2023 Hip and Knee Implant Review

A publication and on-line information service on cost and quality issues in orthopedics.

Orthopedic Network News

VOLUME 34
NUMBER 3
SEPTEMBER 2023

IN THIS ISSUE

The number of US hip and knee implant procedures performed in the United States increased between 2021 and 2022 by 4.6% to 2.06 million according to estimates from iData Research, Inc. of Vancouver, British Columbia. The number of hip replacement procedures grew 3.8% to approximately 766 thousand, and knee replacements grew 5.1% to approximately 1.3 million. The fastest growing segments were revision knee procedures (up 8.1% over 2021) and primary knees (up 5.0% to 1.08 million). Revision knees outnumber revision hips but both represent approximately 10% of annual primary procedures.

The top 10 U.S. hospitals performing Medicare inpatient and outpatient hip and knee replacement procedures contains many familiar names. Mayo Clinic, however, dropped off the top ten list for the first time in more than a decade. Some of the hospitals, such as Hospital for Special Surgery, New England Baptist, Christiana Care Wilmington Hospital have been in the top 10 joint programs for the previous 10 years. Although the methods of providing services may vary between hospitals, the percentage of outpatient cases ranged from a low of 43% at Hospital for Special Surgery to a high of 89% at Christiana Care Wilmington Hospital.

Rounding out the top 10 in 2022 were HOAG Orthopedic Institute, Morristown Medical Center, Orlando Health Orlando Regional Medical Center, NorthShore University HealthSystem Evanston Hospital, Lehigh Valley Hospital - Cedar Crest, Atrium Health Mercy, O.A.S.I.S Hospital.

Estimates of U.S. Hospital Hip and Knee Replacement Procedures: 2021-2022

	2021 Estimated Procedures	2022 Estimated Procedures	% Change 2021-2022
Hip	**737,503**	**765,558**	**3.8%**
Total	555,967	581,043	4.5%
Partial	101,556	102,104	0.5%
Revision	75,141	77,925	3.7%
Resurfacing	4,839	4,486	-7.3%
Knee	**1,235,835**	**1,299,084**	**5.1%**
Primary	1,031,229	1,083,061	5.0%
Unicondylar + PFJ	71,357	72,977	2.3%
Revision	120,584	130,312	8.1%
Patello-Femoral	12,665	12,734	0.5%
Total Hips and Knees	**1,973,338**	**2,064,642**	**4.6%**

Source: HCUP Nationwide Inpatient Sample (NIS) from AHRQ. Procedure estimates for Internal fixation based on ICD-10-PCS codes 0NH, 0NS, 0PH, 0PS, 0QH, 0QS, 0RH, 0RS, 0SH, 0SS and 6th digit 0, 4 or 6. External fixation has same 3-digit roots with 6th digit of 5, B, C, or D.

Top 10 U.S. Hospitals with Medicare Inpatient and Outpatient Hip and Knee Replacements 2022

		2022 Medicare Cases	% OP	10 Year Top 10
Hospital for Special Surgery (3016392)	New York, NY	5,467	43%	10
New England Baptist Hospital (3007473)	Roxbury Crossing, MA	2,091	69%	10
HOAG Orthopedic Institute (3026339)	Irvine, CA	1,321	77%	7
Morristown Medical Center (3007715)	Morristown, NJ	1,317	69%	2
Orlando Health Orlando Regional Medical Center (3022389)	Orlando, FL	1,264	48%	7
Christiana Care Wilmington Hospital (3003826)	Wilmington, DE	1,199	89%	10
NorthShore University HealthSystem Evanston Hospital (3010906)	Evanston, IL	1,198	72%	2
Lehigh Valley Hospital - Cedar Crest (3003945)	Allentown, PA	1,161	74%	1
Atrium Health Mercy (3009040)	Charlotte, NC	1,133	60%	2
O.A.S.I.S Hospital (3029402)	Phoenix, AZ	1,073	49%	1

Cases with DRGs 480-482. Source: Dexur compiled from CMS data for CY 2022 has same 3-digit roots with 6th digit of 5, B, C, or D.

Additional information was solicited from these hospitals, including total case volumes, and percentage of cases that were revisions. Responses were received from 3 of the top 10.

A low percentage of Medicare procedures indicates that the hospital is probably performing higher-paying non-Medicare joint replacements, while a higher percentage indicates more Medicare patients with potentially lower reimbursement. In this group, HOAG Orthopedic Institute had the highest Medicare percentage of patients at 60% (see page 2), and Orlando Health Orlando Regional Medical Center had the lowest at 29%.

A high percentage of revision cases may indicate that the hospital may be a referral center for difficult to treat revisions. The Orlando Health Orlando Regional Medical Center reported 13% of their joint replacements as revision cases.

Top 10 Medicare Hip and Knee Replacement Hospitals (2021-2022)

	Year	Cases	Medicare	Revisions
Hospital for Special Surgery	2021	NA	NA	NA
Ney York, NY	2022	NA	NA	NA
New England Baptist Hospital	2021	5,810	53%	6%
Roxbury Crossing, MA	2022	5,923	55%	6%
HOAG Orthopedic Institute	2021	3,845	63%	6%
Irvine, CA	2022	4,176	60%	6%
Morristown Medical Center	2021	NA	NA	NA
Morristown, NJ	2022	NA	NA	NA
Orlando Health Orlando Regional Medical Center	2021	4,597	25%	12%
Orlando, FL	2022	5,861	29%	13%
Christiana Care Wilmington Hospital	2021	NA	NA	NA
Wilmington, DE	2022	NA	NA	NA
NorthShore University HealthSystem Evanston Hospital	2021	NA	NA	NA
Evanston, IL	2022	NA	NA	NA
Lehigh Valley Hospital – Cedar Crest	2021	NA	NA	NA
Allentown, PA	2022	NA	NA	NA
Atrium Health Mercy	2021	NA	NA	NA
Charlotte, NC	2022	NA	NA	NA
O.A.S.I.S Hospital	2021	NA	NA	NA
Phoenix, AZ	2022	NA	NA	NA

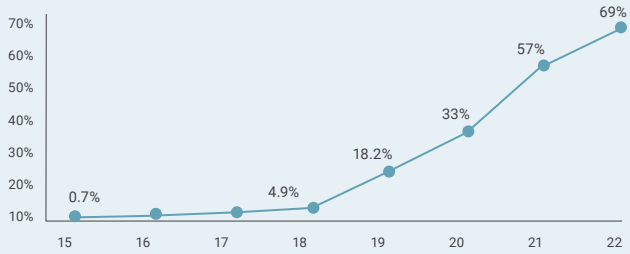
The Shift to Outpatient Joint Replacements

Medicare reimbursement for TKA and total hip replacements began in 2020 and 2021 respectively and the shift to less expensive outpatient surgery departments (HOPDs), or ambulatory surgery centers (ASCs) has been dramatic.

According to Dexur, the percentage of Medicare joint replacements that were performed in hospital outpatient facilities increased from approximately 14% to approximately 69% in 2022.

The movement to outpatient procedures has not been uniform across individual states. States with the highest outpatient penetration, like Maine, Delaware, Idaho and New Hampshire reported high 80% to low 90% of their joint replacements being performed in outpatient settings. The lowest were hospitals in Oklahoma, New York, Massachusetts and West Virginia, reporting 45%-57% of Medicare procedures as outpatients. The large variances could be explained by the prevalence of hospital owned ASCs or physician owned hospitals. Physician-owned facilities doesn't have the incentive to push these cases to outpatient sites of care.

Percentage of Medicare Joint Replacements that were Outpatient



Source: www.dexur.com

Medicare Hospital Outpatient Joint Replacements, by State

State	2018	2019	2020	2021	2022	Chg 18-22
Overall Average	13.6%	18.2%	33.0%	56.6%	68.8%	55.2%
Highest HOPD Penetration						
Maine		24.0%	53.0%	80.0%	92.6%	
Delaware		35.0%	54.0%	82.0%	91.1%	
Idaho		23.4%	46.6%	76.6%	90.3%	
New Hampshire		11.6%	44.7%	67.3%	87.1%	
Lowest HOPD Penetration						
Oklahoma	2.0%	5.0%	23.0%	22.0%	45.1%	43.1%
New York	3.0%	9.0%	20.0%	33.0%	49.5%	46.5%
Massachusetts		11.0%	25.0%	36.0%	57.1%	
West Virginia		12.4%	36.9%	57.8%	57.2%	

Source: www.dexur.com; 1 Includes hospitals with at least 10 cases.

EDITORIAL

Is Product Leadership in Orthopedics Dead?

ANDY PERRY
Co-Founder and CEO at Curvo Labs

Medical Design and Outsourcing publishes a list of the top medtech companies by revenue and tracks research and development spending by company or its relevant medtech division in a few cases. In its most recent list of the top R&D spenders as a percentage of medtech revenue, heart and vascular companies run amuck (as do camel-cased company names, sheesh). Pure play orthopedics companies with a big U.S. market footprint are nowhere to be found.

Some of these figures would be staggering for an ortho company (nearly all are sub ten percent). With surgical robotics officially in a "me too" phase of the product lifecycle, is it reasonable to conclude that the musculoskeletal device space is one where major players are content to iterate on stable technologies in a tacit truce? When every surgeon ASC-owner and every supply chain curmudgeon (full disclosure, I am one) wants a pound of flesh, and when the current go-to-market model in the U.S. requires hefty selling, general & administrative costs, is it any wonder? Amidst all the craze of inflation over the past 24 months, the Bureau of Labor Statistics CPI tracker shows that prices for medical services experienced deflation (-0.8%) in the trailing twelve months ending June 30, 2023 (Source: BLS Consumer Price Index Summary July 12, 2023). Are companies content to let emergent players handle innovation?

I like to keep our editorials thematic and contemporary. That means the relevance may have a short shelf life. What we write here may look either laughably ignorant or laudably prescient within a view short weeks or months. My personal history across many aspects of life suggests I have more hits on ignorance than misses–though I WAS harping on inflation before inflation was cool. We wrote recently about the application of AI in the selection and sale of medical devices for patients. We have also recently covered the market motions toward value-based care.

In the spirit of keeping things relevant and contemporary (hip, with it, cue the Macarena), let's talk about a business concept from the early Clinton administration.

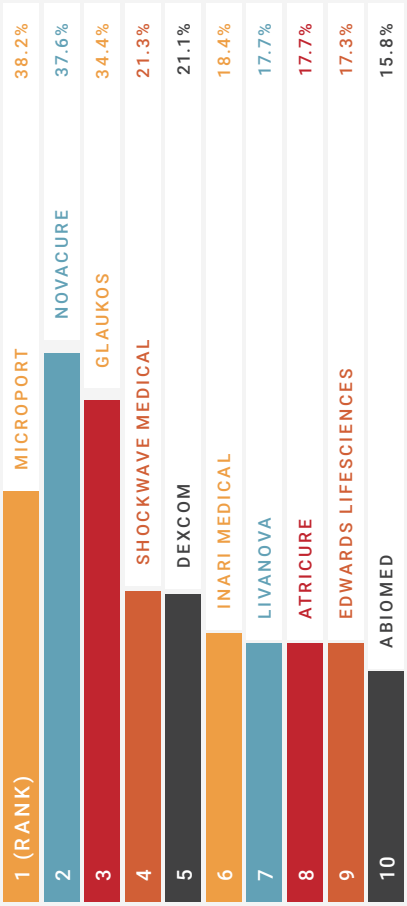
Far more relevant today than its publication date may suggest, Michael Treacy and Fred Wiersema posited that a company's market success depends on its ability to compete, lead, and win on one of three, primary value disciplines: customer intimacy, product leadership, and operational excellence.

At this publication, we have been talking to people up and down the market recently about how well the current, long-in-place medical device go-to-market model has been working for its various stakeholders. We have spoken to corporate sales and marketing leaders in large, global medical device companies. We have spoken;-to supply chain leaders of mega-sized U.S. health systems. We have spoken to distributorships and 1099 medical device sales reps.

What we are learning is fascinating: the current model isn't working for anyone.

Device representatives are busy chasing down inventory in order to service physicians and cases. They don't have the time, the bandwidth, or the data to sell new products. Health system supply chains look at the P&L of device companies and question how much of a dollar is going towards selling costs. They look at their own P&L and see nothing but red. Corporate commercial leaders at device companies bemoan how they can't get talent or reps don't sell, even when there is a clear value prop and competitive advantage.

2022 R&D AS PERCENTAGE OF REVENUE



Source: www.medicaldesignandoutsourcing.com
February 28, 2023

The medical device go-to-market model in the U.S. has largely been a customer intimacy play. Segment by surgeon and build strong relational equity through high-touch hustle, reliable service, and some product collaboration. Health systems lose some money on public payors but make up for it in the private pay market. It's not working anymore. Neither the economics nor the mechanics.

If we view the world through a lens of Treacy and Wiersma, it suggests a couple of things:

1. There's an opportunity for a Product Leadership Winner
2. There's an opportunity for an Operational Excellence Winner

The 2022 WW Hip and Knee Implant Market

The world-wide (WW) hip and knee implant market grew 4.4% between 2021 and 2022 to $17.2 billion, according to data compiled by ORTHOWORLD, of Chagrin Falls, Ohio. US sales accounted for about 63% of the 2022 sales according to ORTHOWORLD. The change in WW sales for 2010-2022 for hip and knee implants are chronicled in the graphic at the right. Since 2011, up until 2020, sales increases have averaged low single digits, dropped substantially in 2020 due to COVID and then rebounded in 2021. ORTHOWORLD estimates that US hip and knee sales grew 5.7% vs. 2.6% for the rest of the world.

All manufacturers, with the exception for Smith & Nephew, reported sales growth on an as-reported basis for 2022. Stryker reported 7.0% growth and Zimmer Biomet reported 3.8% and DePuy Synthes 2.4%. The "Other" manufacturers grew 6.0% between 2021 and 2022 and accounted for more than 27% of the market. The largest hip and knee implant manufacturers in 2022 were Zimmer Biomet with a 27.1% share, followed by Stryker with 20.2%, DePuy Synthes with 16.7%, and Smith and Nephew with 8.7%.

In examining the hip and knee implant market separately, the leaders and dynamics are the same. Zimmer Biomet led both the knee and the hip market with 24.2% of the sales of hips and 30.0% of the sales of knees in 2022 but lost share in hips and was flat in knees. Stryker was number three in hips with 18.1% market share and number two in knees 21.9%. DePuy Synthes ranked number two in hips and three in knees and Smith & Nephew was the number four market share leader in both hips and knees.

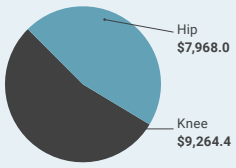
It should be noted that the calculation of market shares for each of these companies is somewhat of an art, because of the different ways that sales are reported. For example, some companies will report sales in North America, which would include Canada, while others will report US sales, and yet others will report sales for the "Americas." In summary, it is a logistical and numerical challenge to report this information consistently between years and between companies.

Curvo Research Network (CRN) further reviewed some of the major brands of the leading manufacturers of hip and knee implants—Zimmer Biomet, Stryker, DePuy Synthes, and Smith & Nephew from the CRN, a group of several hundred hospitals that submit data to CRN or Curvo Labs.

WW Hip and Knee Implant Markets and Shares, 2021-2022

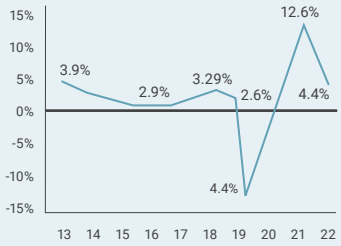
Total WW 2021 Hip/Knee Sales	**$16,506.3** million
Total WW 2022 Hip/Knee Sales	**$17,232.4** million
2021-2022 Increase	**4.4%**

2022 WORLDWIDE SALES DISTRIBUTION



Source: ORTHOWORLD

PERCENT SALES CHANGE US & WW HIP AND KNEE IMPLANTS



Source: Orthopedic Network News, 2006-2017
Note: 2012-2016 is US Sales change, 2016-2022 is WW sales change

HIP AND KNEE IMPLANTS

Company	Sales ($mill) 2021	Sales ($mill) 2022	WW Growth	2021 Share	2022 Share	Share Change
Zimmer Biomet	$4,504.0	$4,673.2	3.8%	27.3%	27.1%	-0.2%
Stryker	$3,247.5	$3,473.7	7.0%	19.7%	20.2%	0.5%
DePuy Synthes	$2,805.3	$2,873.3	2.4%	17.0%	16.7%	-0.3%
Smith+Nephew	$1,497.5	$1,491.1	-0.4%	9.1%	8.7%	-0.4%
Other	$4,452.0	$4,721.1	6.0%	27.0%	27.4%	0.4%
Market Total	$16,506.3	$17,232.4	4.4%	100.0%	100.0%	

HIP IMPLANTS

Company	Sales ($mill) 2021	Sales ($mill) 2022	WW Growth	2021 Share	2022 Share	Share Change
Zimmer Biomet	$1,856.1	$1,894.9	2.1%	24.2%	23.8%	-0.4%
Stryker	$1,366.6	$1,440.5	5.4%	17.8%	18.1%	0.3%
DePuy Synthes	$1,480.2	$1,514.3	2.3%	19.3%	19.0%	-0.3%
Smith+Nephew	$615.1	$587.6	-4.5%	8.0%	7.4%	-0.6%
Other	$2,358.4	$2,530.8	7.3%	30.7%	31.8%	1.0%
Market Total	$7,676.4	$7,968.0	3.8%	100.0%	100.0%	

KNEE IMPLANTS

Company	Sales ($mill) 2021	Sales ($mill) 2022	WW Growth	2021 Share	2022 Share	Share Change
Zimmer Biomet	$2,647.9	$2,778.3	4.9%	30.0%	30.0%	0.0%
Stryker	$1,880.8	$2,033.2	8.1%	21.3%	21.9%	0.6%
DePuy Synthes	$1,325.1	$1,359.0	2.6%	15.0%	14.7%	-0.3%
Smith+Nephew	$882.4	$903.5	2.4%	10.0%	9.8%	-0.2%
Other	$2,093.7	$2,190.3	4.6%	23.7%	23.6%	-0.1%
Market Total	$8,829.9	$9,264.4	4.9%	100.0%	100.0%	

Source: Other includes approximately 150 companies for the hip and knee market including Aesculap, Medacta, Microport Orthopedics, ConforMIS, Exactech, DJO, Waldemar Link, Amplitude, Mathys, Corin, Kyocera, and Lima. Hip and Knee implants include implants, instruments and surgical assistance systems, e.g. robotics and navigation, to replace or revise failed hip and knee joints.
Source: ORTHOWORLD, Inc.

For convenience sake, the sales of total, partial, and revision hips have been combined for hip implants, and total, unicondylar, and revision knees for knee implants.

For the leading manufacturer of hip implants in the CRN, Zimmer Biomet, the Arcos, Taperloc and Avenir accounted for 68% of the hip implant systems, with the Avenir showing the greatest growth. For Stryker, the Accolade, Restoration, and recently launched Insignia were the leading three brands which accounted for 88% of their hip sales. Although there are literally thousands of components that Stryker sells that are branded as "Accolade" brand, the Accolade systems accounted for about 65%+ of Stryker hip sales in 2021 and 2022. DePuy Synthes hip sales were led by Actis, Corail, and Summit which together accounted for about 85% of their hip sales in 2021. Smith & Nephew's Polarstem, Redapt, and Anthology systems accounted for about 77%.

The top 4 manufacturers of knee implants had a similar amount of brand concentration. Zimmer Biomet's Persona, Vanguard and NexGen accounted for 91% of their knee sales, while Stryker's Triathlon, Restoris, and GMRS accounted for 98% of their sales. DePuy Synthes' Attune, Sigma, and LPS accounted for 96% of theirs, and Smith & Nephew's Legion, Journey and Genesis had 100% of their US sales.

CRN identified the "fastest growing hip and knee implant companies" based on sales changes at 143 hospitals that reported sales of hip implants in both 2021 and 2022. There were 142 hospitals that had sales of knees in both years. Because most of these companies' sales are relatively low, CRN reports a range of percentage increases rather than an absolute number to eliminate the distortion accompanying small numbers. Based on the analysis, the fastest growing hip implant companies were Shalby Advanced Technologies (formerly known as Consensus Ortho), StelKast, G21 SRL, LinkBio, NextStep Arthropedix, Onkos Surgical and OsteoRemedies. All reported at least double digit sales growth, while some reported over 100% sales growth in the selection of hospitals. The fastest growing knee implant companies included Shalby, Maxx Orthopedics , Onkos Surgical, Arthrex, Total Joint Orthopedics, Kinamed and Lima USA Inc, all of whom reported over 35% sales growth in the hospital data reviewed. It should be emphasized that the actual sales at these companies is not public information, so it is very possible that they may not see the sales increases reported here.

Distribution of Sales, Selected Hip and Knee Implants 2021-2022

HIP IMPLANTS Mfg	Top 3 Major Brands of Hips	2021 CRN $ Mix	2022 CRN $ Mix	Change 2021-22
Zimmer Biomet	Taperloc	29%	28%	-1%
	Arcos	22%	22%	-0%
	Avenir	15%	18%	3%
	Other	34%	32%	-1%
		100%	100%	
Stryker	Accolade	67%	65%	-2%
	Restoration	18%	18%	-0%
	Insignia	0%	6%	6%
	Other	15%	12%	-3%
		100%	100%	
DePuy Synthes	Actis	40%	45%	4%
	Corail	25%	22%	-3%
	Summit	16%	18%	1%
	Other	18%	15%	-3%
		100%	100%	
Smith & Nephew	Polarstem	34%	33%	-1%
	Redapt	20%	24%	4%
	Anthology	19%	21%	2%
	Other	27%	23%	-5%
		100%	100%	

KNEE IMPLANTS Mfg	Top 3 Major Brands of Knees	2021 CRN $ Mix	2022 CRN $ Mix	Change 2021-22
Zimmer Biomet	Persona	63%	65%	2%
	Vanguard	21%	20%	-2%
	NexGen	6%	6%	-0%
	Other	10%	9%	-0%
		100%	100%	
Stryker	Triathlon	90%	92%	2%
	Restoris	6%	5%	-1%
	GMRS	3%	1%	-1%
	Other	1%	2%	0%
		100%	100%	
DePuy Synthes	Attune	76%	78%	1%
	Sigma	13%	10%	-3%
	LPS	6%	7%	1%
	Other	4%	4%	0%
		100%	100%	
Smith & Nephew	Legion	54%	50%	-4%
	Journey	41%	45%	5%
	Genesis	4%	5%	1%
	Other	2%	0%	-1%
		100%	100%	

Fastest Growing Hip and Knee Implant Companies (US) 2021-2022

FASTEST GROWING HIP IMPLANT MANUFACTURERS

Brands	2021-2022 Increase
Shalby Advanced Technologies	> 100%
StelKast	> 100%
G21 SRL	> 100%
LinkBio	> 50%
NextStep Arthropedix	>10%
Onkos Surgical	>10%
OsteoRemedies, LLC	~ 10%

FASTEST GROWING KNEE IMPLANT MANUFACTURERS

Brands	2021-2022 Increase
Shalby Advanced Technologies	> 100%
Maxx Orthopedics	> 100%
Onkos Surgical	> 100%
Arthrex	> 100%
Total Joint Orthopedics	> 50%
Kinamed	~ 50%
Lima USA Inc	> 35%

The Publicly Traded Companies

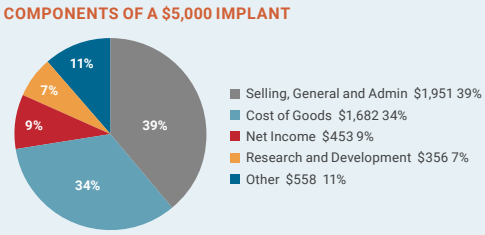
The largest US hip and knee implant manufacturers are publicly traded. As public companies, their financial performance is subject to quarterly and annual reporting through the Securities and Exchange Commission (SEC). Theoretically, one can impute how a company spends its money on products from their filings, however that is often challenging because of mergers and acquisitions or having publicly traded orthopedic companies buried inside larger ones. For example, DePuy Synthes is buried within the public reporting of Johnson & Johnson where the expenses of orthopedic products are not detailed.

This year Curvo Research Network was able to analyze the reports from Zimmer Biomet, Stryker, Johnson & Johnson, Smith & Nephew.

The 10-K's submitted by the companies separate expenses into categories of cost of goods sold, selling/general/administrative expenses, research and development, taxes, and net income. Cost of goods sold is the cost of materials and manufacturing of the implants by the company and is measured as a percentage of sales. Payments to surgeon consultants may be counted in R&D or in cost of goods, depending on the company's policy.

Based on the overall average percentages of expenses, the largest component of these companies' expenses was selling, general, and administrative expenses, which averaged 39.0% in 2022, down slightly from 41.9% in 2021. Research and development averaged 7.1% of sales in 2022, up from 6.9% in 2021, and the cost to manufacturer (cost of goods) was the second largest category of expenses at 33.6% for the group, up from 33.2% in 2021.

Components of an Orthopedic Implant



Source: Components allocated based on ZB, Stryker, J&J and S&N 2022 average.

All of the companies reported increases in net income; Stryker reported net income of more than $2.3 billion, up from approximately $2.0 billion in 2021; Zimmer Biomet reported net income of $231 million, and Smith & Nephew reported income of $223 million.

Sales growth was mixed, with Stryker reporting growth of 3.5%, Zimmer Biomet 1.7%, DePuy Synthes flat and Smith & Nephew reporting a 2.0% reduction in sales.

The world-wide sales of hip and knee implants were obtained from company filings and compared to their overall orthopedic portfolio. A high percentage indicates the company is dependent on hip and knee replacements to drive their sales and growth. The highest percentage was reported for Zimmer Biomet with 67.3% of its orthopedics sales derived from hip and knee replacements. Stryker hip and knee sales represented 43.5% of the company's orthopedics sales, but 18.1% of overall sales. DePuy Synthes and Smith & Nephew reported 33.5% and 28.4% respectively.

Comparison of 2021-2022 Key Financial Statistics, Publicly Traded Orthopedic Implant Companies

	2022 WW	Cost of Goods		Research and Development		Selling, General Admin		Net Income		WW Hip and Knee		WW Sales Change
Manufacturer	**$ (mills)[1]**	**$ (mills)**	**%**	**$ (mills)**	**%**	**$ (mills)**	**%**	**$ (mills)**	**%**	**$ Sales**	**% WW Sls**	**21-22**
Stryker *Stryker Ortho*	$18,849 $7,838	$6,871	36.5%	$1,454	7.7%	$6,455	34.2%	$2,358	12.5%	$3,410 *Hip/Knee*	41.9%	3.5%
All Johnson & Johnson *Orthopedics*	$94,943 $8,588	$31,089	32.7%	$14,603	15.4%	$24,765	26.1%	$17,941	18.9%	$2,873	33.5%	0.0%
Zimmer Biomet	$6,940	$2,020	29.1%	$406	5.9%	$2,762	39.8%	$231	3.3%%	$4,673 *Hip/Knee*	67.3%	1.7%
Smith & Nephew *Orthopedics*	$5,215 $2,113	$1,540	29.5%	$345	6.6%	$2,880	55.2%	$223	4.3%	$1,483	28.4%	-2.0%
Average			33.6%		7.1%		39.0%		9.1%		30.9%	0.8%

Hospital Resources and Implant Cost Management — A 2023 Update

The average cost of a hip and knee implant for US hospitals in 2022 was flat at $4,917. This estimate is based on data obtained from a group of 150 hospitals that submitted data in either 2021 or 2022. Note that the implant costs per case include not only implants, but also bone cement, bone grafts and substitutes, instruments, robotics (usage fees/disposables), soft tissue balancing, loaner fees, and other supply costs associated with the surgeries. These represent 5.9% of the total spend of the overall costs, down from 6.7% last year.

The overall ASP for all hip procedures decreased 4% to $4,883 while the overall knee implant costs increased 3% to $4,981. The largest increases were reported for partial hip (up 13% due to mix shift), and revision knee (9%), while primary knee increased 4%, total and partial hip were flat and revision hip declined.

Procedure mix changed in 2022, with revision and partial hip and total knee growing proportionally. Total hip, revision knee, and partial hip, all declined proportionally.

Total Hips

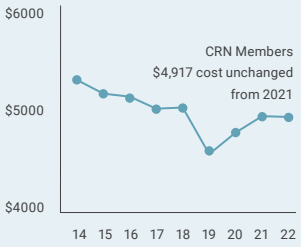
The trends in total hips that began more than a decade ago are now fairly settled. Hard-on-hard surfaces, which include metal on metal hips or ceramic on ceramic hips, have virtually disappeared. Porous stems and ceramic heads with poly liners now dominate. In addition, mobile bearing hips are showing up more because of a reclassification of some devices into a new category.

Hard-on-hard hips all but disappeared in the 2022 CRN, down from as much as 43% in 2007. Ceramic heads with coated hip stems and poly liners accounted for almost 72% of the cases in 2022, while metal heads with coated hip stems accounted for 12% of the cases. Coated hip stems have increased from 40% of the stems in 1999 to 94% in 2022, while the cemented hip stems declined from 54% of the stems in total hips in 1999 to 4% in 2022.

The mobile bearing hips registered a 8% decrease in average selling price (ASP) between 2021 and 2022 to $5,955, while the constructs which used coated hip stem and ceramic head increased 4.8%, and the coated hip stem with a metal head had no change.

Average Cost of Implant Components by Procedure

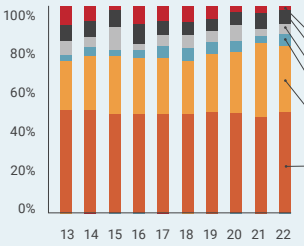
IMPLANT COST/PROCEDURE



	2021	2022	Chg
Overall	$4,925	$4,917	?????
Total Hip	$4,990	$5,007	0%
Primary Knee	$4,047	$4,220	4%
Partial Hip	$3,121	$3,114	-0%
Partial Knee	$3,582	$4,033	13%
Revision Hip	$6,029	$5,797	-4%
Revision Knee	$9,825	$10,725	9%
Overall Hips	$5,043	$4,833	-4%
Overall Knees	$4,837	$4,981	3%
Overall Hip + Knee	$4,925	$4,917	-0%

Source: CRN

CRN Market Share by Procedure 2013-2022

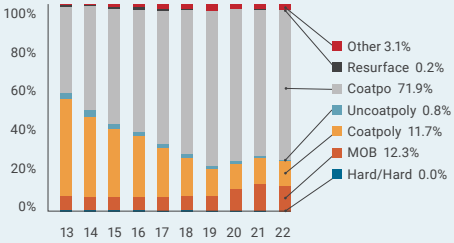


	2021	2022	Chg
Partial Knee	2.5%	1.8%	-0.7%
Revision Knee	8.0%	6.7%	-1.3%
Revision Hip	3.6%	4.9%	1.3%
Partial Hip	3.4%	6.0%	2.6%
Total Hip	35.9%	31.8%	-4.0%
Total Knee	46.7%	48.7%	2.0%
	100.0%	100.0%	

Source: CRN

Trends in Total Hip Constructs, 2013-2022

% OF CASES BY CONSTRUCT TYPE

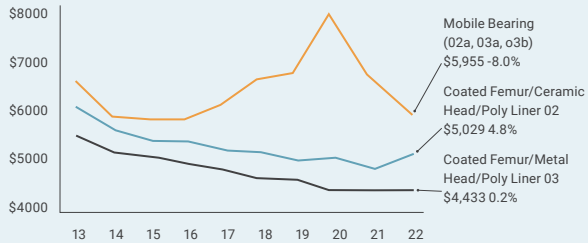


Summary	1999	2010	2021	2022
Coated Hip System (Cons 02,02a,03,03a)	40%	92%	96%	94%
Uncoated Hip Systems (Cons 04,05)	54%	7%	4%	4%

Source: CRN 2013-2022. Includes shares of procedures for selected IDNs.

Trends in ASPs for Total Hip Construction, 2013-2022

AVERAGE SELLING PRICE BY CONSTRUCT TYPE



Source: CRN Cases 2013-2022 for constructs 50, 55a, and 54a for selected IDNs.

Component Usage and Trends in Hip Replacements

According to the CRN, 80% of hips stems were coated, compared to 13% uncoated, 5% long or revision stems, and 2% other stems. Revision hip stems averaged $7,596, down 6% from 2021, coated hip stems averaged $1,907, a 1.3% drop from 2021, and uncoated hip stems averaged $1,279 increased 6% over the prior year. Modular revision stems, such as Zimmer Biomet's Arcos which use multiple components to create a revision stem, are included in the calculation of revision hip stem prices.

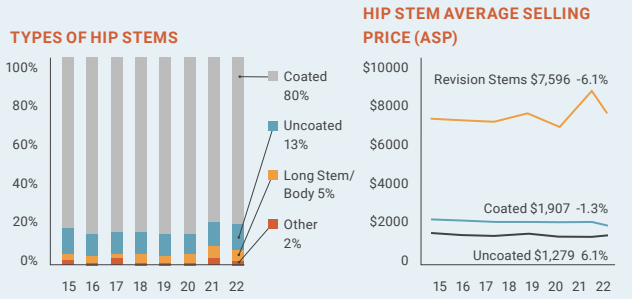
Ceramic heads accounted for 75% of the femoral heads in the 2022 CRN, up from 71% in 2021. The ASP for a ceramic head declined 3% over the prior year to $834. The $472 ASP for a metal head was down 5% from 2021.

The size of the femoral heads was split into the 32mm and less, 36mm, and greater than 36mm. In 2022, 38% of the ceramic and metal femoral heads were 32mm or less, 54% of them were 36mm, and 8% were larger than 36mm. Until hardened acetabular liners appeared on the market in 2002, femoral heads were available in sizes of 22-, 26-, 28-, and 32-millimeter diameters. Larger heads were more "anatomic" but had the disadvantage of providing a greater surface area with the acetabular liner from which polyethylene wear debris could originate. This was thought to be one of the main causes of femoral osteolysis. When hard polyethylenes were introduced in 2002, this encouraged the use of larger femoral heads to reduce dislocations. By 2014, most femoral heads were 36mm or larger, according to historical data from the CRN.

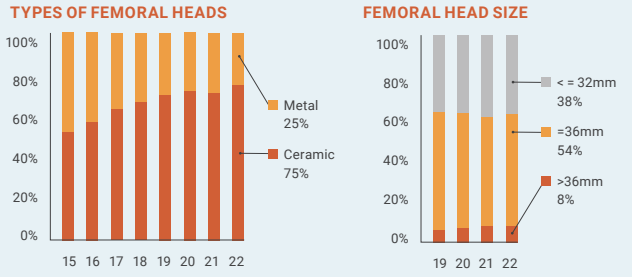
Acetabular liners have been the most significant contributor to changes in orthopedic practice with "hard" surfaces and improved polyethylenes. In 2022, cross-linked poly liners accounted for about 75% of liners sold, the "conventional polyethylene" about 5% of liners, and the anti-oxidant enhanced liners accounted for 19% of the liners. The advantage of anti-oxidant enhanced polyethylene is that it absorbs the free radicals that are released during the crosslinking process. (The most frequently used material for enhancing polyethylene has been Vitamin E.) The average prices of these liners represent the pricing differential for "newer" technology: the cross-linked poly had an ASP of $832, and the anti-oxidant poly cost $1,124 in the 2022 CRN.

Between 2021 and 2022, 4% to 6% of the total hips in the CRN included femoral and acetabular components from different manufacturers. 4.4% of the cases in 2022 included "mix-match" components and two-thirds of those involved a Stryker Trident II cup with a DePuy Synthes femoral component. This is important because it makes the contracting for total hips difficult since a "cap" price must be split between two vendors. There also may be clinical compatibility issues in a total hip that employs designs from two companies.

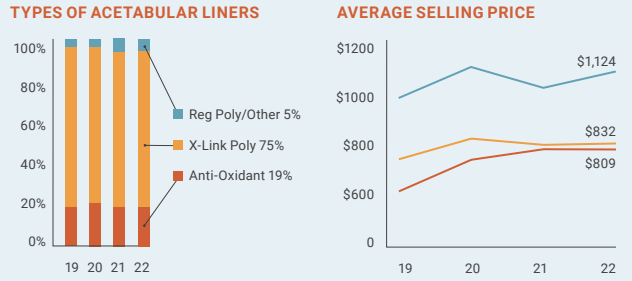
Usage and ASPs of Femoral Stems, 2015-2022



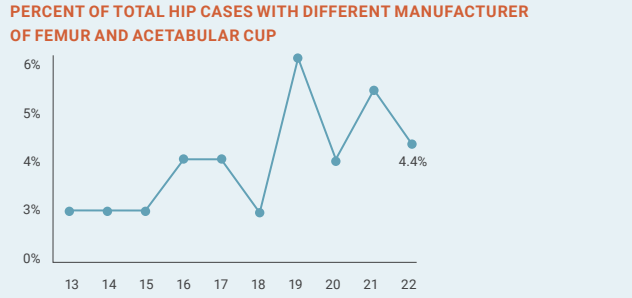
Usage, Size and ASPs of Femoral Heads, 2015-2022



Materials and ASPs of Acetabular Liners, 2019-2022



Total Hip, "Mix-n-Match" Femurs and Cups



Source: Curvo Research Network (CRN), 2021-2022. Note: Nearly 2/3 of the mix-n-match were DePuy Synthes' femoral components with Stryker Trident II cups

The mobile-bearing cups include two-piece cups which include a normal cup and a mobile bearing liner and three-piece cups with a cup, mobile bearing liner, and poly liner. There has been an increase in the use of three-piece vs. two-piece mobile bearing cups between 2015 and 2022. In 2015, 35% of the cases used three-piece mobile bearing cups, which increased to 87% of the cases in 2022. The ASP of cases with two-piece cups was $5,085 in the 2022 CRN compared to $6,087 for cases with the three-piece cup.

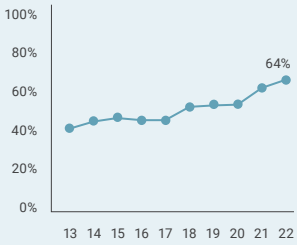
The 2022 CRN indicates an increase in the number of "ultraporous" coatings of acetabular shells, i.e. those with brand names such as Gription (DePuy), Tritanium (Stryker), OsseoTi and Trabecular Metal (Zimmer Biomet), and p² (DJO). The percentage of shells with the ultraporous coating increased from practically nothing in 2000, to 64% in 2022. In 2022, the average selling price of an ultraporous shell was $1,286 compared to $945 for a non-ultraporous shell.

The design of the cups can also drive costs. In response to the need to improve fixation of the cup, manufacturers have provided holes in the cups to screw them into the pelvis. Because the way of counting holes is inconsistent across manufacturers, ONN has grouped them into Solid, 1-2 hole, 3-4 hole, and over 4 hole. There has been a marked increase in the number of holes in cups: in 2013, 65% of the cups were 3 or more holes, and by 2022, 86% of the cups had 3 or more holes.

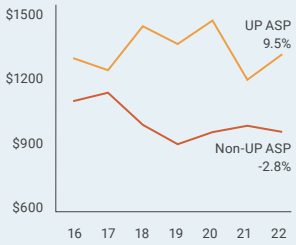
In general, more holes provide greater flexibility for placing screws into solid bone in the acetabulum. However, more holes generally increase the shell cost, and the cost of screws (about $61 each) and the cost of plugs to fill unused holes (about $63 each). This will increase the overall cost of implanting the shell into the acetabulum. According to the CRN, the number of screws used in shells has stayed relatively constant at about 0.8 – 0.9 screws per total hip case between 2014 and 2022. However, in 2022, 90% of the acetabular shells had at least one hole and 46% of the total hip cases had no screws, indicating that there are many cups implanted with holes that had no screws. A portion of the cost differential is not related to the number of holes, but rather to the material. More than 80% of the > 4-hole cups are ultra-porous vs. less than 60% of the < 4-hole.

Materials for Acestabular Shells, 2013-2022

ACETABULEAR SHELL (PRIMARY ONLY) ULTRAPOROUS GROWTH

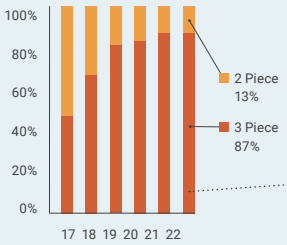


ASPS OF ACETABULAR SHELL (PRIMARY ONLY) MATERIALS

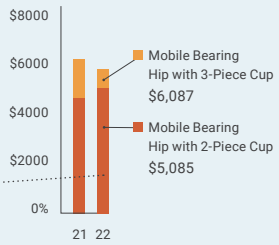


Mobile Bearing Cups, 2015-2022

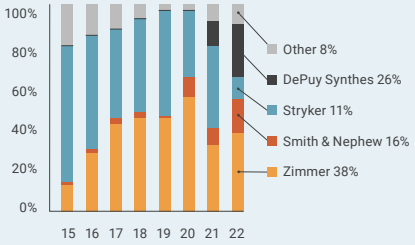
TYPES OF MOBILE BEARING CUPS



AVERAGE CASE COST BY MOBILE BEARING CUP TYPE (2022)

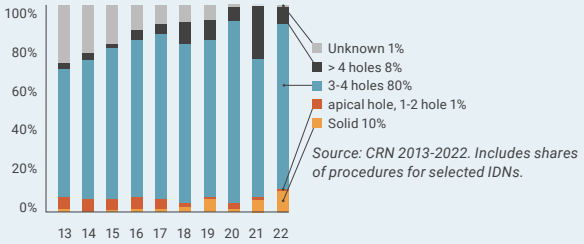


MARKET SHARE (DOLLARS) OF MOBILE BEARING CUPS



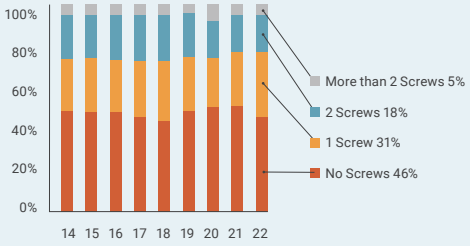
Trends in Number of Hole in Acetabular Shells, Screws, 2013-2022

TRENDS IN HOLES ACETABULAR SHELLS



Source: CRN 2013-2022. Includes shares of procedures for selected IDNs.

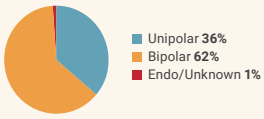
TRENDS IN ACETABULAR SCREWS USED IN ACETABULAR SHELLS



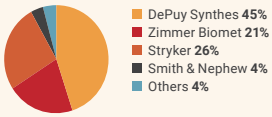
Source: CRN 2013-2022. Includes shares of procedures for selected IDNs.

2023 U.S. Hip Implant Price Comparison
Market Share 2022 CRN

Constructs of Partial Hips



Top 5 Unipolar Constructs (Constructs 08, 08a)



Summit	**DPY**
Stem	1570-03-100
Head	1363-44-000
Spacer	1363-10-000
2022 ASP	**$1,991**

Echo FX	**ZBH**
Stem	12-151307
Head	12-139028
Taper Insert	139249
2022 ASP	**$1,326**

Summit	**DPY**
Stem	1570-03-100
Head	1363-44-000
Spacer	1363-10-000
2022 ASP	**$1,991**

Echo FX	**ZBH**
Stem	12-151307
Head	12-139028
Taper Insert	139249
2022 ASP	**$1,326**

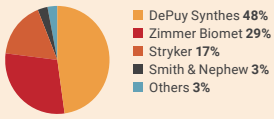
Corail stem, Pinnacle shell w/Gription, AltrX Liner	**DPY**
Stem	3L92501
Head	1365-36-310
Shell	1217-32-052
Liner	1221-36-052
2022 ASP	**$4,273**

Avenir stem w/G7 shell/liner	**ZBH**
Stem	574202040
Head	00-8775-036-02
Shell	110010243
Liner	30103606
2022 ASP	**$5,303**

Polarstem stem, R3 shell and liner	**SNN**
Stem	75018403
Head	7134-3603
Shell	7133-5552
Liner	7133-2752
2022 ASP	**$4,003**

Echo Microplasty stem, G7 OsseoTi shell and G7 liner	**ZBH**
Stem	193111
Head	650-1058
Shell	110010244
Liner	30103606
2022 ASP	**$6,375**

Top 4 BiPolar Partial Hips (Constructs 07, 07a)



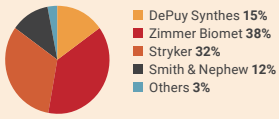
Accolade II, Lfit V40 head, UHR bipolar cup	**SYK**
Stem	6720-0535
Head	6260-9-128
Bipolar	UH1-46-28
2022 ASP	**$3,066**

Summit	**DPY**
Stem	1570-03-090
Head	1365-11-000
Bipolar	1035-46-000
2022 ASP	**$2,427**

Versys	**ZBH**
Stem	00-7833-012-00
Head	00-8018-028-02
Shell	00-5001-046-00
Liner	00-5001-044-28
2022 ASP	**$1,715**

Echo	**ZBH**
Stem	12-151309
Head	163662
Bipolar	11-165216
2022 ASP	**$2,335**

Top 3 Mobile Bearing Hip Constructs (Constructs 02a, 03a, 03b)

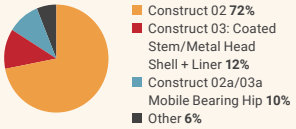


Accolade stem w/ Restoration ADM X3	**SYK**
Stem	6721-0535
Head	6570-0-128
Shell	702-04-52E
Poly Liner	1236-2-848
CoCr Liner	626-00-42E
2022 ASP	**$5,174**

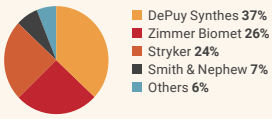
Arcos Modular Revision stem w/G7	**ZBH**
Stem	11-301300
Head	650-1055
Shell	110010244
X-Link Poly Liner	110031012
CoCr Liner	110024464
2022 ASP	**$8,817**

Actis Stem Bi-Mentum liner	**DPY**
Stem	101011060
Head	1365-28-310
Shell	1217-32-054
Poly Liner	DS10014928
CoCr Liner	1218-54-047
2022 ASP	**$5,760**

Constructs of Total Hips



Top 7 Coated Stem, Ceramic on Poly Constructs (Construct 02)



Accolade II stem, Tritanium cup, X3 poly	**SYK**
Stem	6721-0535
Head	6570-0-136
Shell	702-04-52E
Liner	623-00-36E
2022 ASP	**$4,329**

Actis DuoFix stem, Pinnacle shell w/Gription, AltrX Liner	**DPY**
Stem	1010-11-060
Head	1365-36-320
Shell	1217-32-052
Liner	1221-36-052
2022 ASP	**$4,463**

TaperLoc 133 HO stem, shell and liner	**ZBH**
Stem	51-104120
Head	650-1057
Shell	10000664
Liner	30103606
2022 ASP	**$4,690**

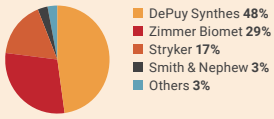
Corail stem, Pinnacle shell w/Gription, AltrX Liner	**DPY**
Stem	3L92501
Head	1365-36-310
Shell	1217-32-052
Liner	1221-36-052
2022 ASP	**$4,273**

Avenir stem w/G7 shell/liner	**ZBH**
Stem	574202040
Head	00-8775-036-02
Shell	110010243
Liner	30103606
2022 ASP	**$5,303**

Polarstem stem, R3 shell and liner	**SNN**
Stem	75018403
Head	7134-3603
Shell	7133-5552
Liner	7133-2752
2022 ASP	**$4,003**

Echo Microplasty stem, G7 OsseoTi shell and G7 liner	**ZBH**
Stem	193111
Head	650-1058
Shell	110010244
Liner	30103606
2022 ASP	**$6,375**

Top 5 Coated Stem, Metal on Poly Constructs (Construct 03)



Actis stem, 36mm head, Pinnacle shell, AltrX liner	**DPY**
Stem	1010-11-040
Head	1365-50-000
Shell	1217-32-056
Liner	1221-36-054
2022 ASP	**$4,201**

Accolade II 36mm metal head, Trident shell, X3 liner	**SYK**
Stem	6721-0435
Head	6260-9-136
Shell	702-04-52E
Liner	723-00-36E
2022 ASP	**$4,435**

Corail stem, Pinnacle Gription shell, AltrX liner	**DPY**
Stem	3L92502
Head	1365-50-000
Shell	1217-32-052
Liner	1221-36-452
2022 ASP	**$3,807**

M/L Taper stem,Continuum shell, Trilogy Longevity liner	
Stem	00-7711-011-10
Head	802203602
Shell	00-8757-054-01
Liner	00-6310-050-32
2022 ASP	**$4,256**

Taperloc 133 HO stem G7 shell and liner	**ZBH**
Stem	51-104120
Head	11-363662
Shell	010000664
Liner	20103606
2022 ASP	**$4,041**

Actis stem, 36mm head, Pinnacle shell, AltrX liner	**DPY**
Stem	1010-11-040
Head	1365-50-000
Shell	1217-32-056
Liner	1221-36-054
2022 ASP	**$4,201**

Accolade II 36mm metal head, Trident shell, X3 liner	**SYK**
Stem	6721-0435
Head	6260-9-136
Shell	702-04-52E
Liner	723-00-36E
2022 ASP	**$4,435**

Corail stem, Pinnacle Gription shell, AltrX liner	**DPY**
Stem	3L92502
Head	1365-50-000
Shell	1217-32-052
Liner	1221-36-452
2022 ASP	**$3,807**

M/L Taper stem,Continuum shell, Trilogy Longevity liner	
Stem	00-7711-011-10
Head	802203602
Shell	00-8757-054-01
Liner	00-6310-050-32
2022 ASP	**$4,256**

Taperloc 133 HO stem G7 shell and liner	**ZBH**
Stem	51-104120
Head	11-363662
Shell	010000664
Liner	20103606
2022 ASP	**$4,041**

2023 U.S. Knee Implant Price Comparison Market Share 2022 CRN

The constructs and components are those reported through the CRN (Curvo Research Network), 2022 edition.

The "ASP" (average selling price) is the average price for each of the components found in 2022 Curvo Research Network. The ASPs were obtained from the 2022 CRN.

Since there are literally thousands of combinations of parts for each of the constructs, the parts selected for each of the constructs shown here are the most frequently used ones for each manufacturer/construct combination in the CRN. As such, the components selected may not make sense clinically.

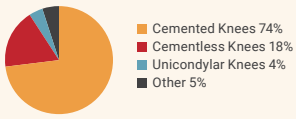
The classification of hip and knee implant components uses the GIC® classification and the constructs are the orthopedic constructs® developed by Orthopedic Network News.

For the most recent pricing and construct information, consult www.curvolabs.com.

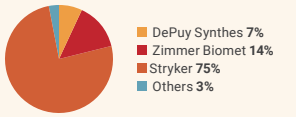
Abbreviations

ZBH: Zimmer Biomet
DPY: DePuy Synthes
SNN: Smith & Nephew
SYK: Stryker
MED: Medacta

Constructs of Primary Knees



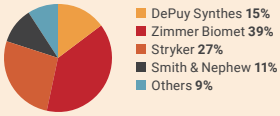
Top 2 Cementless Knee Constructs (Construct 23)



Triathlon	**SYK**
Femur	5517-F-402
Tibia	5536-B-400
Insert	5531-G-409-E
Patella	5552-L-350
2022 ASP	**$3,746**

Persona	**ZBH**
Femur	42-5022-064-02
Tibia	42-5300-079-02
Insert	42-5221-008-10
Patella	00-5878-065-32
2022 ASP	**$4,495**

Top 6 Uncoated Femur/Uncoated Tibia Constructs



Persona	**ZBH**
Femur	42-5026-066-01
Tibia	42-5320-071-02
Insert	42-5121-004-10
Patella	42-5400-000-32
Stem	42-5570-001-14
2022 ASP	**$3,757**

Triathlon PS femur, tibia, X3 insert and patella	**SYK**
Femur	5510-F-402
Tibia	5521-B-400
Insert	5531-G-309-E
Patella	5551-G-320-E
2022 ASP	**$3,442**

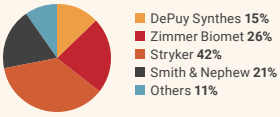
Attune PS Fixed Bearing	**DPY**
Femur	1504-10-207
Tibia	1506-70-004
Insert	1516-40-506
Patella	1518-20-035
2022 ASP	**$3,462**

Vanguard CR femur, I-Beam tibial tray	**ZBH**
Femur	183026
Tibia	141233
Insert	189040
Patella	184766
Stem	141314
2022 ASP	**$3,407**

Journey II Oxinium, PS Hi-flex insert	**SNN**
Femur	7402-2115
Tibia	7402-2213
Insert	7402-7241
Patella	7142-1032
2022 ASP	**$3,974**

Legion	**SNN**
Femur	7142-1204
Tibia	7142-0182
Insert	7145-3112
Patella	7142-1032
2022 ASP	**$3,771**

Top 4 Unicondylar Knee Constructs (Construct 26)



Mako X3 w/Restoris MCK	**SYK**
Femur	180505
Tibia	180614
Insert	180735-1-E
2022 ASP	**$3,151**

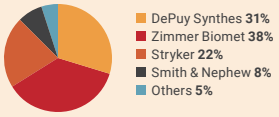
Oxford	**ZBH**
Femur	161469
Tibia	154722
Insert	159576
2022 ASP	**$3,807**

Journey II Uni	**SNN**
Femur	74026026
Tibia	74026715
Insert	74026168
2022 ASP	**$5,745**

Persona	**ZBH**
Femur	42-5580-005-01
Tibia	42-5380-007-01
Insert	42-5182-007-08
2022 ASP	**$3,366**

Constructs of Revision Knees

Top 5 Revision Knee Constructs (Construct 24a)



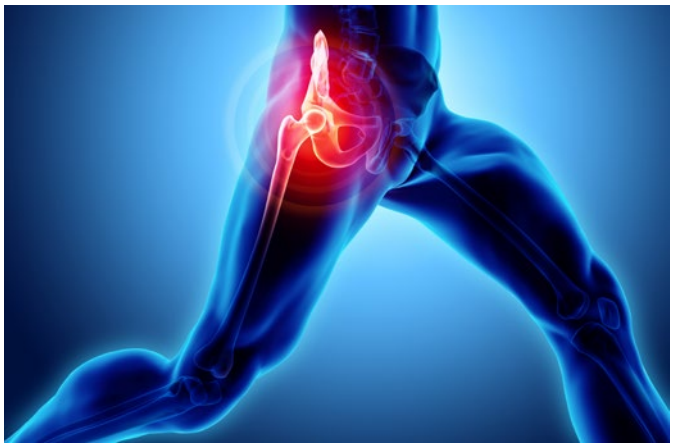
Attune Revision	**DPY**
Femur	1504-40-105
Tibia	1506-60-004
Sleeve	1511-11-202
Insert	1517-10-508
Patella	1518-20-038
Wedge	1549-05-001
Stem	1513-14-060
2022 ASP	**$15,811**

Persona	**ZBH**
Femur	42-5046-066-02
Tibia	42-5420-075-01
Cone	42-5450-005-08
Insert	42-5128-007-10
Patella	42-5400-000-32
Augment	42-5566-062-05
Stem-Fluted	42-5600-075-14
2022 ASP	**$18,340**

Triathalon TS	**DPY**
Femur	5512-F-302
Tibia	5521-B-400
Insert	5537-G-413
Patella	5551-G-320-E
Augment	5543-A-300
Stem-Fluted	5560-S-112
2022 ASP	**$10,185**

Legion	**SNN**
Femur	7142-1164
Tibia	7142-4003
Insert	7142-0524
Patella	7192-6225
Coupler	7142-4223
Stem	7142-4029
Wedge	7142-1805
2022 ASP	**$14,617**

Vanguard SSK	**ZBH**
Femur	185264
Tibia	185201
Insert	183864
Patella	184766
Adapter	185211
Sleeve	148306
Fluted Stem	185302
2022 ASP	**$14,774**



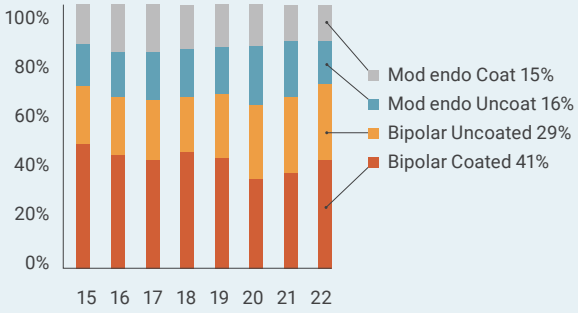
Partial Hips

Bipolar hips accounted for 70% of the cases and the remaining 30% of the partial hip cases were modular endoprostheses. The average selling price of a bipolar hip with a coated stem was $3,464 in 2022, down 1% from 2021. The bipolar hip with an uncoated stem was $2,808 in 2022, down 5% from the prior year. The weighted average of modular endoprostheses with and without coated hip stems was $2,852 in 2022, down 1% from 2021.

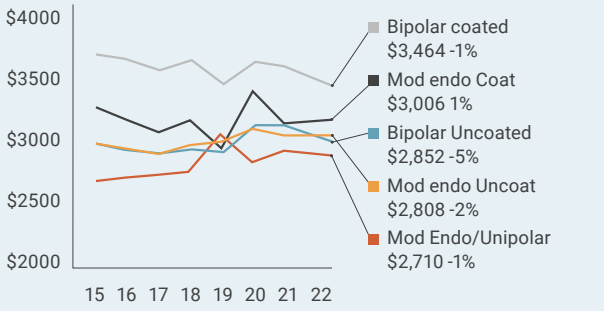
Of the individual components used in partial, bipolar heads accounted for 62% of the heads in 2022, followed by unipolar heads at 38%. The bipolar heads averaged $588 per component in 2022, up 17% from 2021, and the unipolar heads averaged $376 in 2022, up 2% from 2021.

Trends in Partial Hip Implant Construct Types, 2015-2022

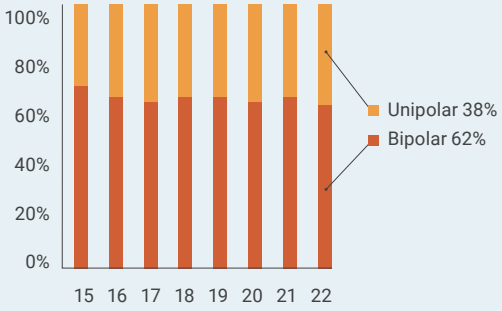
% OF CASES BY CONSTRUCT TYPE 2015-2022



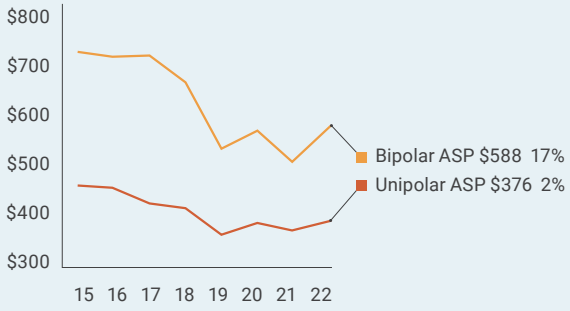
AVERAGE SELLING PRICE BY CONSTRUCT TYPE 2015-2022

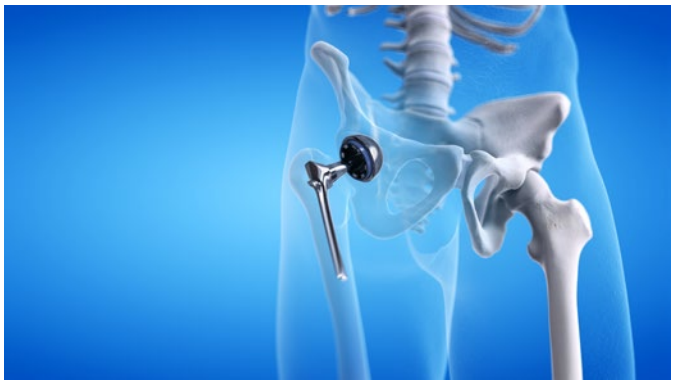


FEMORAL HEADS FOR PARTIAL HIPS



ASPS FOR PARTIAL HIP HEADS





Revision Hips

About 13% of the total hip and revision hip procedures in the CRN in 2022 were revision hip procedures. This statistic is referred to as the "revision burden" and is comparable to the iData estimate of 10.2%.

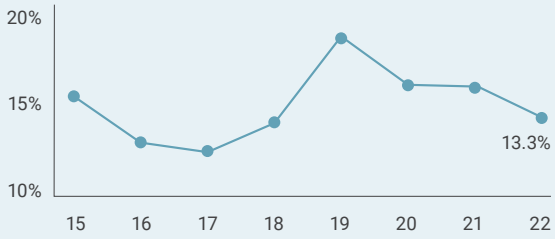
Revision hip market share in the 2022 CRN was led by ZimmersBiomet with 31%, followed by Stryker with 26%, DePuy Synthes with 18%, Smith & Nephew with 8% and "Other" with 18% of the cases. Other includes OsteoRemedies, Microport, LinkBio, Medacta, Exactech, among others. Femoral stems used in revision cases are divided by CRN into one-piece stems, separate proximal body and distal stem combinations, and temporary femurs used in two-stage revisions. Since 2003, there has been a trend away from one-piece stems which accounted for 67% of the stems in 2004 to approximately 25% in 2022. The percentage of temporary stems used in two-stage revisions was unchanged at approximately 19% of the revision stems in 2022. The body/stem combinations accounted for 56% of the revision stems in 2022.

CRN classifies revision hips into categories based on the disruption to the bone structures. In 2022, the most frequent hip revisions were for cases with those where a pelvic disruption occurred which accounted for 46% of the cases. Revisions with disruptions to the femur accounted for 25% of the cases. In 18% of the cases, no disruption to the femur or the acetabulum exemplified by a head or liner exchange. The remaining 10% of the cases involved both the femur and the pelvis. At one extreme, revisions that involved femoral and pelvic disruptions cost CRN members an average of $11,641 and at the other extreme, components which did not interfere with the metal-bone interface cost around $3,782 in 2022.

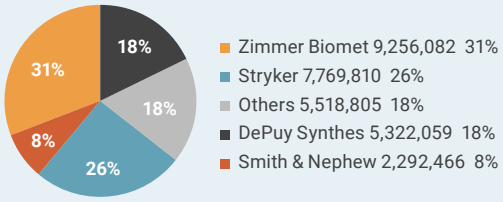
Source: CRN 2013-2022. Includes shares of procedures for selected IDNs.

Revision Hips, 2015-2022

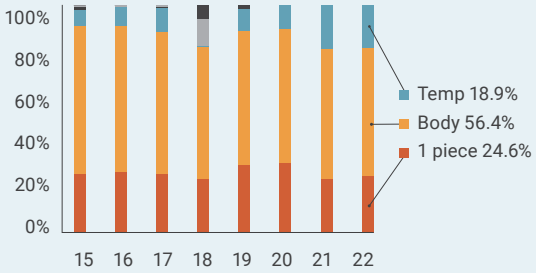
% OF HIPS THAT ARE REVISIONS IN THE CURVO RESEARCH NETWORK



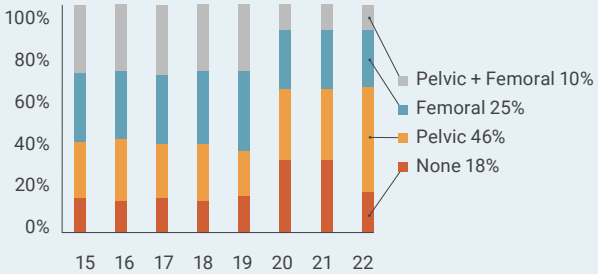
2022 MARKET SHARE OF HIP REVISIONS



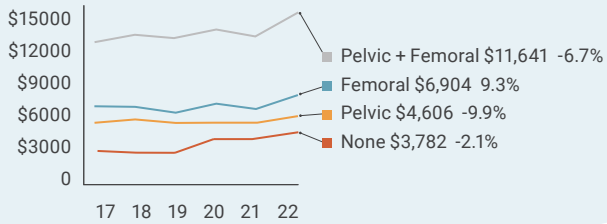
TRENDS IN HIP STEMS FOR REVISION HIPS

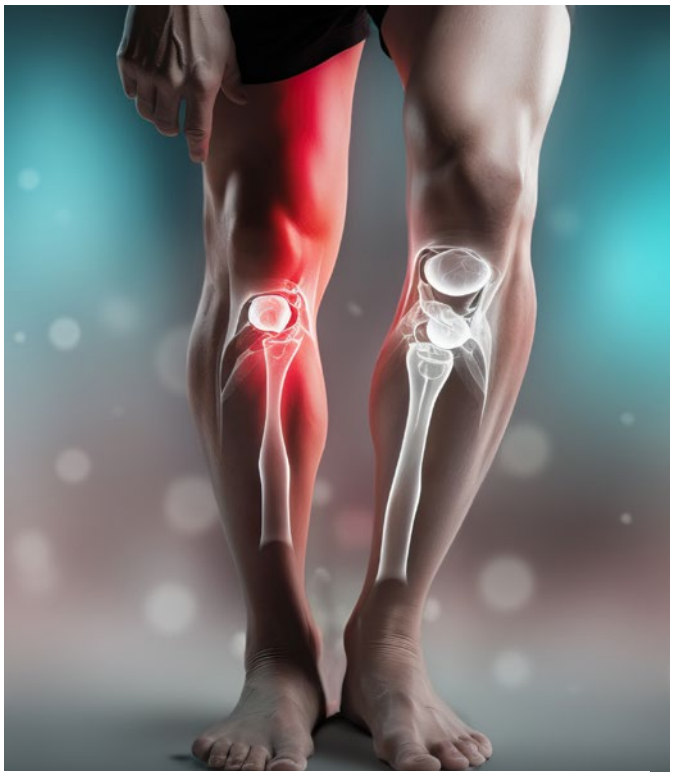


TYPE OF "DISRUPTION" FOR REVISION HIPS



ASPS OF REVISION HIPS





Knee Implants

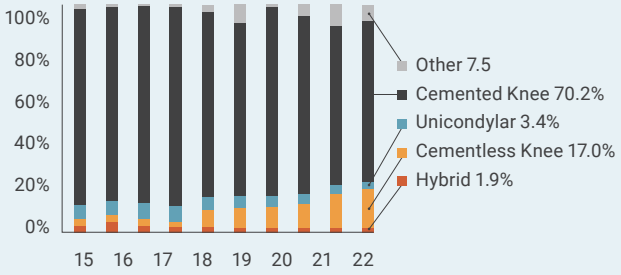
Of the different types of constructs, knee replacements have favored uncoated femur and tibial combinations ("cemented" knees") with 70% of the procedures receiving this construct in 2022. The big story here is the expansion of the coated femur/coated tibia construct. Stryker, among others, are marketing their "cementless" knee systems which are reflected in the growth of the coated knee systems from 3.1% of the cases in 2016 to 17% in 2022. In the first quarter of 2023, these procedures accounted for 18% of the knee replacements. The hybrid cases, i.e., those with a coated femur and an uncoated tibia accounted for 1.9% of the procedures in 2022, and the unicondylar procedures accounted for about 3.4% of the total number of knee procedures in 2022.

The implant costs per procedure of knee implants in 2022 varied from unicondylar knees at $4,033 per procedure, to $4,563 for a coated femur/tibial ("cementless") construct.

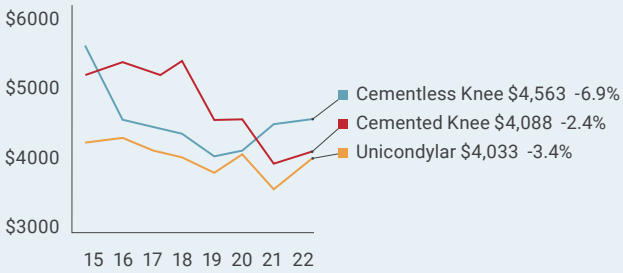
Femoral components for knee replacements in 2022 were largely uncoated (73.3%), followed by coated (16.1%), unicondylar (2.8%), and revision/oncology (7.8%). Average ASPs in 2022 ranged from $1,580 for an uncoated femur, $2,040 for a unicondylar femur, and $1,793 for a coated bicondylar knee femur. Revision-oncology or revision knee femurs averaged $5,917 in 2022.

Total Knees Key Factors, 2015-2022

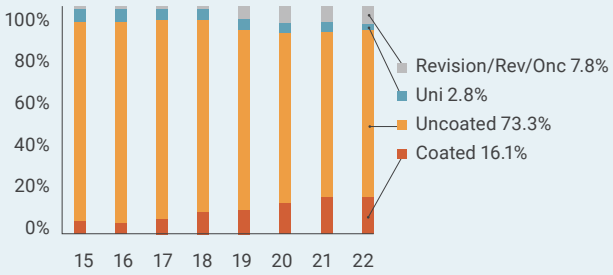
% OF CASES BY CONSTRUCT TYPES, 2015-2022



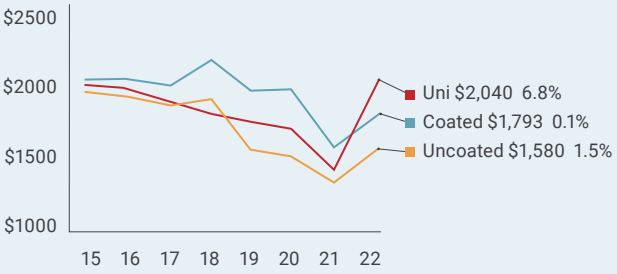
AVERAGE SELLING PRICE BY CONSTRUCT TYPE, 2015-2022



TYPES OF FEMURS



ASP OF KNEE FEMURS BY TYPE



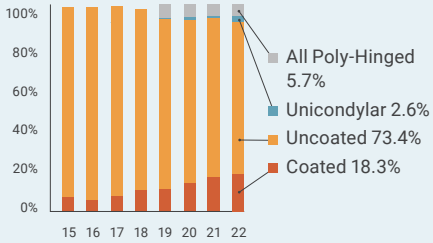
Tibial Components

Tibial components used in bicondylar knees in 2022 were largely uncoated (73.4%), followed by coated implants (18.3%), all poly tibias or hinged tibias (5.7%) and unicondylar tibias (2.6%). ASPs for coated tibias in 2022 were $1,393 (up 2.4% from 2021), and $914 for uncoated tibias (down 3.0%). Tibial inserts decreased 0.5% to $937. Mobile bearing inserts have declined from 12% of the inserts in 2007 to 5% in 2022. 59% of the tibial inserts had some sort of stabilization (posterior or cruciate), while 23% were cruciate retaining, and 6% were constrained. In the CRN sample, anti-oxidant tibial inserts accounted for 36% of the inserts in 2022, up from 32% in the prior year. There was a greater usage of anti-oxidant polys in knees (36%) vs. hips (19%), although the price premium for antioxidant polys in hips was greater than in knees. An anti-oxidant poly tibial insert costs $991 vs. $851 for the non-anti-oxidant, a $140 difference. In hips the difference was $809 for a nonantioxidant poly liner vs. $1,124 for the anti-oxidant version, a $314 premium.

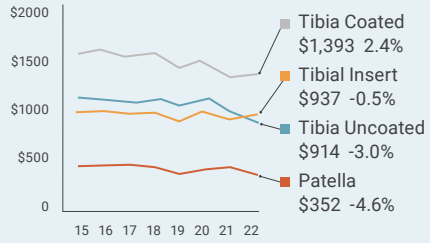
Source: CRN

Tibial Component Key Factors, 2015-2022

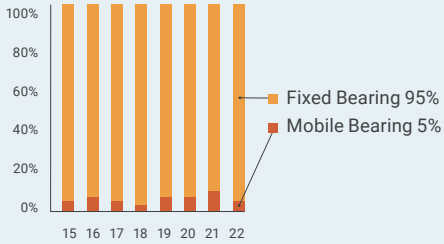
TIBIAL COMPONENTS USAGE (BICONDYLAR)



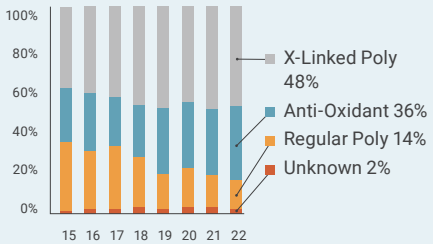
ASP OF OTHER KNEE COMPONENTS



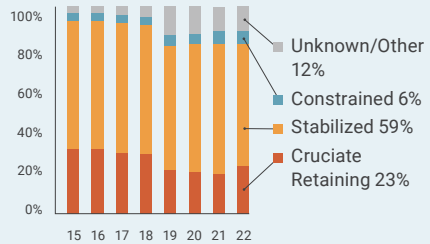
MOBILE VS. FIXED BEARING INSERTS



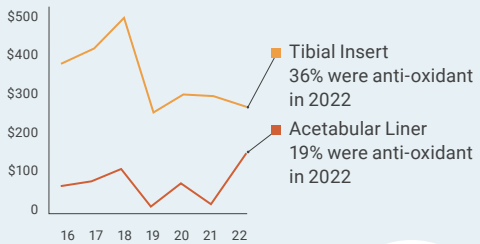
TIBIA INSERT BY MATERIAL



TIBIAL INSERTS BY TYPE



COMPARISON OF PRICE PREMIUMS FOR ANTI-OXIDANT POLYETHYLENES



Bone Cement Use in Total Knees

The use of bone cement in primary knees, identified as Curvo construct 24 (uncoated knee femur/uncoated tibia) was investigated in the CRN. This group included 16,000-30,000 cases annually between 2011 and 2022. The number of 40g packets used per procedure and the prevalence of antibiotic bone cement was examined. Each 40g packet of non-antibiotic bone has a 2022 average selling price of about $52 and manufacturer-provided antibiotic bone cement costs three to four times as much.

The average number of units of bone cement remained unchanged in 2022 at approximately 1.44 although percentage of procedures with zero bone cement increased from 10% to 15%. Twenty-two percent of the bone cement units were antibiotic bone cement. Note that this applies to a subset of the hospitals that report bone cement on each of their cases. The analysis does not include the amount of antibiotic bone cement that is a result of hospital-based compounding of vancomycin along with standard bone cement. This has been reported as means of reducing cost. Hospital-based compounding may be increasing as the percentage of CRN cases using antibiotic bone cement has declined from 54% in 2014 to 22% in 2022.

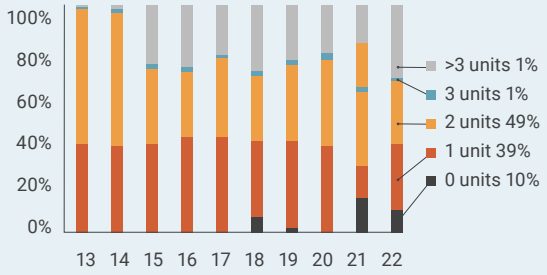
Bone Cement Used in "Cementless" Knees

The promotion of "cementless" knees has included economic arguments, (along with the clinical ones of improved patient outcomes), that cementless knees will decrease operating room time and overall costs by eliminating the extra step of preparing and deploying bone cement. Curvo Research Network reached back into its archives to 1991 to determine the number of "cementless" knee cases that actually had used bone cement, negating the economic argument. Although the number of cases prior to 2000 were relatively small, the percentage of "cementless" knee cases with bone cement varied from 0% some years to over 60% in other years. Since 2015, the percentage has hovered between 15 and 20% of the cementless cases. In the 2022 CRN, approximately 33% of the cementless knees had some bone cement. It is estimated that this extra bone cement can add between $45 to $500 per case.

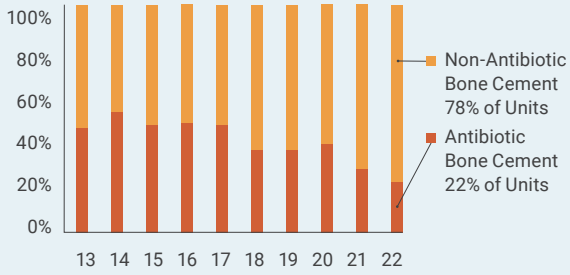
Source: CRN, 1991-2022

Bone Cement Usage in Primary Knee Replacement

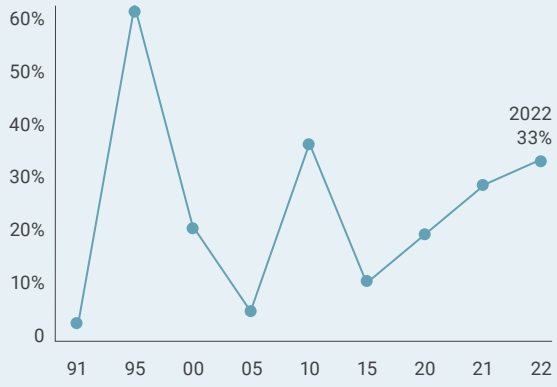
UNITS OF 40G BONE CEMENT USED IN PRIMARY TOTAL KNEE REPLACEMENTS



ANTIBIOTIC BONE CEMENT USED IN PRIMARY TOTAL KNEE REPLACEMENTS



% of Porous or "Non-Cemented" Knees that Actually Use Cement



Tibial Stems Used in Primary Knees

Tibial extension stems have been used extensively in revision surgery in which a tibial base plate is removed and an extension stem is attached to a revision tibia to provide greater stability. Stem extensions are also used when there is instability due to compromised collateral ligaments. A study in the April 2018 issue Orthopedic Network News documented the extensive use of tibial extension stems in primary knees. The cost of these extension stems is not trivial— the cost averaged $638 in the 2022 CRN and the percentage of primary knee cases receiving an extension stem increased from 5.4% of the cases in 2012 to 12.6% in 2022. The primary manufacturers of tibial extension stems are Zimmer Biomet, Stryker and Total Joint Orthopedics.

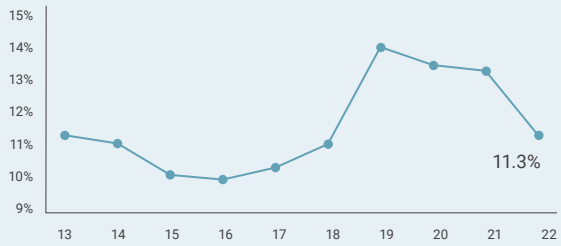
Source: CRN

Tibial Stem Extensions in Primary Knee Replacement

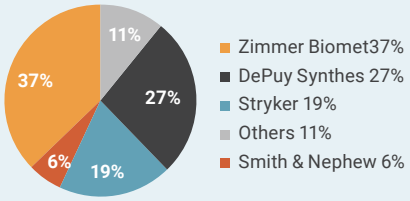
PERCENTAGE OF PRIMARY KNEE CASES WITH TIBIAL EXTENSION STEMS

Revision Knee Procedures and Market Shares

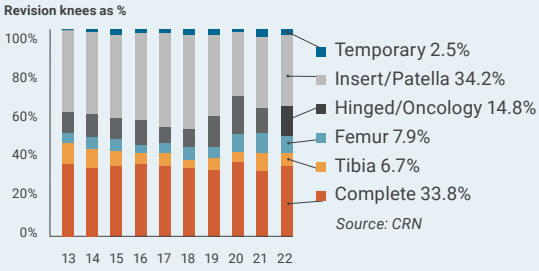
PERCENTAGE OF KNEES THAT ARE REVISIONS IN THE CRN



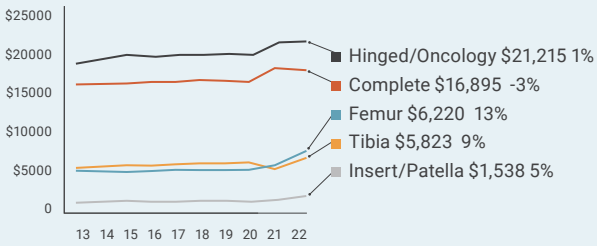
2022 CRN SHARE OF KNEE REVISIONS



TRENDS IN COMPONENTS USED FOR REVISION KNEES



AVERAGE COST FOR REVISION KNEE SYSTEMS



Revision Knees

It should be stated that "revision knees" are inferred from the data sources provided to Curvo Research Network, which are mostly purchase orders. Some cases may include multiple purchase orders which may look like a revision knee. Where possible these have been excluded from this analysis.

There were 7,138 revision knees in the 2022 CRN (compared to 6,035 in the 2021 CRN). Revision knees as a percentage of all knees were 11.3% in 2022, down from 13.1% in 2021. The largest market share of manufacturers of knee revision systems in the CRN in 2022 was Zimmer Biomet (37%) followed by DePuy Synthes (27%), Stryker (21%), Smith & Nephew (6%), and others (11%).

Curvo Labs classifies knee revisions based on the disruption to the major bones involved: femur and/or tibia. That is, some revisions require a removal and replacement of the femoral component, others require removal/replacement of the tibial component, and some, such as a tibial insert or patellar exchange, disrupts neither femur nor tibia. CRN also includes the OSS and Finn of Zimmer Biomet, the GMRS and MRH from Stryker, the NexGen RHK and MOST from Zimmer Biomet, and the Noiles from DePuy Synthes as hinged/oncology systems. CRN classifies the Vanguard SSK, NexGen LCCK, TC3, Scorpio TS, Triathlon TS as "complete" systems. They may be used in revision or primary procedures.

Based on a review of the 2022 CRN revision knees, the largest number of revisions were for replacement insert/patella systems, which accounted for 34.2% of the cases. Following insert/patella systems were "complete" replacements, which accounted for 33.8% of the revisions, hinged/oncology systems (14.8%), femoral disruptions (7.9%), and tibial disruptions (6.7%). The most expensive systems used for knee revisions in the 2022 CRN were those designated as hinged/oncology systems $21,215, "complete" systems $16,895, femoral disruptions $6,220 and those with tibial disruptions $5,823. "Temporary" implants (not shown in the graph), i.e. those used in two-stage revision procedures averaged $5,641 per case. Those requiring a replacement of either a tibial insert or patella averaged $1,538 for implant components per case. Note that these costs include the costs for bone grafts and substitutes.

As was reported in previous years, the implant costs for a revision knee are ~ 80% more expensive than those for a revision hip — $10,406 vs. $5,797. Given that the revision knees often involve infection and treatment with two-stage procedures, it is logical that increased infection-control vigilance be applied for knee procedures, not only for patient safety issues, but also economic ones.

Data Sources and Methods

In 2022, all of the cases reported in this analysis came from data submitted through either Curvo Labs or through services of Mendenhall, Associates, Inc. The cases and parts are designated as the Curvo Research Network (CRN), previously known as the Orthopedic Research Network (ORN). Most of the data are derived from purchase orders submitted by the hospitals to the manufacturers of orthopedic implants or related suppliers. Between 2019 and 2020, some attempts were made to weed out data from hospitals that didn't represent "true" cases.

Average selling prices (ASPs) are calculated from hospitals submitting detail pricing information. Average selling prices for components in "cap" constructs were calculated based on allocating the total cap prices to components based on the ratio of the list price of the component to the total cap price. ASPs for both components and constructs are calculated.

Data from the current year (i.e. 2022) is updated quarterly, since data is received from hospitals on an ongoing basis which is reported in a variety of products and services from Curvo Labs.

There are two files derived from the quarterly update:

(1) Cases: These are the case-level specific information that is used to calculate average selling price by procedure, construct, percentage of cases with bone cement, etc.

(2) Parts: These are the component level data for each part with a sales, hospital usage, and an average selling price.

Number of cases and parts used for reporting this newsletter:

CRN Cases	Hips *	Knees **	Hospitals
2021	48,797	48,453	245
2022	63,322	60,203	200

Different Parts for CRN Cases	Hips	Knees
2021	336,405	374,261
2022	413,195	505,878

Although this may be the largest detailed sample of hip and knee implant cases, these hospitals are self-selected, that is, no claim is made that they are nationally-representative, although informal surveys indicate that the experience with this group is reflective of many national trends.

** Hips include total hips (THA), partial hips, revision hips, resurfacing hips.*
*** Knees include total knees (TKA), unicondylar knees, patellofemoral joint replacements, revision knees*
****Parts include the "hardware" (i.e. femurs, femoral heads, shells, liners, inserts, stems, wedges), as well as bone grafts, bone substitutes, bone cements, and non-implantable devices such as cutting guides.) Some hospitals provide information on these extra components and others do not.*

Robotics in Joint Replacements—a 2023 Update

Robotic assisted surgery to enable less invasive and more precise surgeries continues to gain traction in orthopedics. Stryker acquired Mako in 2013. Globus completed the first Excelsius GPS robot cases for spine in 2017 and plans to launch a robotic application for knee in 2023. Medtronic purchased Mazor in 2018. Zimmer Biomet's announced the first ROSA knee procedure in 2018. DePuy Synthes launched VELYS and Smith & Nephew launched the CORI handheld robot procedures in 2022. Chinese company MicroPort received FDA clearance for the SkyWalker robot in 2022. The list of companies with recent clearances for robotics, navigation, augmented reality and imaging is long: Augmedics, Curexo, Fusion Robotics, Kico Knee Innovation Company, Medacta, Naviswiss AG, NView Medical, PathKeeper Surgical, Pixee Medical, Point Robotics, Proprio, Remex Medical, THINK Surgical...

In addition to robotics, companies are investing in enabling technologies related to planning, imaging, navigation, augmented reality and machine learning. Creating an "ecosystem" of enabling technologies and selling to hospitals and ASCs through earn-out arrangements that are paid for through implant purchases.

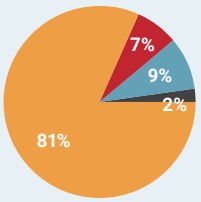
In analyzing the types of digital assistance available, CRN has chosen to include not only the high-profile robots, but also instruments used for soft tissue balancing, custom cutting guides, navigation and custom-made implants and instruments. There are two reasons for this: at present, a very small percentage of procedures are using two competing digital assistance technologies in our data. The second reason is that as the manufacturers of these devices gain acceptance in one specialty—unicondylar knees, for example, it is often a matter of time where they will be deployed for others, such as total hips or spinal fusions.

Of the approximately 14,500 cases with digital assistance that were examined, 81% used a robot or nav, 7% used custom cutting guides, 9% used soft tissue balancing systems, and 2% involved custom designed implants. The procedures that the digital technologies were used in skewed heavily toward total knee replacements, with 61% of the digital devices used in total knees, followed by total hips with 16%, unicondylar knees with 5% and shoulders with 2%. The use of a robot varied considerably by procedure: 40% of the unicondylar knees in the Curvo Labs Research Network (CRN) utilized a robot in 2022, followed by total knees with in which 15% of the procedures utilized a robot.

Types of Total Joint Replacement Digital Assistance

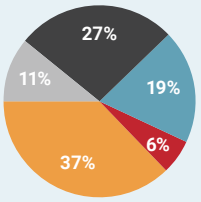
Type Robot/CAS/	Functions	Examples
Provides guidance for Navigation	Mako (Stryker) removing bone/tissue under surgeon supervision	Navio (SNN) ROSA (ZBH) VELYS (DPY) Exactech GPS OMNIBotics (Corin)
Custom Implants	Manufactures implant based on patient specific anatomy	ConforMIS Patient Matched Implants (ZBH)
Custom Cutting Guides	Provides disposable cutting guides based on patient specific anatomy	TruMatch (DePuy) Signature, PSI (ZBH) Visionaire (SNN) MyKnee (Medacta)
Soft Tissue Balancing Devices	Provides feedback on balance of soft tissues during knee replacement	Verasense OrthAlign iAssist (ZBH)

Share of Cases by Digital Assistance Type



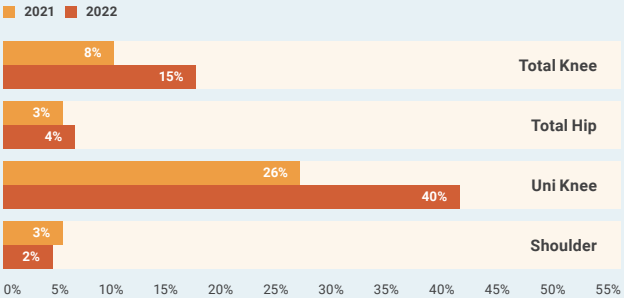
Source: Curvo Labs, 2022 Curvo Research Network (CRN), 14,500 cases

Digital Assistance by Procedure Type



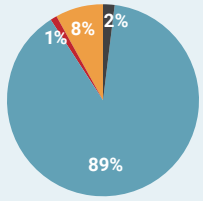
Source: 2022 CRN

Percentage of Joint Replacement Cases Utlizing Robots



Source: CRN 2022.% of cases based on number of trauma cases with osteobiologics, GIC 62, with type1 Allo bone, DBM, Bone subs, BMP, Cell based matrices (CB Matrix), allograft tissue. Distribution of costs for these products.

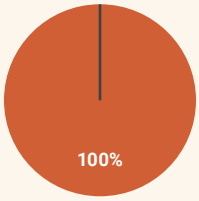
Robots Used in Joint Replacements



- Stryker (Mako) 9,512 89%
- Zimmer Biomt (ROSA) 874 8%
- DePuy Synthes (Velys) 191 2%
- Smith & Nephew (Navio) 108 1%

Source: 2022 CRN

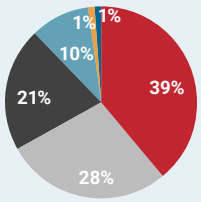
"Custom" Implants



- Conformis 100%

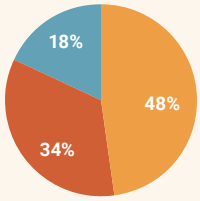
Source: 2022

Custom Cutting Guides



- Signature/PSI 39%
- BluePrint 28%
- Visionaire 21%
- TruMatch 10%
- Match Point 1%
- MyKnee 0%
- Other 1%

Soft Tissue Balancing Devices



- i-Assist 48%
- KneeAlign 34%
- Verasense 18%

Of the different types of devices, Stryker's Mako dominates the robot sector with 89% of the cases in the CRN, followed by Zimmer Biomet's Rosa with 8%, DePuy Synthes Velys with 2% and S&N Navio with 1%. ConforMIS is the market for custom implants. The company was acquired in June 2022 by restor3d. Custom cutting guides were led by Zimmer Biomet's Signature and Patient Specific Instruments with 39% followed by Stryker's BluePrint with 28%, Smith & Nephew's Visionaire with 21% and DePuy Synthes' TruMatch with 4%.

Soft tissue balancing devices were led by Zimmer Biomet's iAssist with 48%, followed by OrthAlign's Knee Align with 34% of the cases and Stryker/OrthoSensor's Verasense with 18% of the cases.

Navigated procedures were led by Zimmer Biomet's NaviTrackER with 48%, followed by Stryker's OrthoLock with 14% and Medacta's iMNS with 5%. 88% of the navigated procedures related to total knee and 2.5% of total knee procedures were navigated.

Caveats on Market Shares

Data for this article was taken from the 2022 Curvo Research Network (CRN), which obtained case information more than 140 hospitals in 2022. For each of the robots, certain part numbers were identified as markers of a robot, such as the Vizadisc from Stryker, and specialized bone pins for the Rosa and Navio. Even if a robot is identified through the unique disposables used on the case, there is no understanding of the degree to which a robot was used in completing the surgical procedure.

As such, the estimates presented here are our "best guesses" on the volume of cases and market shares for the different types of devices.

OrthoTrends 2013–2023/Q1

The data for the OrthoTrends are taken from the Curvo Research Network (previously known as the Orthopedic Research Network), a quarterly database of purchasing and clinical data submitted to Curvo Research Network and Curvo Labs. There were over 22,000 cases in Q1/2023 from 105 hospitals for joint replacements, trauma, spinal fusions. The purchase data includes $209 million in spend. The number of cases and amount of spend will vary from quarter to quarter depending on how data is received by the hospitals submitting. Note that the statistics reported for hip and knee replacements here are the 2023/Q1 update of those reported on pages 9-17.

Hip Replacements

Construct Mix: Coated hip stems with either a metal or ceramic head, shell and poly liner accounted for about 95% of the total hips in the CRN in 2023/Q1. The remaining 5% include those with cemented hip stems and resurfacing hips. The average selling price (ASP) of a ceramic-headed system was $5,114, up 7% from 2022 and a metal-headed system was $4,920, up 6% from 2022.

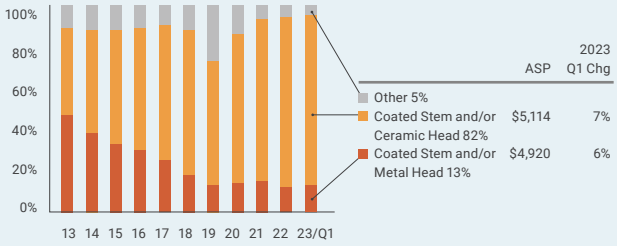
Femoral Stems: Femoral hip stems were primarily coated hip stems, representing 78% of the hip stems sold, with an average selling price of $1,947. Uncoated (cemented) hip stems accounted for 15% of stems, and revision/long stems were 7% of the total. The ASPs for uncoated stems were $1,457, and revision/long stems were $7,151.

Femoral Heads: Ceramic femoral heads accounted for 75% of the femoral heads sold through 2023/Q1 in the CRN. These had an ASP of $888, up 4% from 2022 compared to $581 for metal heads, which increased 24% from 2022.

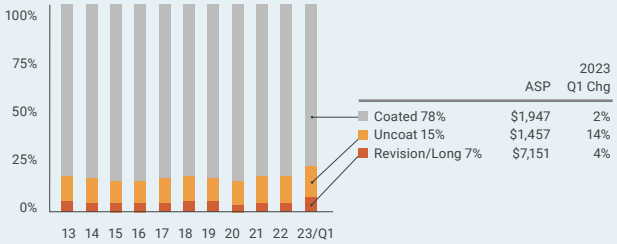
Femoral Head Size: Consistent with prior year, 53% of femoral head were 36mm with an ASP of $743, down 3% from 2022. Smaller heads cost the least $666, compared to the 36mm and larger heads $839.

Key Factors in Total Hips 2013-2023/Q1

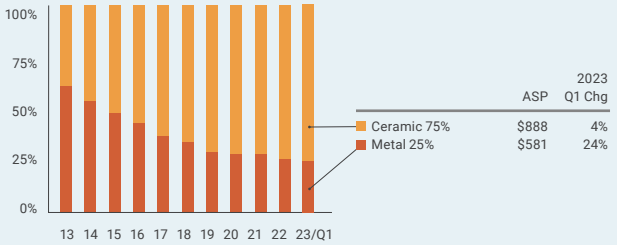
TOTAL HIP CASES BY CONSTRUCT TYPE, 2013-2023/Q1



THU02: TYPES OF HIP STEMS

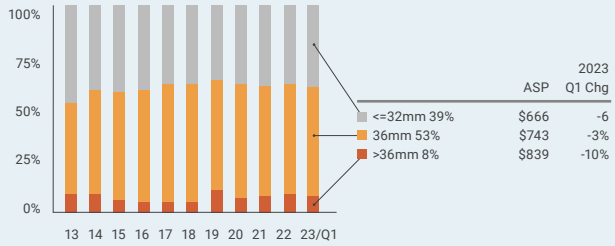


THU03: TYPES OF FEMORAL HEADS

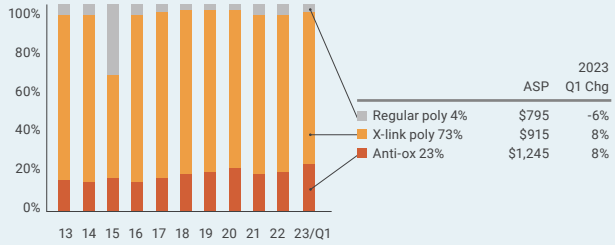


Total Hip Cases by Construct Type, 2013-2022 *continued*

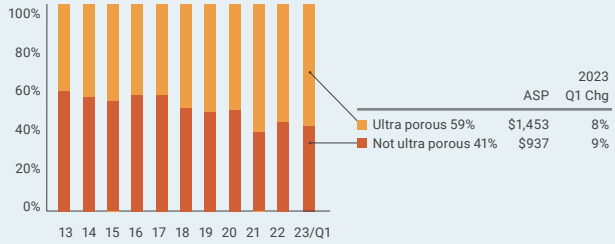
THU04: FEMORAL HEAD SIZE



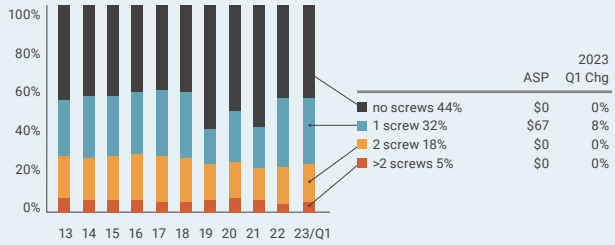
THU05: ACETABULAR LINERS MATERIAL



THU06: ACETABULAR SHELL MATERIAL



THU07: ACETABULAR SCREW USAGE



Acetabular Liners: Anti-oxidant liners accounted for 23% of the acetabular liners in 2023/Q1 compared to 73% for the crosslinked poly liners. Anti-oxidant liner ASPs were $1,245 compared to $915 for cross-linked and $795 for regular poly liners.

Acetabular Shells: 59% of the acetabular shells sold in 2023/Q1 were ultraporous with a price of $1,453 compared to $937 for nonultra porous shells. Ultraporous shells are designed to increase the surface area for the bone to grow into, thus providing a more secure foundation for the cup in the pelvis.

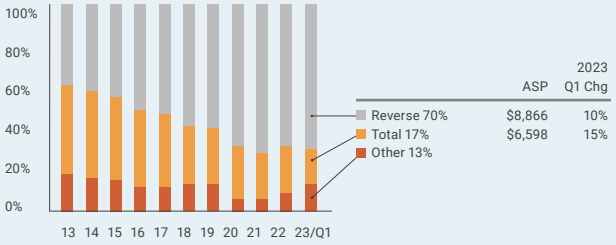
Acetabular Screws: Acetabular screws are used to augment fixation of acetabular shells. In the 2023/Q1 CRN, 44% of the cases had no screws, 32% had one screw, 18% had two screws, and 5% had more than 2 screws. Each screw averaged $67.

Shoulder Replacements

Construct Mix: Reverse shoulders accounted for about 70% of the shoulder replacements in 2023/Q1 with an ASP of $8,866 compared to $6,598 for a total shoulder. Total shoulders accounted for 17% of the implanted shoulders, and partial shoulders, once the second largest group of shoulders accounted for 13% of the cases.

Shoulder Key Factors, 2013-2023/Q1

SHU01: SHOULDER CONSTRUCTS



Knee Replacements

Construct Mix: Cementless knees accounted for 18% of the total knees in 2023/Q1 CRN, down slightly from 19% in 2022. Cementless knee ASP was $4,533, compared to $4,255 for the cemented knees which accounted for 78% of the total knees. Partial knees accounted for 4% of the cases with an ASP of $4,251.

Tibial Inserts: Though there is not as much difference in costs as there used to be, the material composition of tibial inserts is a significant differentiator. Anti-oxident polyethylenes accounted for 33% of the tibial inserts in 2023/Q1 CRN with an ASP of $1,122, compared to cross-linked poly with accounted for 52% of the inserts with an ASP of $853.

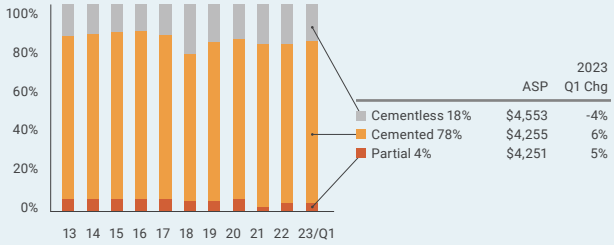
Bone Cement: Although bone cement can be used for a variety of orthopedic procedures, the vast majority is used in cemented knees. Thirty seven percent of the cemented knee cases had a single 40g pack of bone cement; 59% had two, and 3% had more than two packs. The use of antibiotic bone cement has tracked downward since 2013; in the 2023/Q1 CRN, antibiotic bone cement units used on knee replacements accounted for 23% of the units, with an ASP of $219.

Tibial Extension Stems: Tibial extension stems can add stability to a tibial baseplate, and some, such as Stryker's Triathlon TS or Zimmer's Persona can accommodate either a long extension stem or a simple "cap" on the bottom of the tibia. Tibial extension stems were used in about 10% of the total knee procedures in the 2023/Q1 CRN, with an ASP of $624.

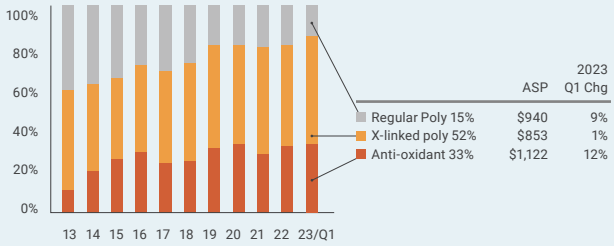
Note: IDN "28" Or "33" Or "38" Or "47" Or "58" Or "72" Or "73"
Source: Curvo Research Network (CRN), 2021 Percentage of cases assigned to construct 24 (Primary cemented knee) with a tibial extension stem for all CRN designated hospitals

Total Knees Key Factors, 2013-2022

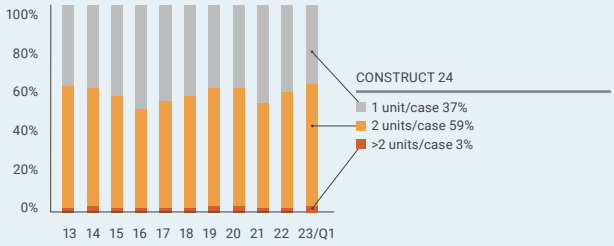
TKU01: KNEE CONSTRUCTS 2013-2023/Q1



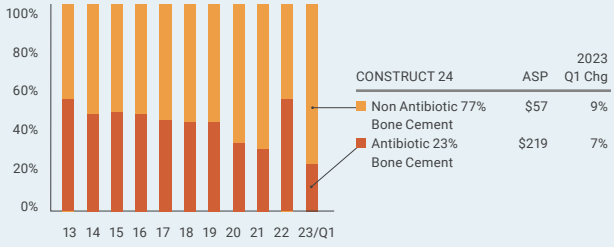
TKU02: TIBIAL INSERTS BY MATERIAL



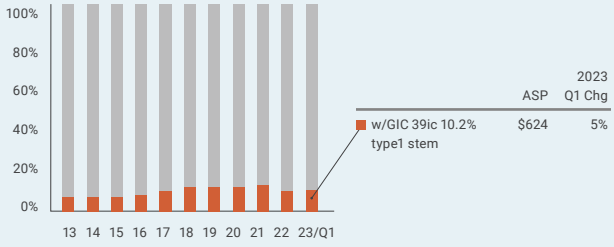
TKU03: UNITS OF 40G BONE CEMENT USED IN PRIMARY TOTAL KNEE REPLACEMENTS



TKU04: ANTIBIOTIC BONE CEMENT IN TOTAL KNEES



TKU05: PRIMARY KNEE CASES WITH TIBIAL EXTENSION STEMS



Lumbar Fusions

Lumbar Fusions Levels Fused: Seventy-five percent of the lumbar fusions involve either one or two levels, and 25% of the cases fused three or more vertebra in 2023/Q1. The levels are estimated based on the starting and ending vertebral body listed for the case, and hence may not reflect the number of levels that were actually instrumented during the surgery. The ASP of the cases increase with the number of levels fused from $11,635 for a single level, $13,828 for a two-level fusion, and $15,374 for a three level fusion case

Treatment of Single Level Lumbar Fusions: The most common treatment for a single level lumbar fusion is a pedicle screw construct with an interbody fusion device, which accounted for 67% of the single level lumbar fusions. This was followed by pedicle screw constructs (20%), and interbody only (11%). Pedicle screw plus interbody constructs are the most costly at $13,823. Interbody-only is nearly as expensive at $12,256 followed by plate plus interbody $10,996 and pedicle screw-only at $6,077.

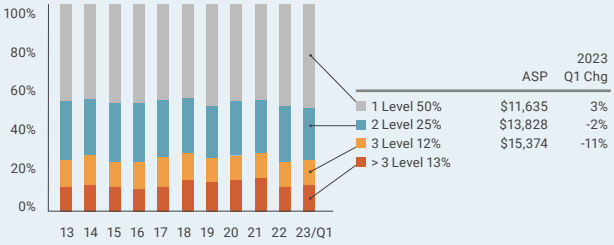
Resources: Metals (rods, plates, and screws) accounting for 35% of the costs of single level lumbar fusions is tied with followed by interbody fusion devices. Biologics follows at 24% and the remaining 7% relates to instruments, monitoring disposables and other misc.

Biologics: There are literally hundreds of osteobiologics that are used in spine procedures. Among the most costly are BMPs (which include Medtronic's Infuse as well as Cerapedics i-Factor), and cell-based matrices (e.g. Trinity Elite). Others include variations of demineralized bone matrix, bone substitutes, and allograft bone. We took a different look at biologics use this year, looking at cases that used only Infuse or i-FACTOR, only cell-based matrix (CBM) products, only a DBM or bone graft substitute (BGS), and two or more biologics in combination. BMP-only was used in 10% of the lumbar fusions in 2023/Q1, cell-based matrices-only in 5% of the cases, DBM or BGS in 28% and two or more biologics in combination were used in 24% of the cases. Thirty three percent of the cases did not use any purchased biologic but may have used autograft or traditional allograft chips. ASPs for BMP-only cases were $4,977, CBM $4,372, DBM or BGS $2,214 and the cases with multiple biologics used in combination had an ASP of $8,056 per case.

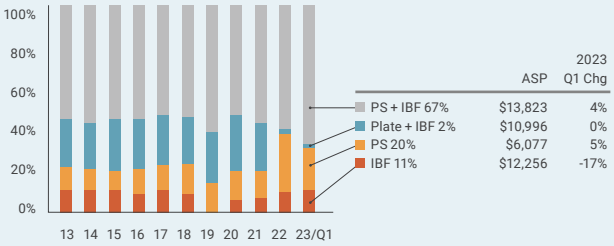
The size of the dosage of BMP has a large impact on the cost per case. Use of the smaller sizes (XXSM and XSM) has stayed up. The smallest sizes averaged about $1,817 in 2022 and the largest average $5,646. In the 2023/Q1 CRN, XXSM or XSM sized BMP accounted for 23% of the mix compared to 42% for small, and 35% for medium/large/extra-large. The overall cost per purchase averaged $4,135 in 2023/Q1, up 7% from 2022.

Lumbar Fusions, 2013-2022

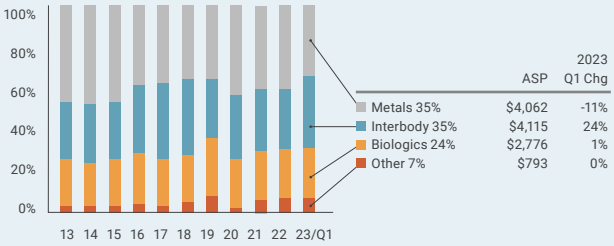
LFU01: LUMBAR FUSION LEVELS



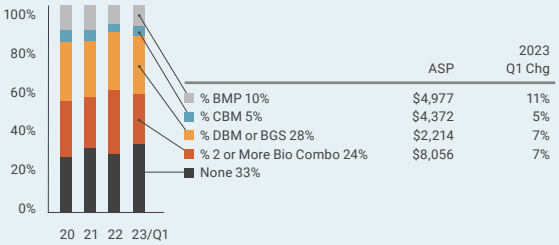
LFU03: 1-LEVEL LUMBAR FUSION IMPLANT $/CASE BY TYPE



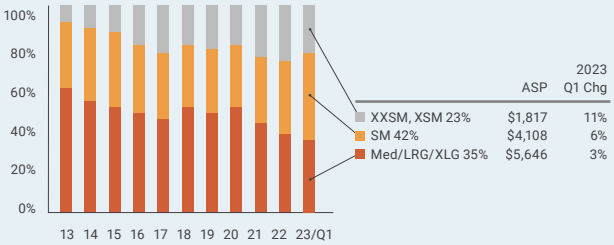
LFU02: TREATMENT OF SINGLE LEVEL LUMBAR FUSION



LFU05: BIOLOGICS IN LUMBAR FUSION



UBU01: BMP SIZE DISTRIBUTION



Cervical Fusions

Levels Fused: Thirty-six percent of the cervical fusions involved three or more vertebrae in 2022, while one- and two-level fusions accounted for 64% of the cases. The ASP of the cases increases with the number of levels fused from $3,420 for a single level, $4,725 for a two-level fusion and $6,412 for a three-level fusion. The mix of cervical levels fused has shifted as more one and two-level cervical procedures are treated with cervical disc. In 2011 approximately 80% of cervical fusions were one or two-level compared with 62% for 2023/Q1.

Treatment of Single Level Cervical Fusions: Sixty-seven percent of the single level cervical fusion cases were treated with a combination of interbody fusion device and a cervical plate in 2023/Q1, interbody-only accounted for 19% of the cases, and posterior cervical cases represented 8% of the total. Plate-only cases accounted for 6% of the single-level cervical fusions in 2023/Q1.

Resources for Single Level Cervical Fusions: The most expensive components of the cervical fusions were the plates and screws which accounted for 43% of the costs of the cervical fusions, and the interbody fusion devices which accounted for an additional 38% of the total. Osteobiologics, and "other" accounted for the remaining 19% of the costs.

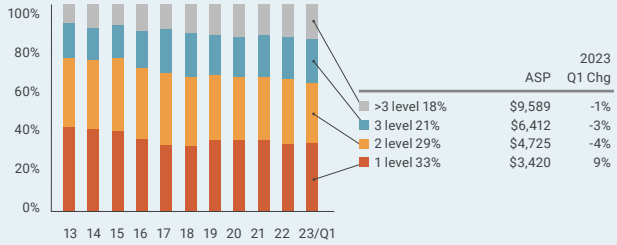
Trauma

Hip Fracture Treatment: There are a variety of modalities available to treat hip fractures, although treatment will depend on the location of the fracture and available resources. Although it is not possible to definitively say how hip fractures are treated in the hospitals contributing data to the CRN, the modalities listed above are generally used for the treatment of hip fractures. According to the 2023/Q1 CRN, the most frequent treatment modality were troch nails which accounted for 35% of the cases, followed by bipolar hips at 29%, modular endoprostheses at 19% and hip pins at 12%. The highest ASPs for the cases were bipolar hips $3,446, followed by modular endoprostheses $3,228 and troch nails $2,958.

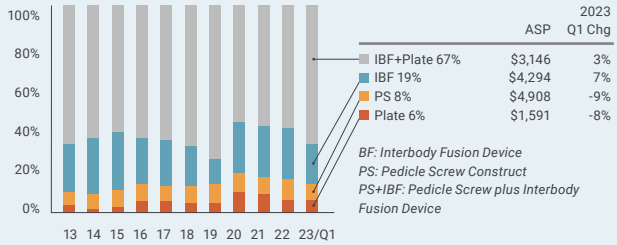
Source: All data on this page, Curvo Research Network (CRN)

Cervical Fusions, 2013-2022

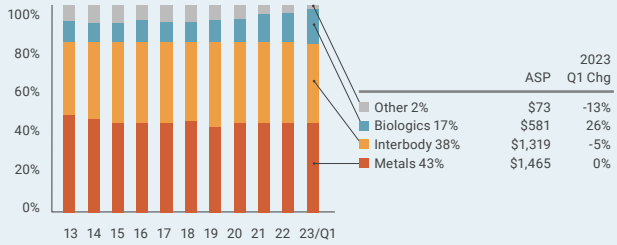
CFU01 NUMBER OF LEVELS FUSED IN THE CERVICAL SPINE



CFU03 1-LEVEL CERVICAL FUSION TREATMENT

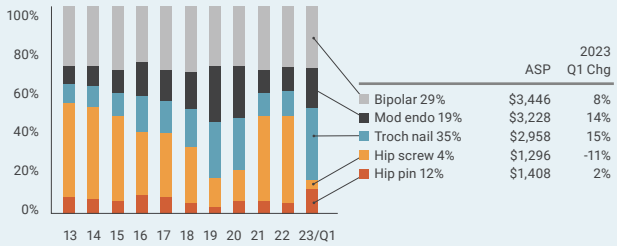


CFU02 1-LEVEL CERVICAL FUSION IMPLANT $/CASE, BY TYPE



Trauma Devices 2013-2023/Q1

% OF CASES BY TREATMENT TYPE



ABOUT THE SAMPLE

Cases examined in the database for this article:

	CY 2021	Q1 2022	Q1/2022 Hospitals
Total hips	34,092	5,023	105
Total Knees	50,921	7,865	105
Shoulders	11,141	2,242	92
Lumbar Fusions	20,022	3,337	60
Cervical Fusions	11,443	1,865	60
Hip Fracture Constructs	13,293	2,002	96

Cases are excluded from the analysis if it appears that the data does not reflect bona fide cases.

2023 Newsletter Topics

Volume 34, Number 1 (Available):
Extremity

Volume 34, Number 2 (Available):
Trauma

Volume 34, Number 3 (Available):
Hip and Knee Implants

Volume 34, Number 4 (Coming Soon):
Spinal Surgery, Bone Grafts and Substitutes

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ISSN # 1059-311X

Orthopedic Network News is a publication of Curvo Labs, Inc. of Evansville, Indiana.