Trends-in-Medicine

February 2007

by Lynne Peterson

SUMMARY

Compared to 2006, surgeons expect total knee replacements this year to be up 12% and hip replacements up 8%. ♦ Zimmer's Gender Solutions Knee for women is viewed by many surgeons – Zimmer customers as well as non-customers – as mostly marketing hype, but it is resonating with women, who are asking their doctors about it. Most Zimmer doctors are switching to it almost 100% for women (and even a few men), from whatever Zimmer implant they were currently using, even though it is a premium over Zimmer's NexGen Hi-Flex, but it isn't converting many non-Zimmer users. ♦ Hospitals are more price conscious than a year ago, but surgeons said that is not causing any shifts in the brands or numbers of implants they are using, and they expect vendors to be able to raise prices 3%-5% this year. ♦ Hip resurfacing is expanding the market, bringing in new, younger patients who are not eligible for a total hip replacement, and private payors are covering it, usually at a markup to an implant procedure. The surgery is complex, with many doctors taking a wait-and-see approach, but it is catching on. ♦ Implants made of metal-on-metal and highly cross-linked polyethylene each have proponents, but use of ceramic-on-ceramic is continuing to fall due to fractures and squeaking.

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AMERICAN ACADEMY OF ORTHOPAEDIC SURGEONS (AAOS)

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Attendance at the AAOS meeting was down slightly this year, which a speaker blamed on weather effects on travel, and there was little breaking news. Based on interviews with 35 orthopedic surgeons, the hot topics this year were: Zimmer's Gender Solutions Knee (GSK) for women, squeaking with ceramic-on-ceramic hip implants, hip resurfacing, and reverse shoulders. Two smaller, privately-held companies also were getting a lot of attention and booth traffic: Cayenne Medical and TranS1.

Which company is best positioned with new implant technology for the future? Most surgeons agreed that all five of the major companies are well positioned. Not surprisingly, many doctors favored the vendor they use most often. A Michigan doctor said, "The bigger companies are best positioned because of the money they spend on R&D." A Texas doctor said, "The small firms that develop technology and then get bought are the leaders. Johnson & Johnson/DePuy, Biomet, Smith & Nephew are good, and Synthes is a real leader in cement-less hips and knees. The worst is Zimmer; it's the Wal-Mart of orthopedics. I wouldn't use Zimmer if anything else is available." A Midwest doctor said, "Zimmer is the leader. It has really kept up. It has a tantalum coating that I really like, cutting edge technology on eliminating wear and debris in joints, and a full gamut of products, with fast availability."

What other new technology is getting the attention of these doctors?

- Artificial grafting materials.
- Stem cells and gene therapy.
- Posterior dynamic stabilization.
- Computer-assisted surgery, computer navigation, and perhaps a robot in the future.

TOTAL KNEE ARTHROPLASTY (TKA)

In the U.S., ~60% of TKAs are in women. This year, surgeons estimated that their total knee replacements (TKRs) will be up an average of 12% over 2006, due to aging baby boomers, greater awareness of the implants/procedure, and new technology.

What's new in knees? Zimmer's Gender Solutions Knee for women stole the stage at AAOS. An Ohio surgeon also pointed to Smith & Nephew's Journey and Deuce knees – as well as some competitors' knees – which offer more stability of the knee in various knee flex positions. He said, "Functional outcome (of TKA) is not as good from patients' perspective as from doctors' perspective, especially in kneeling and squatting."

Most Popular Total Knees in the U.S.

Johnson & Johnson/ DePuy Orthopaedics	Zimmer	Stryker	Biomet	Smith & Nephew
Sigma RP	NexGen CR	Triathlon	Vanguard	Genesis II
LCS	NexGen LPS	Scorpio	Maxim	Journey
	NexGen LPS Flex	Duracon	Ascent	Profix
	NexGen CR Gender Knee			

ZIMMER'S Gender Solutions Knee

In May 2006, the FDA approved this new implant, which Zimmer claims is "contoured to fit the unique shape and size of women's knees." Zimmer describes the Gender Knee as having a thinner profile than other knee implants, more natural movement, and a shape specially contoured for women.

Zimmer and its speakers were touting the Gender Solutions Knee, but most sources – even some Zimmer users – called the GSK a marketing ploy. However, the marketing did appear to be resonating with Zimmer users. Surgeons who were using Zimmer implants before the Gender Solutions Knee was introduced, generally plan to switch all or almost all their women to it. Prior to GSK, these sources used a variety of Zimmer implants, including Natural Knee, NexGen, and NexGen Hi-Flex.

The marketing for GSK also is striking a chord with the public. Surgeons – non-Zimmer users as well as Zimmer users – said patients are asking about it, but only one doctor not currently using Zimmer knees plans to switch to Zimmer knees in general, or the GSK in particular. Rather, non-Zimmer surgeons said they are telling patients who ask about GSK that they get comparable results with whatever knee they currently use, and if a patient really insists on a GSK, they refer her to someone else.

Zimmer is charging a premium for the GSK, and an official described this as a "small" premium. Surgeons insisted they do not know the price their hospitals pay for this or other knees, but they said they were not getting any push-back or resistance from their hospital when they do use it. A Midwest user said, "I don't know how much the premium is, but I know it is more than the NexGen Hi-Flex."

Among the comments **by non-Zimmer users** were:

- *Midwest:* "I don't call it a marketing gimmick. It is clever marketing…I agree it fits the bone better, but is it worth the added expense? I don't think so."
- *California #1:* "Zimmer had a prosthesis that failed, and then they found a niche for it. I have yet to have a patient ask for it. Zimmer won't sell it to physicians, but they may sell it to the public, and some doctors may use it as a marketing tool."
- *Ohio:* "The Gender Knee is ridiculous. There is no anatomic or scientific evidence for it. Patients ask about a specific implant very little (<5% of the time), and for that knee even less. It might slightly increase total knee replacements because it may reassure some women, but that's tragic because it might put the surgery in the hands of surgeons doing fewer joints."
- *Michigan:* "What Zimmer has is a prosthesis that is longer front-to-back and narrower, which works well for women but doesn't cause a problem if used in men… The prosthesis (GSK) fits better in women, but it is a misnomer because the company doesn't have a male prosthesis and a female prosthesis…Patients ask about it all the time. I tell them I use Triathlon, which is also a gender-specific knee, that it is also redesigned and similar to the Zimmer Gender Knee, but I absolutely have to discuss it with patients. I don't lose patients because I don't use the Zimmer knee…Zimmer will increase its market share somewhat with the GSK vs. everyone else, but transiently. It is not a major deal."
- *North Carolina:* "The Gender Knee is a good idea. It is a refinement of what we have. It is sometimes hard to match the width of the prosthesis to the width of the bone, considering the anterior-posterior dimensions. The Gender Knee might make it a little easier, but with my experience, doing it with the Smith & Nephew knee is not a problem."
- *Texas:* "It is all about marketing. It is a totally dishonest presentation, a fraud…Knees are knees. You do need different sizes, but not because a body is male or female."
- *California #2:* "I use the J&J/DePuy knee, and I haven't had any problem with overhang. It is more appropriately dimensioned to women. No patients have asked me about Zimmer's Gender Knee. They ask about incision size. If they did ask (about GSK), I would tell then J&J has no problem with oversizing, though there could be under-sizing with men – but that isn't a problem."
- *Florida:* "It (GSK) is size-specific, not gender-specific."
- *Colorado:* "A lot of it is marketing, but there is some physiologic basis. I use Stryker's Triathlon, which is comparable, and I'm happy with that. I've used Zimmer knees, but I'm not changing to the Gender Knee… Patients are already asking for the Gender Knee, and I tell them we can get the same results with the Triathlon."

- "Right now, GSKs are 0.1% of our implants, and that won't change because there are other knees on the market with similar results."

Comments **by Zimmer users** included:

- *North Carolina:* "We use Zimmer knees, but we are leery of the Gender Knee."
- *Florida #1:* "Most other companies found a compromise that works for both men and women. The Zimmer implant was wider, which is good for men, but surgeons complained they didn't fit well for women, so Zimmer came out with a second line to address that problem. So, the new Gender Knee fixes a problem they (Zimmer) created. This requires the reps to carry two lines, which makes the inventory cost for the reps higher…Gender Knees won't expand the market, but they will raise awareness in women. Patients are asking more questions and doing more Internet research, so they are creating a stir…I haven't done any Gender Knees yet, and I'm not sure if I will do any."
- *Missouri:* "I'll use the Gender Knee now for any female. It gives a little better fit. The Gender Knee is just a variation on the NexGen Hi-Flex; it has more physiologic patellar tracking. I haven't had any trouble with the NexGen Hi-Flex with females, but intellectually, the Gender Knee seems to fit better."
- *Midwest:* "Only six of my 150 knees in 2006 were a Gender Knee…It replaced the NexGen Hi-Flex. This year, it will probably be 15% of my knees...The Gender Knee is size and anatomy, not gender. Zimmer isn't misrepresenting it; it's just marketing, but I have problems with how they are marketing it. They are using direct-to-patient advertising, and I would like to see the Academy (AAOS) approve all ads first, like the American Dental Association does for dental ads. There are voluntary Academy guidelines for member advertising; I'd like to see something for vendors."
- *Texas #1:* "I'll start doing all my women with the Gender Knee. I used to use the NexGen, then switched to the Smith & Nephew Journey, but now I will go back to Zimmer with the Gender Knee. But I do want one system for men and women, so if I get great results in women with the Gender Knee, I might also convert men to the NexGen."
- *Texas #2:* "I'll use Gender Knee for all my women patients, replacing the NexGen, and for men I'll replace NexGen with NexGen Hi-Flex."
- *Florida #2:* "I've been a Natural Knee user, but I've done a few Gender Knees in women recently. I think it is real, not a flash in the pan, and women are asking for it. So, I'll switch to Gender Knee for most women, but stick with Natural Knee for men. One problem with Gender Knee is that I have to let the rep know in advance when I want to use it because there is limited access to the instrumentation."

The Zimmer view

Talks on the GSK in the large circle-in-the-round theater in the Zimmer booth were well attended. Speakers explained in great detail studies that found anatomic differences between the sexes that the Zimmer implant claims to address. Dr. Jean-Noel Argenson of France said, "We are moving into an era where we try to customize the implant to the patient…Design evolutions should be oriented to patient function, surgical technique, and patient anatomy." He pointed out that females have a less prominent anterior flange and more internal rotation than males. With GSK, he said, women get a better fit, with less overhang, and better patellar tracking.

Dr. Argenson estimated he now uses GSK for 80% of his female patients. He said he is starting a study comparing a traditional implant in one leg and a GSK in the other leg. He did not say when those results would be available.

Dr. Mohamed Mahfouz of the University of Tennessee told doctors that designing a successful gender-specific implant consists of three important steps:

1. Accurate quantitative measurement and interpretation of the differences.
2. Translation of the difference in anatomy into differences in design.
3. Quality in how the design addresses the differences.

Dr. Kim Bertin, also of the University of Tennessee, said a review of NexGen registries in the U.S. and the U.K. of 44,217 Zimmer implants found differences in male and female anatomy are significant, and surgeons were forced to perform adjustments to make the knee replacement functional because women had:

- Smaller femoral implants than men ($p<.0001$).
- Smaller tibial trays ($p<.0001$).
- Smaller patellar implants ($p<.0001$).
- The frequency of later retinacular releases is higher in women ($p=0.10$).
- Tibial components are thicker in women ($p=0.01$ U.S. and $p=0.004$ OUS).

Dr. Bertin added, "With the Gender Solutions Knee, down-sizing has vanished...We did that not uncommonly, and now we don't have to do that…Overhang has vanished, and the lateral release rate is dramatically lower, which should decrease blood loss and post-op pain, speed recovery, and decrease patellar complications."

GSK implants also are being used for men! Dr. Bertin said he is using it for 5%-10% of his male patients. Several non-Zimmer doctors pointed to that as proof that GSK is merely a new size for Zimmer, not something revolutionary or important for women.

Zimmer also plans to introduce other gender-specific implants, including a gender-specific Natural Knee in 4Q07, and a gender-specific hip.

An AAOS debate on gender-specific implants

- **Pro.** Dr. Robert Booth of the University of Pennsylvania argued:
  - "Anthropologists and archeologists have been able to differentiate male and female bones for a hundred years…Why do we care? The literature is beginning to show we are not doing as good a job with women's knees as with men's. Women have more disability and a tendency to more pain, stiffness, and discomfort."
  - "It is a matter of shape and not size."
  - "Many people are annoyed by direct-to-consumer (DTC) marketing, but I suggest this is more responsible and better-based on science than Jack Nicklaus (advertising Stryker's ceramic-on-ceramic hip) or mobile bearing knee ads of three years ago."
  - "In my own experience with a fair number of these, now I go up a size, not downsizing…I think there is 7-8 degrees more motion (with GSK), but the comfort difference is still uncertain."
  - "If you get a component that fits the patient, not make the patient fit the component, the patient may do better."
- **Con.** Dr. Merrill Ritter of St. Francis Hospital in Indianapolis claimed GSK is all "marketing hype." He argued:
  - "There is no question there is a difference in the distal femur in men and women, and that is well documented…(But) there are no data to support the hypothesis that proper implant sizing can avoid complications and maximize outcomes."
  - "(Dr. Booth has) good data, but the wrong conclusions."
  - "My review of 7,300 knees (found) in the majority, you put in a smaller knee. The Knee Society score shows absolutely no difference between men and women (on outcomes with traditional knees) – no difference in pain or range of motion. There is a difference in function score, which is driven by the stairs score – but this is only a four-point difference. Could that four-point difference be due to the prosthesis?...All we could find is that (patients with underhang) had better function on stairs in women, and there was no deleterious effect to oversizing the femur. If anything, overhang had poor function in stairs in ***men***, not women."
  - "Survivorship is 99% in females and 99% in males. This is data."
  - "There is no deleterious effect from overhang."
  - "None of the data supports the Gender Solutions Knee. You make the call, but do it with data, not marketing."
  - "In general, women don't do as well as men (with TKR), and I think there are a lot of factors to that besides size."
- **Moderator, Dr. William Maloney of Stanford.**
  - "It seems they (industry) are always advertising the thing right out of the box." This comment brought applause from the audience. He continued, "We need a close relationship with industry, but this issue of DTC marketing has impacted all of us in a negative way…I would tolerate it if it had a benefit for patients…Now that it (DTC) has started, and I can't see it going backwards…but we still have to deal with patients coming in with the ads."

A comparison study. Dr. Wayne Goldstein and his colleagues at the University of Illinois presented a study disputing the clinical need for, or benefit from, a gender-specific implant. They studied femoral implant design measurements and sizing in female patients to assess the need for gender-specific implants, comparing Johnson & Johnson/DePuy's Sigma RP and LCS knees and Zimmer's NexGen, NexGen LPS, NexGen LPS Flex, and Gender Solutions knees. They found:

- "Differences do exist in the anatomy between male and female distal femora."
- 50%-60% of female patients had an average BMI ≥30.
- For common anterior/posterior (A/P) dimensions in female patients, most current implants have very similar medial/lateral (M/L) sizes, with some exceptions.
- In implants with extremely large overhang, problems may occur with impingement if the implant edge should obliterate the medial and lateral gutters.
- Female knees more frequently had a tibial component one size down from the femoral component, and male patients had the same size component.
- There are manufacturers who may be at the extremes on the large M/L dimension for a given A/P dimension in the femoral component. In those cases, there may potentially be evidence of soft tissue pain, particularly in women.

Comparison of TKA in Men and Women

Measurement	Male	Female	p-value
Average flexion	120 degrees	119 degrees	Nss
Pain score 50 (none)	74%	63%	Nss
Pain score 45 (occasional)	18%	23%	Nss

Feature	Zimmer NexGen	J&J Sigma RP	Stryker Triathlon
Medial/lateral measurement	5.7 mm wider than Sigma RP	Smaller than many competitors	1.5 mm wider than Sigma RP

Comparison of TKA in Men and Women

Measurement	Male	Female
Average BMI	30	31
Average height	70 inches	64 inches
Average weight	208 pounds	180 pounds
Most common femur size implanted	5	3
Most common tibial tray size implanted	5	3
Average of both the femoral and tibial components	---	4

Dr. Goldstein said, "It is correct that there are anatomic differences between men and women, and you may not get a perfect match on women with a particular implant…There is overlap (of the implant) in some women, and the front flange of the knee after the implant may be slightly thicker in a women – but it doesn't show on the outside…Does it make any difference? Certainly, if we had been putting in the wrong size (in women), there should have been a difference in pain and function between men and women, but I looked back and took a sampling of 1,428 women and 782 men as of February 1, 2007, and found no difference in pain or flexion…The biggest problem for women (TKR patients) is that they are overweight." Dr. Goldstein said, "Most of the various total knees are pretty close on the femoral aspect ratio. He is planning a head-to-head study of Zimmer's GSK and one or more other implants.

TOTAL HIP ARTHROPLASTY (THA)

Surgeons estimated that total hip replacements (THRs) will be up in 2007 vs. 2006, but not up as much as knees. Sources estimated procedures in 2007 will be up an average of 8% vs. last year.

Bearing surfaces

The debate over the best implant bearing surface material continued, with ceramic-on-ceramic implant squeaking a common topic of discussion. A panel of experts discussed the pros and cons of each material.

➢ **Ceramic-on-ceramic.** Use of ceramic-on-ceramic hips has gone down substantially, and surgeons predicted it would decline further as a result of both squeaking and fractures. Some members of the panel said they believe the cause of the squeaking is inherent to ceramic, others thought it is a technical issue, but most thought it was a combination of both.

One panel member noted that the risk of fracture is small (about 1 in 7,000), and the difference in cost from metal is "negligible," but clicking and squeaking is an issue. He said the incidence in his large practice is 2.7%, though industry claims <1%, "There are a variety of causes…Over 12-14 months, which is the average time to onset, causes and prevention are as yet unknown…The question is how to deal with it. Inform patients, reassure them. I wouldn't waste time with Synvisc (Genzyme, hyaluronic acid) injections…The bottom line is, ceramic-on-ceramic has superior wear properties and is a good bearing surface for the young, active patient."

Additional panel comments on squeaking included:

- "More and more we are hearing about this…And it is a loud squeak that causes giggling. Socially people are bothered by it."
- "The theories are that the head has to ride against the cup longitudinally and sets up vibration…But it could be a variety of things…The bottom line is it is happening, and it is a devastating complication."
- "(A survey found) it occurred sometimes in 7% of patients."
- "I wouldn't call it 'devastating,' but it is something I've done revisions for. I would like a better understanding of it, so I can avoid it, but there are some surgeons who've done ceramic for 10 years without squeaks."

Other comments on ceramic-on-ceramic squeaking included:

- *New York:* "A squeaky hip is a real disability, and patients are ***not*** happy."
- *Montana:* "Use has gone way down because of this in the U.S. and in Europe, too…If you had a squeaky hip, you would be unhappy…That hip may work very well – even with a squeak – but patients don't like the squeak."
- *California:* "There are real benefits to it, but now we are seeing potential complications or dissatisfaction with the results...It's a very small percentage of folks, but...it has definitely led us to have less enthusiasm than a year or two ago."
- *Illinois:* "Squeaking is a big deal."

➢ **Highly cross-linked polyethylene (PE).** All but one of the surgeons on the panel agreed there are enough data at five years to say cross-linked PE performs well enough. The exception was a doctor who said, "We still need to keep watching it."

A speaker said, "The good news is: So far, so good…Three-year data, which is not yet published, indicated that highly cross-linked PE has no significant difference in head penetration at Year 1, but less at Years 2 and 3…*In vivo* studies show minimal – and in some studies no – detectable wear after the bedding-in period…Lab wear studies have predicted the *in vivo* behavior. Fractures are limited – to my knowledge – to malpositioned sockets with large femoral heads. New materials are coming to enhance the mechanical properties."

➢ **Metal-on-metal.** A speaker commented that all metal-on-metal bearings "are not created equal." Questions about ion levels, possible long-term cancer risks, and ALVAL

(aseptic lymphocytic vasculitis-associated lesions) continue to haunt metal-on-metal implants, but the clinical outcomes are good with these implants, they don't break, and they allow large diameters (and, thus, resurfacing). Panel comments included:

- "The main concern long term is the effect of metal ions, but we don't have long enough data to know if we have a problem."
- "We don't know what ions will do long term…We have to educate patients. And we shouldn't use them in patients with renal insufficiency or the potential for renal insufficiency. The data are not out for women of child-bearing age, so I tend to avoid that."
- "If a patient has sensitivity to metal or jewelry on the skin, I don't put in a metal implant."
- "Carcinogenicity…is a >20 year legacy…so it will take another 10 years before we know, but we are getting close…With second generation metal-on-metal, we have 18 years experience, and the fact that a rabbit hasn't jumped out of the hat is comforting, but we have another 10 years before we know for sure."
- "Metal-on-metal is not cost effective at the current price and complication rate."

Hip resurfacing

This is a redux of an old technology, but proponents claim the problems of the past have been solved. Smith & Nephew's Birmingham Hip Resurfacing System, which was approved by the FDA in May 2006, is the only FDA-approved hip resurfacing system in the U.S., but others are in development, including Biomet's ReCap, Stryker's Cormet, and Wright Medical's Conserve.

Most doctors questioned were taking a wait-and-see approach, wanting to be sure that the results hold up over 3-5 years before they start doing it. However, resurfacing is catching on, and surgeons predicted it will expand the number of hip patients treated because it offers an option for men and women under age 55 who are too young for a total hip replacement.

Pro. Dr. Harlan Amstutz of UCLA, a consultant for Wright Medical, said the advantages of hip resurfacing in patients under age 50 include:

- Conservative surgery.
- No leg length inequality issues.
- Reduced morbidity.
- More future options.

Con. Dr. Harry Rubash of Boston claimed hip resurfacing is not ready for widespread adoption and warned surgeons against jumping on the latest fad or wave, but he stopped short of saying surgeons shouldn't do it at all. He offered several arguments against resurfacing, including:

- **Inferior short-term survival.**
- **Lack of cost-effectiveness.** He said, "A 50-year-old patient would need a 19% reduction in the 20-year implant failure rate for resurfacing to be cost-effective at the current cost."
- **Complexity of the procedure.** He described it as a more difficult procedure requiring more complex instrumentation and said there is a "significant" learning curve. Dr. Michael Mont of Baltimore also emphasized that surgeons who want to do hip resurfacing need to know the indications and need to learn the technique well, or they will have femoral neck fractures, which he called a "devastating complication." He said, "Two years ago, I reported 11 fractures in my first 50 patients, but in the second 50, there was only one fracture." He estimated that the incidence of fracture with hip resurfacing is 0.2%-0.3%, once a surgeon gets past the learning curve. He advised surgeons: "There is a learning curve, avoid intraoperative notching, and be careful with obesity…I truly believe you can reduce the fracture rate to <1%."
- **More invasive surgery.**
- **"Unique" complications.**

Dr. Thomas Schmalzried of UCLA also defended hip resurfacing, which he said was being unfairly "bashed" on the Internet. He said he believes there is a role for both THA and resurfacing, and he challenged the idea that hip resurfacing provides better range of motion than THA. He compared his first 50 hip resurfacing patients with 44 total hips done during the same period, all with a minimum of two-year follow-up. He noted that there were significant differences in the baseline patient characteristics of the patients who got the two procedures, which may account for why the outcomes varied.

Dr. Schmalzried also compared a subset of 10 patients who got a 36 mm metal-on-metal hip who were very similar demographically to the hip resurfacing patients, and he

Hip Resurfacing vs. Replacement

Patient characteristics	Resurfacing	THR
Baseline		
Average age	46	55
Male	62%	41%
Height	3.2 inches taller	---
BMI	Lower	---
Harris Hip Score (HHS)	46	52
Marked pre-operative pain	94%	58%
Surgical time	174 minutes	148 minutes
Blood loss	456 ml	618 ml
Length of hospital stay	Nss	
2 years		
HHS	97	96
Functional improvement	Greater	---
No pain	48%	80%
Range of motion	Nss	
Dislocations	1 patient	1 patient

reported those THR patients had significantly better outcomes than other THR patients. He concluded, "Hip resurfacing patients are different – younger, male, taller, with lower BMI – and the procedure requires different exposure and a longer surgical time…The Internet myths are not supported. THR has an image problem. There is no difference in range of motion or dislocation risk."

A panel of experts was polled about their attitudes toward hip resurfacing:

- They unanimously agreed the early failure rate of resurfacing is higher than with conventional implants.
- None thought durability at 10+ years will be better with hip resurfacing than with conventional arthroplasty.
- They unanimously predicted that long-term durability will be worse with hip resurfacing than with conventional arthroplasty.
- There is a subset of patients who may be good candidates and in whom it may beat arthroplasty. One panel member estimated that this subset is about 15% of the patient population. Another warned that patient characteristics have to be carefully matched when comparing the outcomes in resurfaced and conventional patients, "Patient characteristics matter a lot…I think what happens is that patients select themselves. They think they (believe they) have a safety net with resurfacing, so they don't restrict activity (which makes them appear to get more activity)."
- In 10 years, resurfacing will have found a "legitimate place" in orthopedic surgeons' armamentarium.

The (large) audience was also polled. About 20% already are doing resurfacing, another ~30% said they plan to start, and ~50% said they won't do it because of worries about problems.

Most sources agreed that hip resurfacing will bring in more patients – younger patients – who are not eligible for a hip replacement, but they also agreed that the market for hip resurfacing is relatively small, estimating it will be about 16% of procedures.

- *California:* "It is pretty popular. About 200 surgeons have been trained on the Birmingham system, including two surgeons at our hospital. But it has a higher fracture rate than a standard hip, and there is a pretty limited population who qualify – men under age 66 and women under age 55…It won't expand the market, but if I had to get a hip done, I'd get resurfacing. It is less invasive, and the bail-out is a standard hip replacement. There are some real advantages to resurfacing."
- *Ohio:* "I do resurfacing in males under age 55. It is bringing patients in earlier who wouldn't have been a candidate for a hip replacement until 60 or 65…But you have to be a very good hip surgeon to do resurfacing well."
- *Florida:* "I'm just starting hip resurfacing, but in one year, it will be 25% of my procedures. It's a different patient mix – younger patients who don't have an option – that will increase the number of cases. It is an exploding market."
- *Texas:* "I'm suspicious, but it is premature to say it is bogus. The idea is good, and it could expand the market. I'm waiting to see how it does."
- *Missouri:* "None of the surgeons at our hospital are doing it because I remember the history (with this procedure). I want more follow-up before we do that. Hip resurfacing might be good, but in five years we also might be glad we didn't do it."

Will insurers pay for hip resurfacing? Medicare does not cover it, but hip resurfacing patients are younger than that. Sources said private payors are covering it, but they are not paying any more for it than for a TKR.

- *California:* "It is a hospital expense more than an insurer issue."
- *Ohio:* "There is not enough volume yet in resurfacing for insurance companies to react…I would expect some pressure from the hospital on resurfacing soon, but there hasn't been any yet."
- *Florida:* "Private payors have to cover it, and most are paying for it as a markup on the implant cost. I can't do it on Medicare patients because the hospital would lose money."

Other comments about hip resurfacing included:

- *New York:* "There is a lot of hype about (hip resurfacing) right now…It is an operation with a history, which was not very good. It has resurfaced…The technique is somewhat different, but there are still problems with the technique that we don't see with conventional THRs…The claims are not accurate…The younger patient in my office who thinks he can have resurfacing and go back to basketball and a marathon is overstating (the outcome)."
- *Montana:* "I think there will be some market expansion …There are a lot of people who don't want to lose their femoral head. They feel they are losing part of their body. Some patients mourn losing their femoral head…It will serve some patients who haven't been served, but it won't significantly add to the number of patients treated."
- *Michigan:* "It may have been released too soon."
- *Illinois:* "Resurfacing may increase in the short term, but long term it won't because it is difficult to do even in experienced hands, and it has a complication rate that hasn't really been fully examined…Part of the requirement is picking the right patient, but doctors want to choose an implant that is good for everyone."

- *Illinois:* "AAOS is really trying to make our decisions based on evidence-based medicine instead of marketing-based decisions…And we don't have enough data yet on this."
- "Many doctors trying to market their practice will start doing it."

Zimmer's Birmingham Hip System. Surgeons who are doing hip resurfacing or plan to start said this is their preferred system – because it has been around longer and has more data and experience.

Dr. Munawar Hashmi of the U.K. reviewed the functional results with the Birmingham hip and lessons learned with this system, concluding, "It can deliver in 90%-95% of patients…with outstanding patient satisfaction scores." Out of 99 patients with 107 THAs, he reported four failures, including:

- 1 at Week 8 in a patient with chronic renal failure but no known cause for the failure.
- 1 at Week 10 with a cystic head, which he called a selection mistake.
- 1 at 3 years in a prostate cancer patient.

Minimally Invasive Surgery (MIS) or Less Invasive Surgery (LIS) for Total Joint Replacement

Most orthopedic surgeons have adopted some kind of less invasive approach to total knee or hip replacements, whether they call it MIS or LIS or just "small incision surgery." Clinically, the results of less invasive or transitional surgical approaches differ very little, but patients generally prefer small incisions. Advantages of MIS/LIS include: cosmesis, quicker functional return/return to work, less patient fear factor, less blood loss, and possibly less narcotic use. Dr. Thomas Sculco of the Hospital for Special Surgery in New York said, "The trend is there to less invasive surgery, but it is not for every surgeon nor for every patient."

Dr. Steve Wilson of Stanford remains a critic of MIS. He explained, "I'm a skeptic because I think it was brought out to the public and to general orthopedic surgeons the wrong way. I think the studies should have been done before the procedure was widely disseminated…There is no proof MIS is any better than the standard procedure. (MIS) has been done since 2001, and there are only about 30-40 articles that are actually published and in English. Only two of these are randomized clinical trials…In one of these (by Dr. Sculco), the only difference between regular surgery and less invasive surgery was patients lost less blood – 1.3 ounces (40 cc). That is statistically significant, but that doesn't matter…The statistics kind of lie in that case…The bottom line was the patients did not require any more blood…Patients are pleased to have a smaller scar, but that is not an important factor in hip replacement. Most patients would rather have a hip last longer than have a smaller scar…The other study was an Irish study with >100 patients, comparing a 6-inch vs. a 3-inch incision …They found no benefits to MIS, no differences in MIS and standard therapy…So, there is no clinically important short-term benefit from MIS. Some studies showed increased complications, and there are no long-term data. And it is not known if lower-volume and less experienced surgeons can achieve similar results."

Dr. Sculco said it was difficult to enroll patients in his randomized trial comparing MIS to standard therapy because patients refuse to go in the traditional therapy arm, "They all preferred the shorter incision."

Dr. Lawrence Dorr, a consultant to Zimmer which has pushed MIS, defended it. He emphasized that small incision patients have greater patient satisfaction, "For 6-12 months (post-procedure), incision size is not important, but one-third of patients said they would not do a long incision again because they felt they would feel better about themselves with a shorter incision…My aunt on the farm doesn't care about a small incision…but I practice in Los Angeles, and in LA this is a big deal."

Total Ankle Arthroplasty (TAA)

An exceedingly small number of total ankle replacements (TARs) are currently being done, and sources expect it to continue to be a very niche market, but surgeons are excited about advances in the field. At AAOS, J&J launched its new Agility LP total ankle (it has had approval since 2002 for Agility, and since 2005 for the Topez ankle) as an alternative to ankle fusion surgery, which J&J estimated is performed on more than 12,500 people each year in the U.S.

Total Shoulder Arthroplasty

Reverse shoulders were the hot topic in this space. It is a niche procedure, with only a few thousand total shoulders done a year, and only a small percent of those reverse shoulders. Four companies currently offer reverse shoulders: Johnson & Johnson/DePuy, Zimmer, Encore, and Tornier. Comments included:

- *Utah:* "I use all but the J&J shoulder. There is not enough difference in any of them to say this is clearly 'The One.' There is some theoretical advantage to Encore's shoulder; it is a little more offset from the socket laterally, but we need more data to know if that is a real advantage. Encore claims its reverse implant should have better motion function, but the others have good results and less failures."
- *Connecticut:* "It is a great tool in the right application. I use the Tornier because I learned with their regular shoulder implant, but all four are comparable…The disadvantage is that the design is such that eventually, it will loosen. It is really a salvage operation for <2%-3% of shoulder replacements. I try my best not to do it."

- *Texas:* "It is not much of a solution, but no one has a better solution."
- *Michigan:* "It is the latest rage, but we need to find the best indications and watch long-term complications. Everyone is jumping on the bandwagon pretty quickly. I plan to start with the Tornier reverse shoulder. About 5% of shoulder replacements will be reverse shoulders…Only a few doctors do 20-30 a year, and it is hard to get a lot of experience even with that volume."
- *Colorado:* "The Tornier total shoulder is awesome. I plan to try their reverse shoulder, but I haven't done it yet."

SPINE

Percutaneous fusion

TRANS1 has developed an innovative, minimally-invasive surgical procedure for treatment of low back pain. It allows lumbar fusion to be performed through a percutaneous, trans-sacral approach, which permits preservation of the annulus and all paraspinal soft tissue structures. Single-level fusions can be performed in the U.S. up to L5-S1, and two-level procedures up to L4-5 are approved in Europe.

So far, the company says 350 orthopedic surgeons have been trained on its system, and 150 have started using it. At 10 centers, the procedure has moved from inpatient to outpatient. An official said, "We reached 1,000 procedures last year… Patients ambulate in about 4 hours, and they are back to work in 2 weeks." Interventional radiologists have been asking about it as well, but a company official said they are "avoiding that because we don't want to alienate the spine surgeons."

About 275,000 lumbar fusions are done annually, and a TranS1 official estimated 40%-50% of these are L5-S1, but he also said that about 20% of L5-S1 cases are ineligible because of (inappropriate) anatomy. Thus, about 36% of all fusions might be eligible for this percutaneous approach. An official said some doctors are using Medtronic's InFuse (rhBMP-2) with it, which makes it "faster but not better fusion."

The procedure is appealing, and the average sales price is $8,000. An official said this is not a Medicare procedure, and doctors pre-negotiate with insurers before procedures. He said that the company needs to:

1. Demonstrate good clinical results, which it is doing.
2. Change the site of cases from inpatient to outpatient, which they are also doing.
3. Get the message to primary care doctors and patients.

Artificial discs

Uptake of artificial discs has been slower than anticipated, in part because of reimbursement challenges. **JOHNSON & JOHNSON'S Charité** was the first to be approved (in 2004), followed last year by **SYNTHES' ProDisc-L**. A spine surgeon at AAOS said only a few surgeons are doing artificial discs, but the volume is expected to remain flat this year but perhaps decline in the future, "Not too many new doctors are starting use of artificial discs…We'll see more long-term complications and revisions, and people will get scared off…I know how to do Charité, but I'm not using it because I'm concerned about extrusion. I may start the ProDisc in the lumbar spine." He cited a recent survey of spine surgeons which found acceptance of artificial discs has been hindered by:

- Lack of revisability. This was the No. 1 reason surgeons cite.
- Insurance reimbursement.
- Medicare. In February 2006, CMS proposed denying any Medicare coverage for Charité, saying there wasn't enough data to say it was "reasonable and necessary," but CMS finally determined in May 2006 that it would allow local medical directors to decide whether or not they would reimburse for Charité.

PRICING

Most surgeons reported that their hospital has become more price conscious over the last year, but they generally can still get whatever implant they want to use. While about half the sources said their hospitals are trying to hold the line on orthopedic implant/device pricing this year, the others predicted that the industry will be successful in getting small price increases (~3%-5%) approved this year. Comments included:

- *Ohio:* "Our hospital has become more price conscious, but companies are taking new approaches to get premium products into the hospital. They are pre-selling implants to patients and insurers even before the surgery, so the hospital doesn't have to carry the implant cost. And some patients are willing to pay more for an 'upgraded' implant."
- *New York:* "Hospitals are more price conscious today, but at some big hospitals, it (implant pricing) slips under the radar."
- *Florida:* "What we're seeing is manufacturers becoming more accommodating to price caps…With our hospital, price is No. 1 and quality No. 2. It's all about cost for the hospital and the insurance companies, but the hospital's focus is more on price caps than on limiting the number of competitors."
- *Texas:* "The hospital never turns down my equipment requests or challenges the cost. They trust us."
- *Missouri:* "My hospital is more price conscious. When we got new orthopedic surgeons, we twisted their arms to use Zimmer. We try to agree jointly on any changes, so the hospital doesn't have to keep too much inventory. Zimmer has been good with putting in things on consignment."

- *California:* "More and more hospitals, like mine, are choosing two key vendors, but my hospital doesn't complain if I throw in an expensive implant."
- *Colorado:* "Our hospital is tightening a little. We can no longer bring in any vendor we want…Vendors can't keep raising prices."

Several doctors commented that they themselves are trying to be better stewards of healthcare dollars, but they feel torn between a medical malpractice risk, if they don't use the latest, greatest implant, and their desire to control costs.

None of the surgeons questioned reported any gain sharing going on at his/her hospital. A Midwest doctor's comment was typical, "I have a problem with that because it almost always leads to too much temptation to give patients less than they should be getting to make a profit for the doctor." An attorney gave gain sharing a "yellow light," suggesting doctors and hospitals get pre-approval from the government before doing this.

REGULATORY ISSUES

Kathleen McDermott, a partner in the law firm of Blank Rome and a former Assistant U.S. Attorney, warned surgeons that the Department of Health and Human Services' Office of the Inspector General (OIG) is focused on orthopedics. She offered some insights into how the government is thinking about issues affecting orthopedics right now:

What is the government enforcement perspective?

- Physician financial interests in product selection or use corrupts independent medical decision-making. "Every government lawyer believes that," she said.
- Regulatory agencies and hospitals cannot police the issue. "There is some truth in this," she added.
- Industry practices and incentives distort medical technology advancement and access to quality care. She said a good example of this is the proliferation of physician investors, joint venture arrangements, and switching behavior where doctors get money to be with one manufacturer, "There is evidence of that in the industry. AdvaMed asking the OIG for guidance on this, and got an answer in 30 days. That ought to scare all of us. It is unprecedented (to get an answer that quickly)…(The OIG) is very concerned about the influence of money, and they don't accept the argument that there is an advancement of medical technology (through these arrangements)…They perceive that it stifles advancement of medical technology and creates an unlevel playing field for all manufacturers because medium and small companies can't pay…There is real evidence of switching behavior, of doctors asking for money."

  She emphasized that the OIG has ***clear*** evidence of this, with sales reps or doctors on:

  - Tapes, with comments like, "I won't look good in stripes."
  - Emails, with comments like, "You know…greedy doctors…have to pay to play."
  - Power point presentations, with industry frequently making a pitch on why doctors should use a particular product including arguments about reimbursement or the ability of a practice to achieve greater revenue.
- Government enforcement efforts are likely to come against hospitals "soon," and may include any or all of the following:
  - Criminal prosecutions.
  - False Claims Act whistleblower prosecutions.
  - Administrative sanctions and exclusions.

A number of new issues are on the government horizon, and she urged surgeons and the orthopedics industry to pay attention because Assistant U.S. Attorney for the eastern District of Pennsylvania James Sheehan – a key prosecutor in the fraud area – has been talking a lot of this in the past year. "Take it seriously," McDermott advised.

- **Quality care prosecutions for unapproved, uncredentialed procedures.** She called this a "very dicey area," where hospitals, doctors, and manufacturers are in the mix when a procedure is not fully credentialed or approved, "The government may not fully understand what occurs. But as new technology is advancing and procedures are done a little differently than what was approved, are they being credentialed? Is there a hospital technology committee looking at what's happening? The government believes…that docs sometimes go to weekend courses by industry, learn how to put in a carotid stent, and then go home and do it at the hospital…Sheehan says he will focus more on this."
- **Research funding for physician practices.** She said, "There appears to be more large, private physician practices doing research with industry – in interventional cardiology, for example."
- **Charitable donations and foundations organized or run by private physician practices.** McDermott warned that there will be both media stories and government actions in this area.

The ongoing government investigations of the orthopedic industry – subpoenas were issued in March 2005 (to J&J, Biomet, Smith & Nephew, Stryker, and Zimmer) and again in 2006 – but these investigations can take years before there is any outcome or news. McDermott said she expects some announcement/action in a year to a year and a half. Surgeons said they have seen few changes in industry behavior, though a few said industry has gotten somewhat more conservative in the venues for its meetings (less elegant), dinners, or trips, but not a decrease in research funding.

Medicare

A study presented at AAOS warned that Medicare recipients who become candidates for total joint replacement in the next decade will likely see their out-of-pocket expenses increase. One of the authors, Kevin Ong, Ph.D., said, "National annual hospital charges for primary THA could increase by 340% to $17.4 billion, while TKA may go up 450% to $40.8 billion. Surgical charges to THA are projected to increase by 180% to $1.9 billion, and TKA will rise 250% to $5.1 billion."

These researchers also predicted hip revisions will grow by 137% and knee revisions by 601% between 2005 and 2030. Dr. Ong added, "This may have enormous impact on hospital and surgeon utilization, especially since Medicare reimbursements average only 32%-38% of the charges per procedure."

MISCELLANEOUS

Gene therapy. Experts on a gene therapy panel were excited about progress being made with gene therapy in orthopedics. Steven Goldstein Ph.D. of the University of Michigan predicted that there will be "a lot" of Phase I clinical safety trials within five years and "likely a couple of Phase II trials in 3-8 years from now" using gene therapy to enhance tissue regeneration. He pointed to a study that applied adenovirus-delivered genes in a 3-D matrix to diabetic foot ulcers, saying, "That trial not only proved safety, but almost all the patients healed well with a very low dose."

Dr. Regis O'Keefe, Director of the University of Rochester's Center for Musculoskeletal Research, said the FDA is currently considering a proposal by the Musculoskeletal Transplant Foundation, "The FDA wants additional experimental evidence before a clinical trial, but we hope to start a trial in the next 1-2 years." This effort has no commercial involvement.

Gene therapy may prove most useful in orthopedics in combination with something else, such as bone morphogenic protein (BMP), experts suggested. Dr. Goldstein said, "As general principal, recombinant protein therapies (e.g., BMP) are relatively short-lived therapies…They cause a high level response early that then goes away, which is partly because your body always tries to get rid of protein placed in it…So, they degrade quickly…But, it (protein therapies) kick start the process…With a gene therapy regimen, it is 3-6 weeks before cells die off…So, you could see circumstances where you would want to have something to give it a kick early and then genes to continue the process."

BIOMIMETIC THERAPEUTICS' GEM OS1 bone graft is in develop-ment to speed bone healing in ankle fractures. The company did not have a booth at AAOS, and only one of the surgeons questioned – including experts on BMP – knew anything about it or GEM OS1. However, one source (past president of the American Shoulder and Elbow Surgeons Society) said he is working with the company on a variation of GEM OS1 for the shoulder, and he was fairly enthusiastic about it.

CAYENNE MEDICAL was getting a lot of traffic at its booth with its AperFix System for anterior cruciate ligament (ACL) repair, which was approved by the FDA in November 2006. So far, only about 20 cases have been done, and the company said it is building product. It is designed for use in outpatient surgery centers, and it is being sold through independent distributors.

AperFix, which was developed by a spine surgeon, was described as "like a wall anchor" – the type used for hanging pictures in plasterboard or drywall. The concept is simple, and doctors liked it, but they raised several issues:

- **Is there a need?** A Texas doctor said, "There are some potential advantages, but how much practical advantage there is remains to be seen…It is not the wheel re-invented. ACL surgery is successful. But Cayenne's device is well-designed and has promise. I'll try it."
- **Is the cost justified?** Standard instruments used for ACL repair cost about $600-$700 in an outpatient surgery center, but this device lists for $895, though a company official indicated it would negotiate pricing. And he pointed out that the device can cut the time of a procedure in half. He said, "We don't want the price to keep us from becoming the gold standard." One doctor who looked at it said, "It's a great concept, but doctors are getting more active in surgery center (investments), so they are more price conscious. It's really nice, but it is a fix for a problem that doesn't exist…It is high tech, but the cost is preclusive. The time saving won't justify the cost." Another doctor thought pricing was less of an issue, "In one center I use, the cost is passed on to the insurer, so cost doesn't matter to me, but I want more data first." A California doctor said, "If it lets us do an ACL faster, and if it is cheaper, I might use it."
- **Anchoring.** AperFix anchors into cancellous bone, and that is a concern for some doctors who looked at it. One said, "I won't use cancellous fixation. I prefer cortical fixation because it has better pull-out strength."
- **Material.** AperFix ligament is made out of PEEK (Poly-Ether-Ether-Ketone), and one source thought that wasn't innovative enough. A doctor said, "My biggest concern is PEEK. I want a more biofriendly material."

Doctors also pointed to two other companies as having interesting new products:

- **APERIO**, which provides systems and services for digital pathology.
- **KLS MARTIN**, which in September 2006 got FDA approval for Sternal Talon, a sternotomy plate. This fixation system for open heart procedures was developed by an orthopedic surgeon, Dr. Lawrence Levin of Duke. ♦