate, first assess what the patient already knows and then ask questions to determine what he or she might be wondering.
- Remember that education has not taken place until the patient has learned something.

Importance of Education

Enlistment

- Enlistment is an invitation by the clinician to the patient to collaborate in decision-making regarding the problem and the treatment plan
- The relationship between the clinician and the patient is a critical factor in patient adherence.
- Before they even enter the clinician's office, most patients have made their own diagnosis—a diagnosis that more often than not, they are looking to confirm.
- Enlistment requires that a clinician and patient come to an agreement about the problem and prescribed treatment.
- To ensure collaboration, provide a "possible explanation" and ask how it fits with what the patient has been thinking

Discharge planning

- There should be a multidisciplinary approach for effective and efficient discharge planning.
- This will be the last process your client/patient will remember
- Typically scores low on the satisfaction scores.
- Delayed D/C affects reimbursement.
- Many of the D/C can be planned ahead but often end up being a last minute process.

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