SoFCOT Total Hip Arthroplasty Register

Biennial Report 2022

2006-2021

Institut für Sozial- und Präventivmedizin ISPM
SwissRDL Medical Registries and Data Linkage

SWISSRDL

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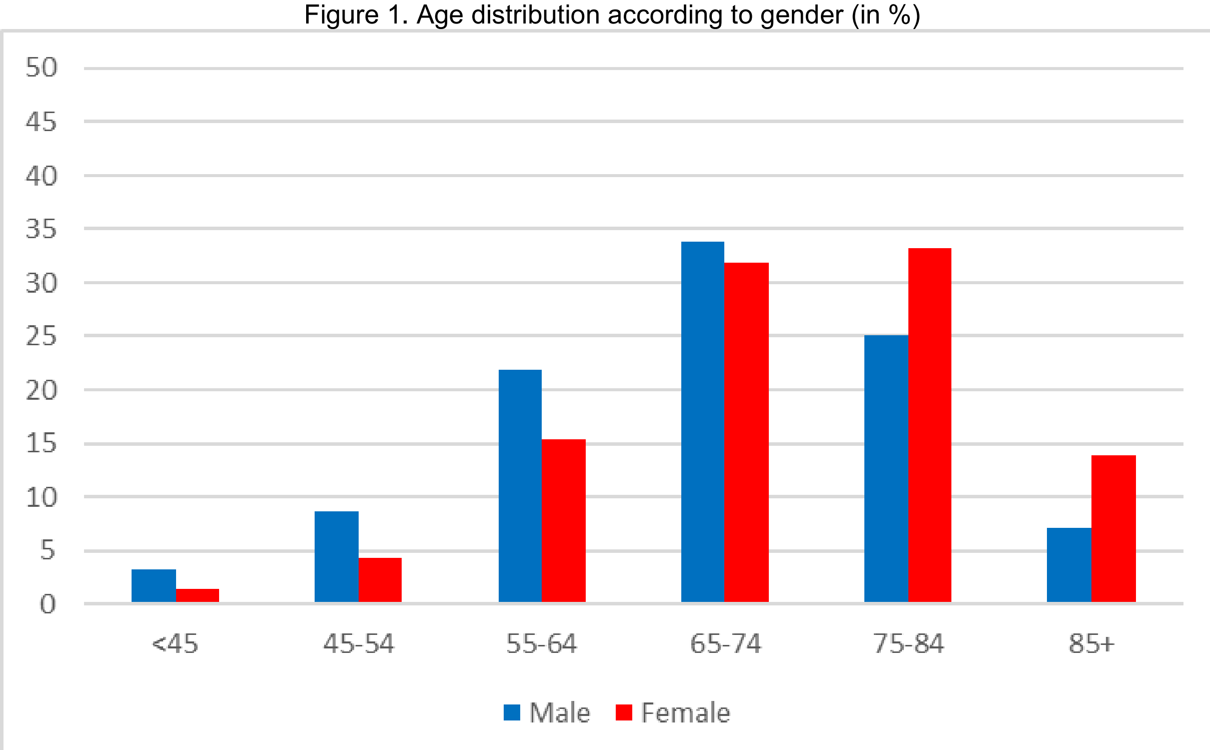
Part I: Primary Total Hip Arthroplasty

From January 1st 2006 to December 31th 2021, a total of 53'119 Total Hip Arthroplasties (THA) were registered in the SoFCOT hip register. The annual number of primary registrations peaked in 2015 at over 5'600 procedures, then remained stable at a high level in 2016 and 2017. However, that number fell to just over 5'000 annually in 2018 and 2019. Annual registrations then declined further to under 4'000 in 2020 and 2021. The average age of the patients was 70.9 years (SD, 11.6 years). A total of 30'299 patients (57%) were female with an average age of 72.8 years, and 22'783 were male with an average age of 68.5 years (Table 1, Figure 1).

Table 1. Patient age at operation

Gender	N	Min	Max	Average	Std Dev
Male	22783	15	103	68.5	11.8
Female	30299	13	113	72.8	11.1
Total	53119	13	113	70.9	11.6

Figure 1. Age distribution according to gender (in %)



Osteoarthritis is the main indication for THA (76%), followed by acute fracture, osteonecrosis of the femoral head and hip dysplasia (Table 2).

Table 2. Underlying diagnoses

Diagnostics	Frequency	Percentage
Primary osteoarthritis	40 379	76.0
Recent fracture	4 412	8.3
Femoral head necrosis	2 237	4.2
Hip dysplasia	2 120	4.0
Rapid destructive arthritis	1 804	3.4
Traumatic sequelae	1 182	2.2
Others	596	1.1
Rheumatoid arthritis	263	0.5
Post-Perthes Calve	126	0.2

The postero-lateral approach was used in more than half of the interventions (51.8%). The distribution of the individual approaches was relatively stable between 2009 and 2015, but in recent years, the postero-lateral and the antero-lateral approaches have been on the increase (Figures 2a and 2b). “Other” responses declined to practically zero by 2020. Those responses consisted of minimally invasive variants of the other approaches (in particular antero-lateral and lateral) as well as Rottinger’s approach.

Figure 2a. Distribution of surgical approach (%)

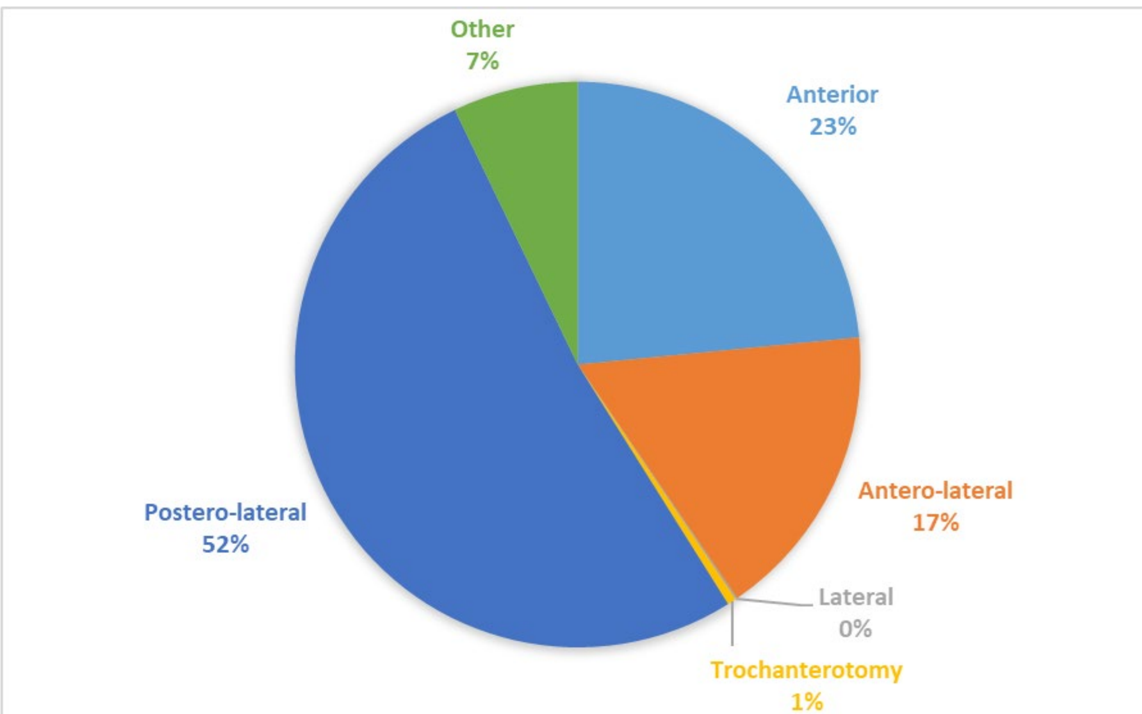


Figure 2b. Distribution of surgical approach: change over 16 years

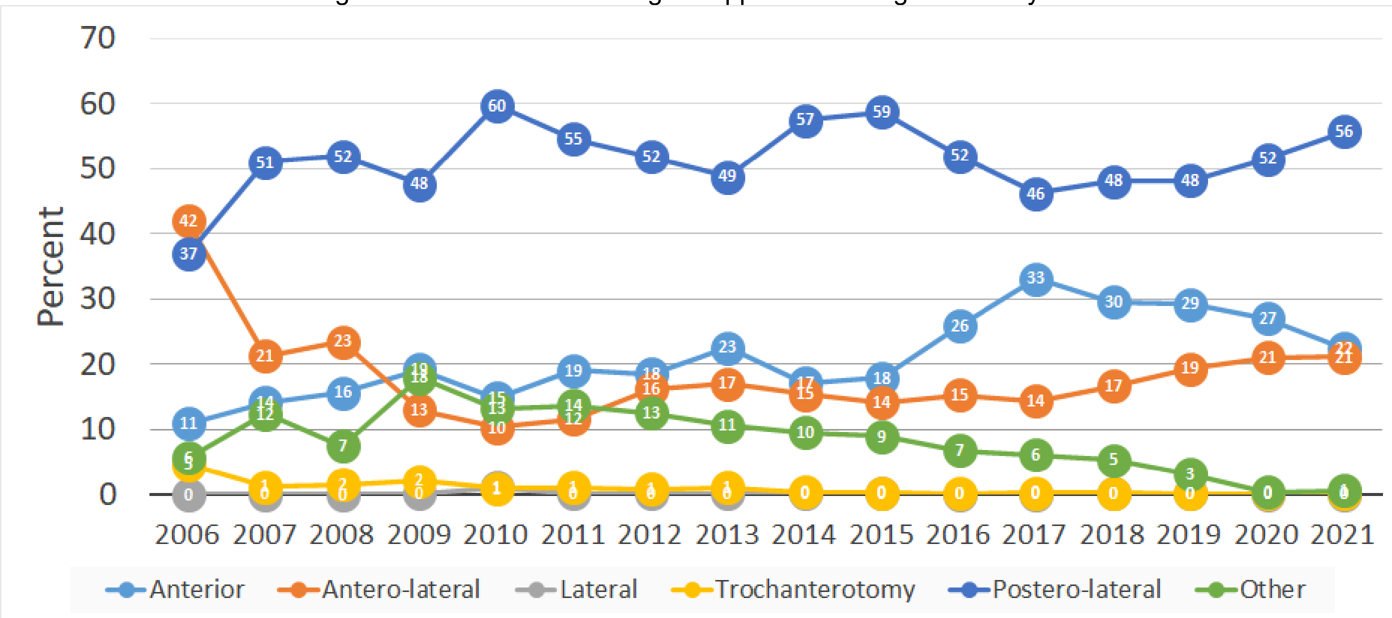


Table 3 shows that 88.9% of THAs are done conventionally and that a dual mobility cup was used in 42.7% of cases. However, the share of dual mobility cups has increased steadily and they are not the dominant form of cups currently registered (Figure 3a). More than two thirds of THAs were fixed without cement (Figure 4a). A steady increase of the uncemented fixation type can be observed over 16 years, which occurs in parallel to the decline of the cemented fixation in particular since 2009 (Figure 4b). When cement is used, it is in the majority of cases antibiotic-impregnated cement (up from 82% in 2006 to 97.5% in 2021) (Figure 5a/5b).

Table 3a. Types of THA for primary implantation

Type of Prosthesis	Frequency	Percent
Conventional THA	47 208	88.9
THA with short femoral stem	2 847	5.4
Femoral prosthesis with mobile cup (bipolar)	2 434	4.6
Total resurfacing	350	0.7
Other	264	0.5
Femoral resurfacing	8	0.0
THA with trans-cervical fixation	8	0.0
Total	53 119	100

Table 3b. Type of cups for primary implantation

Type of Cup	Frequency	Percent
Conventional	28 222	53.1
Dual mobility cup	22 663	42.7
Mobile head	2 234	4.2

Figure 3a. Share of registered dual-mobility cups: change over 16 years

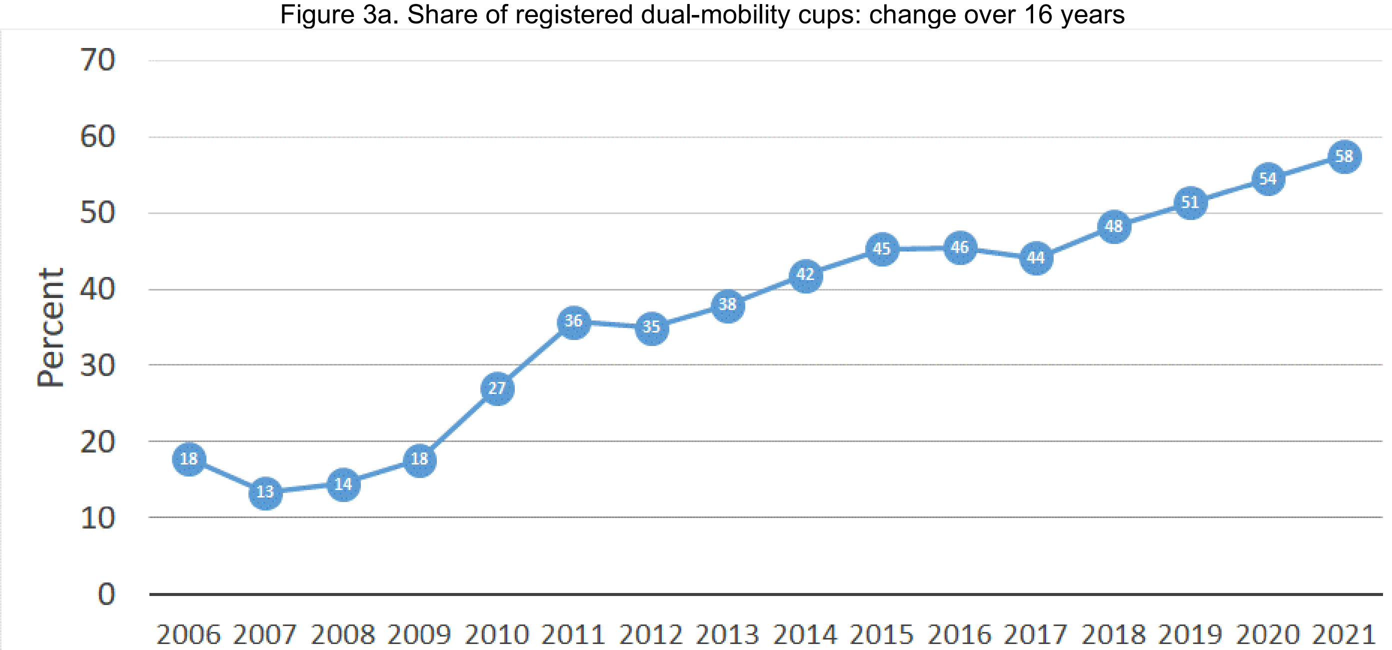


Figure 4a. Fixation of components (%)

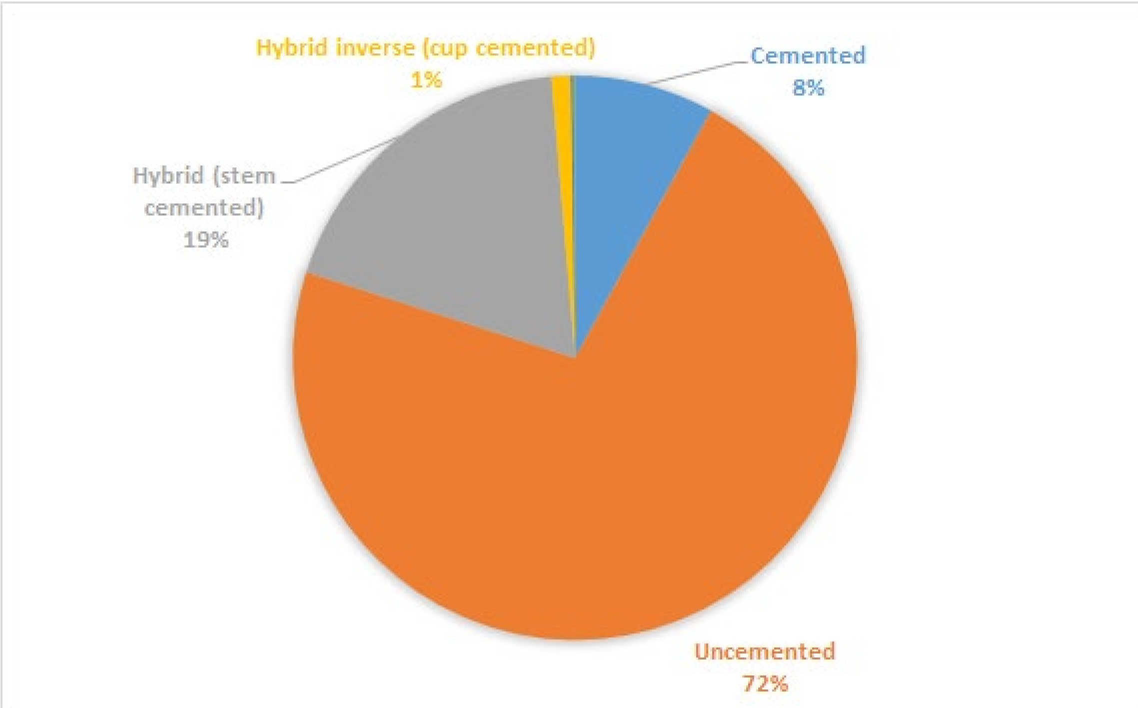


Figure 4b. Fixation of components: change over 16 years

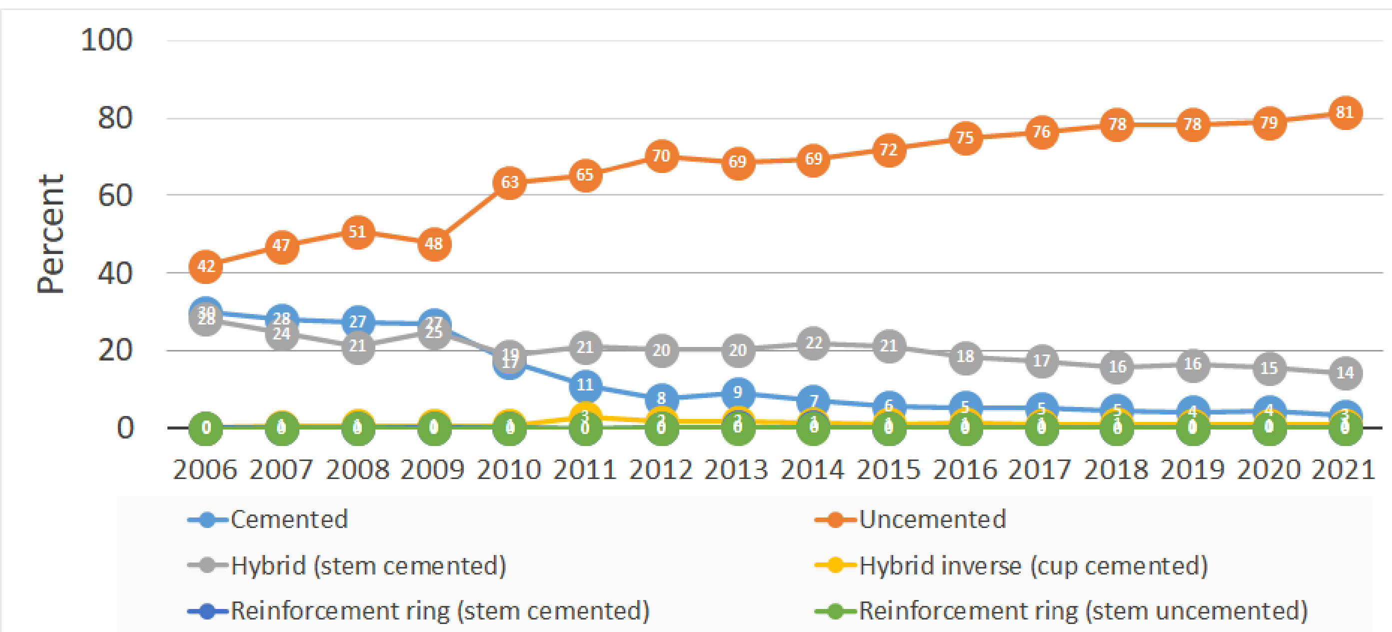


Figure 5a. Use of antibiotic-impregnated cement

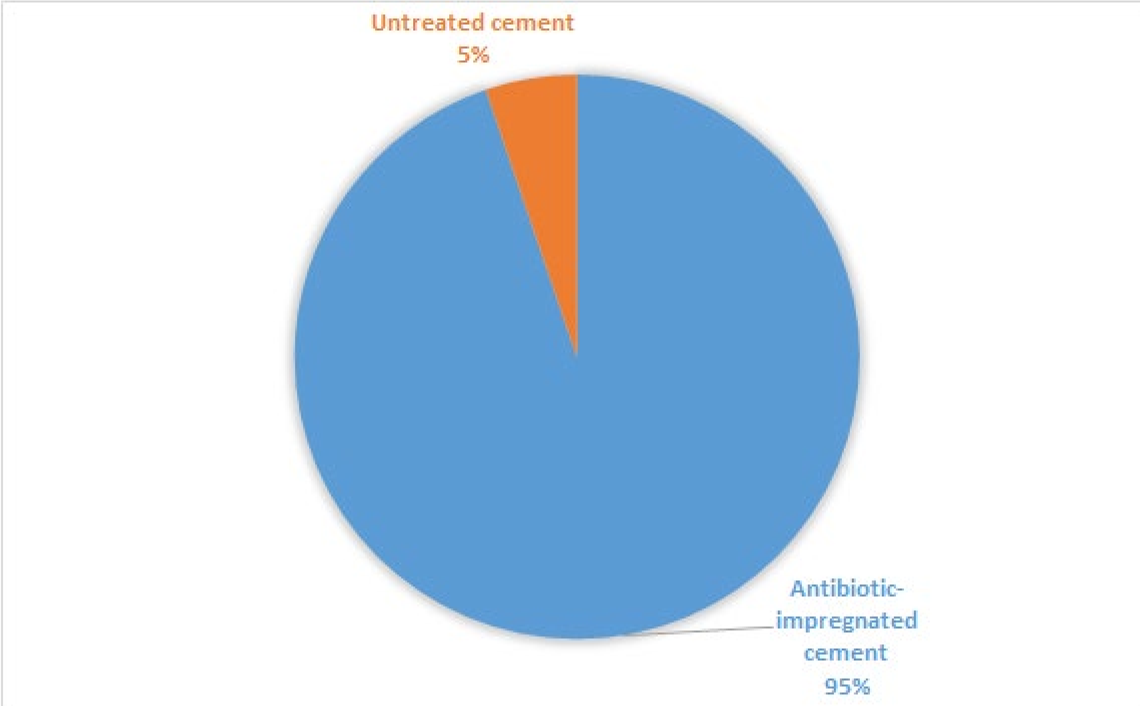
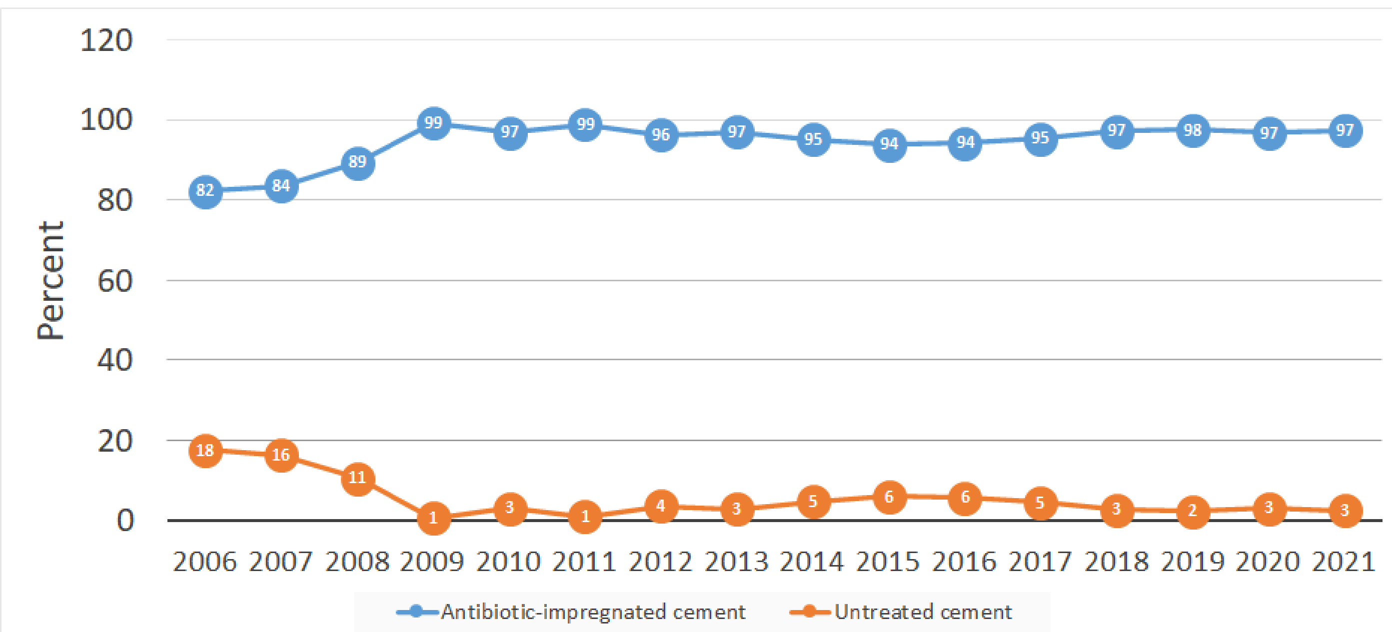


Figure 5b. Use of antibiotic-impregnated cement: change over 16 years

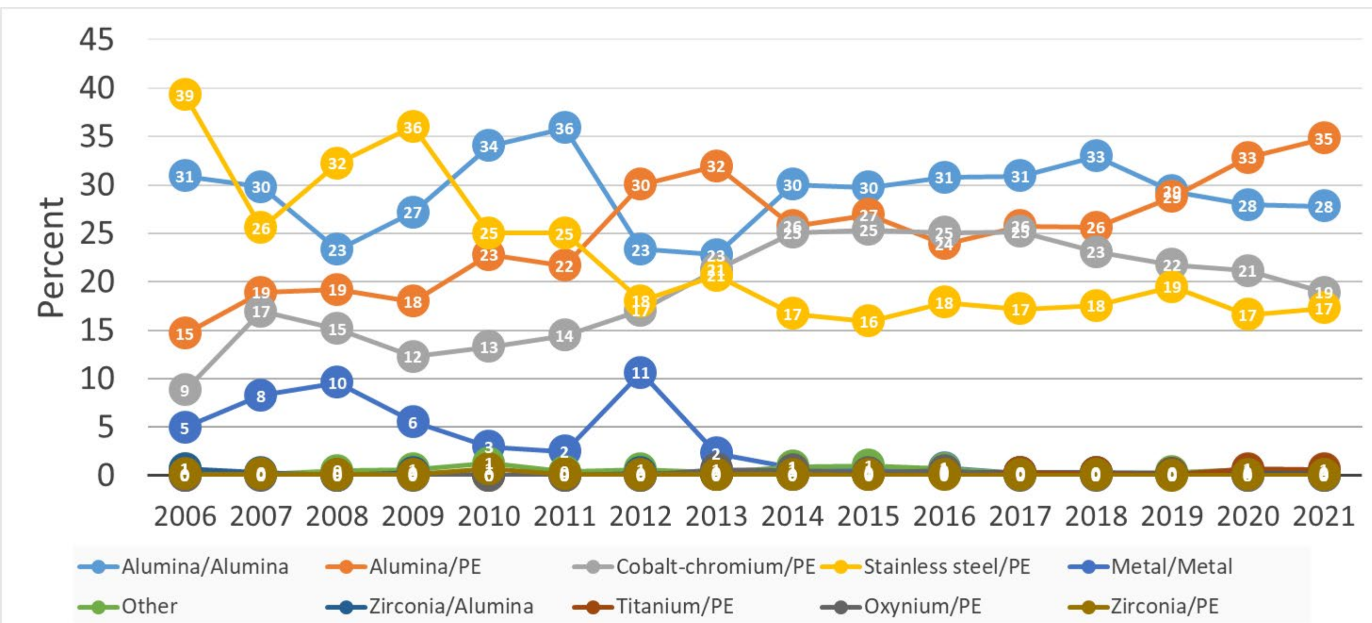


Four weight-bearing materials represent nearly 97% of THAs (Table 4). The order of frequency of the bearing materials did not change significantly since 2011, except that the proportion of Stainless steel/PE was declining between 2009 and 2015 whilst Cobalt-chrome/PE was seeing a corresponding increase. In recent years, Alumina/PE became the dominant coupling (Figure 6).

Table 4. Weight bearing materials

Material	Frequency	Percent
Alumina/Alumina	15 610	29.4
Alumina/PE	14 213	26.8
Cobalt-chromium/PE	11 414	21.5
Stainless steel/PE	10 296	19.4
Metal/Metal	954	1.8
Other	284	0.5
Zirconia/Alumina	116	0.2
Titanium/PE	106	0.2
Oxynium/PE	84	0.2
Zirconia/PE	38	0.1

Figure 6. Weight bearing materials: change over 16 years

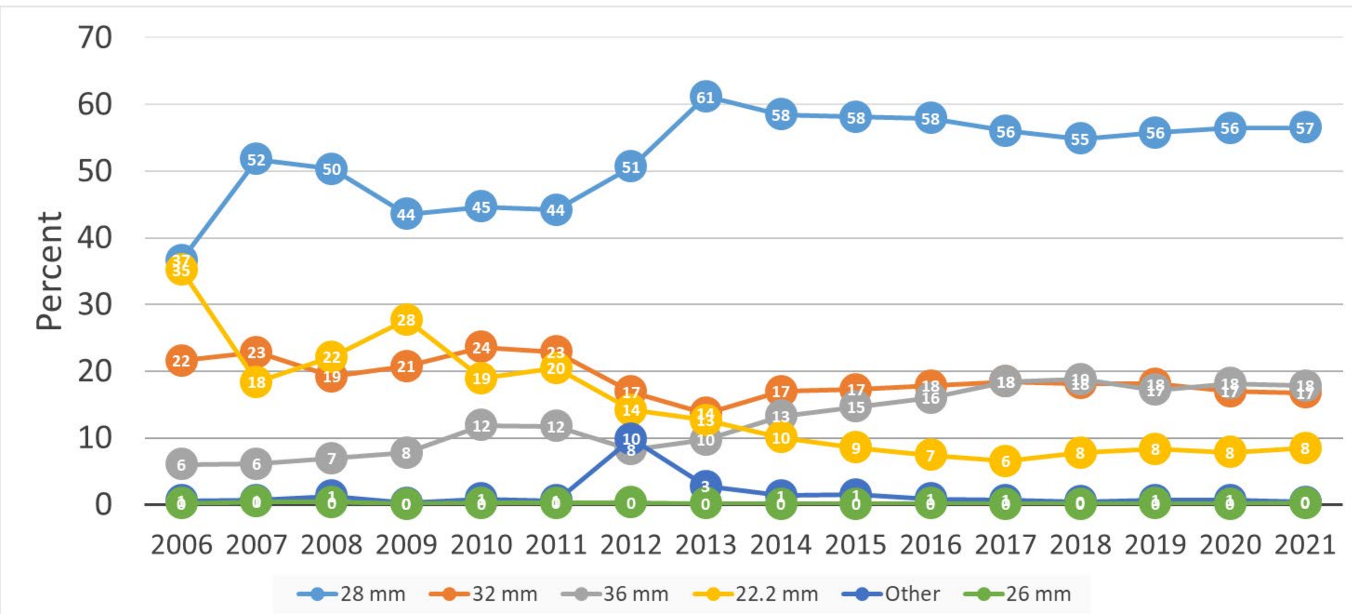


The use of 28mm heads increased steadily between 2006 and 2013 and thus remains the predominant femoral head size. There has been very little distributional change since 2013. 28mm, 32mm and 36mm heads account for the majority of heads registered (Table 5/ Figure 7).

Table 5. Size of femoral head

Size	Frequency	Percent
28 mm	29 199	55.0
32 mm	9 580	18.0
36 mm	7 765	14.6
22.2 mm	5 765	10.9
Other	736	1.4
26 mm	70	0.1

Figure 7. Size of femoral head: change over 16 years



The most commonly used primary implants are listed below by type of fixation and restricted to at least 50 primary implantations (Tables 6, 7, 8 & 9). Please note that this only covers implants that could be reliably identified in the SwissRDL/SoFCOT implant library (see methodological notes below).

Please note that some figures have changed compared to previous reports due to improvements in implant recognition and other data quality improvements. For instance, there were several misclassifications regarding dual mobility vs. standard cups and regarding cemented vs. uncemented implants. SwissRDL has also adapted numerous brand names to bring them in line with a unified SwissRDL implant library. Upon the release of a new report, all previous reports are to be considered superseded.

Table 6. Most frequently used cemented cups (>=50)

	Implant name	Frequency	Cumulative percent
1	Kerboull MKIII	862	30.6
2	Original Mueller	404	44.9
4	Initiale PE	333	56.7
3	Chirulen	244	65.4
5	Novae stick	229	73.5
6	Ceraver cotyle PE	125	77.9
7	Saturne	113	81.9
8	Tregor	90	85.1
9	Exafit	79	87.9
10	Oceane	58	90.0
11	Symbol DM cem	51	91.8
	Total (all cemented cups)	2820	100

Table 7. Most frequently used uncemented cups (>=50)

	Implant name	Frequency	Cumulative percent
1	Novae TH/Bi-Mentum	4873	11.4
2	Pinnacle	4089	21.0
3	Quattro	2861	27.7
4	Avantage	2037	32.5
5	Saturne	1619	36.3
6	Cerafit	1595	40.0
7	RM pressfit vitamys	1438	43.4
8	Allofit	1293	46.4
9	Versafitcup trio/ccl.	1247	49.3
10	RM pressfit	1219	52.2
11	Saturne II	1076	54.7
12	Restoration ADM	1074	57.2
13	Trident	1018	59.6
14	Continuum	890	61.7
15	Gyros	870	63.8
16	Tregor	813	65.7
17	Hype	808	67.6
18	Exclusif	755	69.3
19	Symbol DMHA/DS evol.	691	70.9
20	Liberty	690	72.6
21	Ades DM	653	74.1
22	Capitole	589	75.5
23	April ceramic	570	76.8
24	ABG II	510	78.0
25	HNG	456	79.1
26	Corin DM	414	80.0
27	Horizon II	414	81.0
28	Cotyle xlfit	413	82.0
29	Cerafit DM	376	82.9
30	Dynacup	361	83.7
31	RM classic	352	84.5
32	X.Cup MOB	337	85.3
33	Stafit	322	86.1
34	Evora	315	86.8
35	Polarcup	303	87.5

	Implant name	Frequency	Cumulative percent
36	Exceed	294	88.2
37	Must	258	88.8
38	Atlas IV	234	89.4
39	Atlas III	228	89.9
40	Selene	226	90.4
41	Eternity	222	91.0
42	Xlfit	218	91.5
43	Novae evolution	205	91.9
44	Versafitcup DM	194	92.4
45	Delta PF	187	92.8
46	Alloclassic	186	93.3
47	X.Cup	177	93.7
48	Symbol NA	169	94.1
49	Isis II	167	94.5
50	Plasmafit	163	94.9
51	Mpact DM	160	95.2
52	Pavi	147	95.6
53	Trident II	139	95.9
54	Delta motion	128	96.2
55	HNG DM	107	96.5
56	Selexys DS	106	96.7
57	Lagoon	100	96.9
58	Quartz	94	97.2
59	Fixa	92	97.4
60	Atlante	91	97.6
61	Cargos	91	97.8
62	Plasmacup	89	98.0
63	Freeliner	80	98.2
64	Horizon	79	98.4
65	Mixt	72	98.5
66	Tritanium	64	98.7
67	Jump system/JS traser	62	98.8
68	Maxera	62	99.0
69	MBA	53	99.1
	Total (all uncemented cups)	42 665	100

Table 8. Most frequently used cemented stems (>=50)

	Implant name	Frequency	Cumulative percent
1	Initiale modular	1475	11.9
2	Legend V40	1203	21.6
3	Avenir (cem)	1083	30.3
4	Exafit	925	37.7
5	PF	748	43.7
6	ABG II (cem)	732	49.6
7	Sterwen	723	55.4
8	Amistem-C	525	59.7
9	Lemovice	474	63.5
10	Oceane+	421	66.9
11	Osteal	397	70.1
12	Excia	386	73.2
13	CCA	326	75.8
14	Generic	302	78.2
15	CMK	298	80.6
16	Dedicace V40	289	82.9
17	Hype (cem)	271	85.1
18	Institution	226	86.9
19	Valmer	173	88.3
20	Corail (cem)	130	89.4
21	Exception (cem)	114	90.3
22	Kerboull MKIII	110	91.2
23	Harmony (cem)	105	92.0
24	Amis-K	100	92.8
25	Original Mueller	99	93.6
26	Naos	91	94.4
27	Centris	77	95.0
28	Polarstem (cem)	77	95.6
29	Twinsys (cem)	75	96.2
30	Pavi	62	96.7
31	Silene	61	97.2
32	Meije Duo	54	97.6
	Total (all cemented stems)	12 428	100

Table 9. Most frequently used uncemented stems (>=50)

	Implant name	Frequency	Cumulative percent
1	Corail collared	4611	12.9
2	Avenir	3964	23.9
3	Corail	2575	31.1
4	Exception	2401	37.8
5	Cerafit	1915	43.2
6	Targos	1896	48.5
7	Targos mini	1497	52.6
8	Hype	1429	56.6
9	Optimys	1423	60.6
10	Integrale	1130	63.8
11	Thelios HAP	1124	66.9
12	HNG	742	69.0
13	Amistem-H	625	70.7
14	Accolade II	616	72.4
15	Hactiv HAC	597	74.1
16	Meije Duo	595	75.8
17	Alloclassic	570	77.3
18	Linea	527	78.8
19	Silene	517	80.3
20	Twinsys	420	81.4
21	Valmer	358	82.4
22	Naos	341	83.4
23	ABG II	337	84.3
24	SPS evolution	313	85.2
25	Symbol	310	86.1
26	Libra	251	86.8
27	Pavi	236	87.4
28	H-Max	231	88.1
29	Esop	228	88.7
30	Evok	218	89.3
31	Excia plasmapore	212	89.9
32	Louxor	195	90.4
33	Harmony	193	91.0
34	SL-plus/SL-plus MIA	187	91.5
35	Optimum	186	92.0

	Implant name	Frequency	Cumulative percent
36	Avenir complete	177	92.5
37	ACOR modular	175	93.0
38	Aura	160	93.5
39	Cineos	158	93.9
40	Hype mini	157	94.3
41	Fitmore	153	94.8
42	Amistem-P	147	95.2
43	ACOR monobloc	139	95.6
44	Polarstem	130	95.9
45	Rhino	125	96.3
46	OK baby	123	96.6
47	Respect	121	97.0
48	Quadra-H	93	97.2
49	BHS	86	97.5
50	Hagap	81	97.7
51	Stellaris	66	97.9
52	Individual/custom hip	64	98.0
53	Stemsys MI	55	98.2
54	Anato	51	98.3
	Total (all uncemented stems)	35 828	100

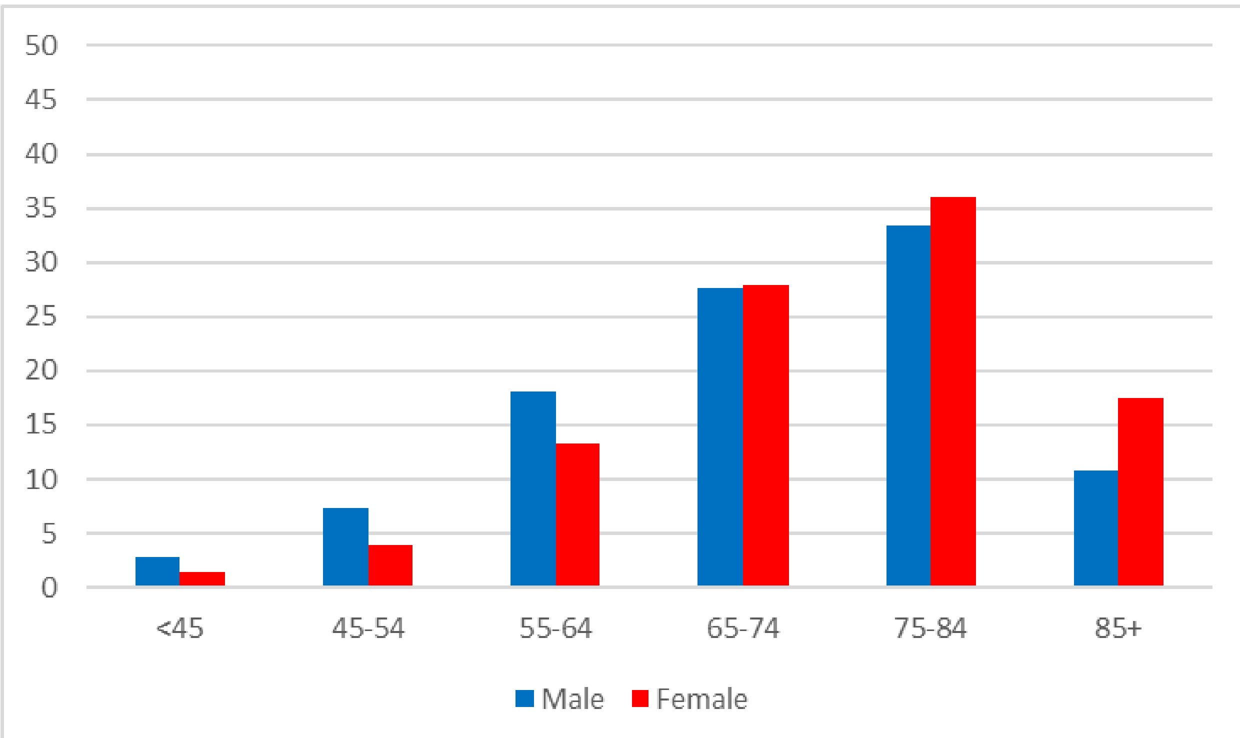
Part II: Re-intervention and THA Revision

Between January 1st 2006 and December 31th 2021, 5’496 re-interventions of THAs were registered in SoFCOT. The average patient age was 72.6 years (SD, 11.8) at revision. A total of 3’064 patients (56.7%) were female with an average age of 74.1 years, and 2’432 patients were male with an average age of 70.7 years (Table 10, Figure 8).

Table 10. Age of the patients at the re-intervention/THA revision

Gender	N	Min	Max	Mean	SD
Male	2 432	21	99	70.7	12.1
Female	3 064	24	113	74.1	11.3
Total	5 496	21	113	72.6	11.8

Figure 8. Age distribution at the time of re-intervention/revision according to gender



Aseptic loosening remains the principal cause of re-interventions. However, it decreased from 53.4% in 2011 to 44.5% in 2021. Hip dislocation represents the second most common cause of re-interventions. Reinterventions due to wear and osteolysis have only marginally increased over the last years, and the same is true for the periprosthetic fractures. Other causes of re-interventions worth mentioning are acute infection, pain, septic loosening and fracture of the implant, with frequencies between 3.1% and 7.5% (Table 11).

Table 11. Causes of re-intervention and THA revisions

Diagnosis	Frequency	Percent
Aseptic loosening	2 481	45.1
Dislocation	650	11.8
Peri-prosthetic fracture	603	11.0
Septic Loosening - chronic infection	412	7.5
Wear and/or osteolysis	410	7.5
Deep acute infection	280	5.1
Pain	225	4.1
Other	214	3.9
Implant fracture	165	3.0
Peri-operative fracture	23	0.4
Head and neck resection	19	0.4
Calcifications	10	0.2
Removal of material	4	0.1

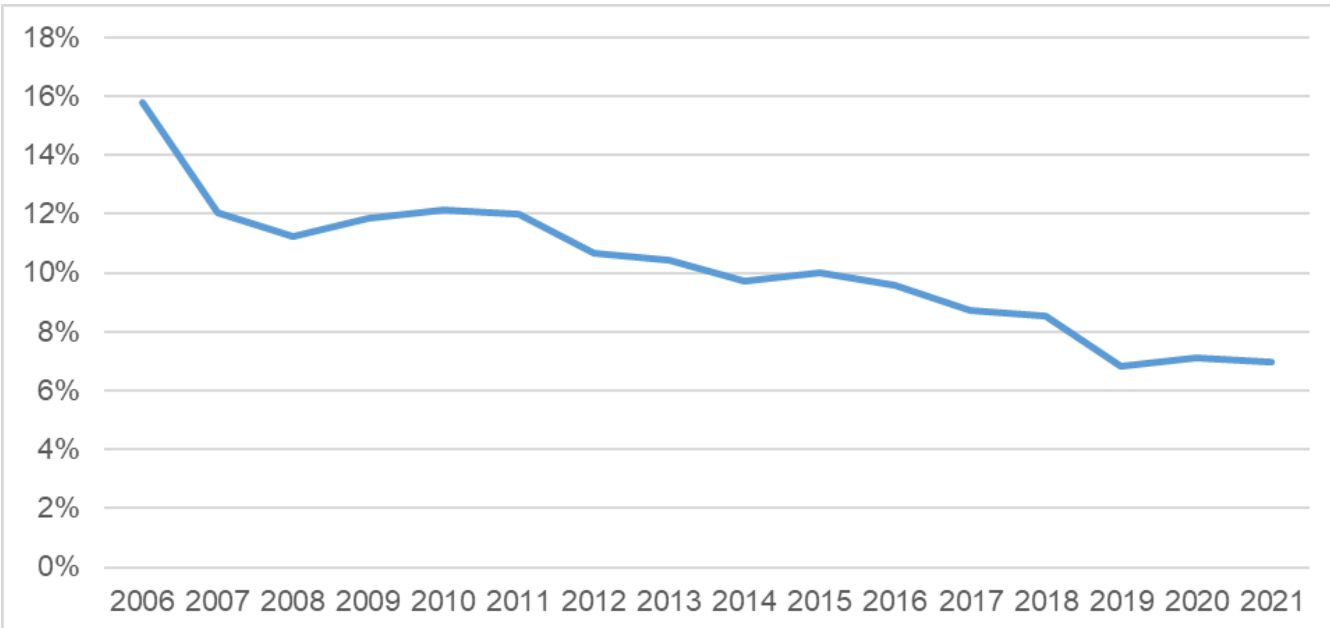
In accordance with the causes of revision, the most common reintervention remains the change of both the acetabular and femoral components, albeit with slightly decreasing frequency since 2009. The proportion of isolated replacement of acetabular or femoral components did not change significantly since the last report (Table 12).

Table 12. Types of re-interventions / revisions

Intervention	Frequency	Percent
Complete exchange	2 476	45.1
Acetabular implant only	1 699	30.9
Femoral implant only	746	13.6
Head and liner	249	4.5
Reimplantation after resection	112	2.0
Others	60	1.1
Totalisation	59	1.1
Head only	29	0.5
Implant removal+spacer	25	0.5
Liner only	18	0.3
Head-neck resection	10	0.2
Osteosynthesis	9	0.2
Prosthetic lavage	4	0.1

We can calculate an annual revision burden according to the formula "N annual revisions/ (N annual primaries + N annual revisions)". Currently, with 5'496 revisions recorded compared with 53'119 primary THAs registered since January 1st 2006, the overall 16-year revision burden is 9.4%. The annual revision burden between 2008 and 2011 was relatively stable at around 12%, but there appears to be a relatively steady decline in the revision burden since then (Figure 9). It should be noted that this statistic does not represent a true "revision rate" of the implants used, but merely provides an indication of the relative burden caused by revision procedures in participating services.

Figure 9. Annual revision burden during the 16-year period 2006 and 2021 (%)



Part II-A: Characteristics of the revised implants

Unsurprisingly, the majority of the revised THAs are of the conventional type with a femoral stem and an acetabular component, either with conventional or dual mobility cups (DMC). Given the growing use of dual mobility cups in this register, their share of cups withdrawn is also growing steadily. The other arthroplasty types represent only 11% of the total THAs revised (Table 13).

Table 13a. Characteristics of the revised implants

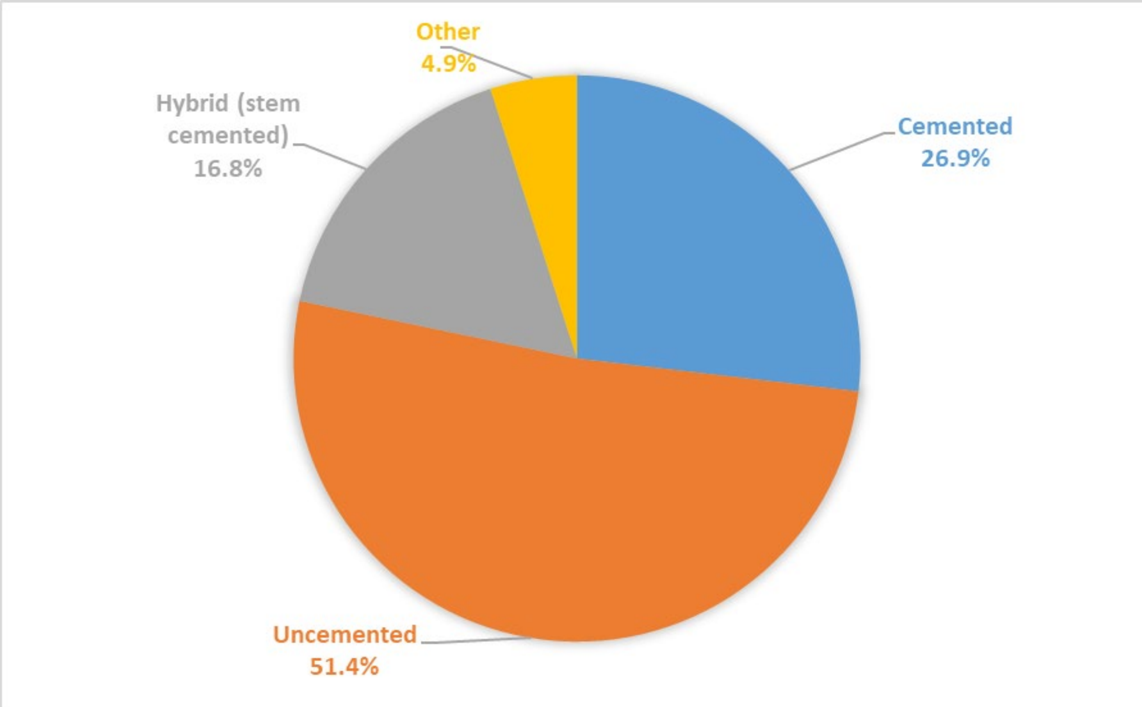
Revised	Frequency	Percent
THA with femoral stem	4 892	89.0
Femoral prosthesis with mobile cup	243	4.4
Others	196	3.6
Spacer	97	1.8
THA with short femoral stem	54	1.0
Femoral head resurfacing	7	0.1
Total resurfacing	6	0.1
THA a trans-cervical fixation	1	0.0

Table 13b. Type of cups withdrawn

Cup type	Frequency	Percent
Conventional	3 871	73.4
Dual mobility cup	1 147	21.7
Mobile head	245	4.6
Other	13	0.3

Just over half of the implants revised were uncemented and that proportion has steadily increased over the last years (Figure 10).

Figure 10. Fixation of the revised implants



Most of the revised acetabular cups or inlays are still made of conventional polyethylene (PE). Its proportion has marginally decreased over the last years, as have the proportions of the bulk alumina or Co-Cr sandwich cups (Table 14). Reflecting its growing market share in primary procedures, the share of highly cross-linked PE (HXLPE) is also growing in revised components.

Table 14. Material of revised cups or inlays

Insert	Frequency	Percent
Conventional PE	3 434	67.1
Bulk alumina	670	13.1
Highly cross-link PE	522	10.2
None	153	3.0
CoCr-sandwich	139	2.7
Alumina-sandwich	92	1.8
Others (or unclear)	68	1.3
Non-modular CoCr	39	0.8

In contrast to the revised inlays, the distribution of the replaced heads has seen more pronounced changes after 2011. Compared to 2011, the proportion of the revised stainless-steel heads decreased by 15 percentage points, down to a level of 15.4% in 2021. Alumina heads accounted for 46.5% of the replaced heads in 2021, and the proportion of the revised Co-Cr heads increased by more than 10 percentage points to its current level of 31.1%. However, as the absolute numbers per year are comparatively small, these figures are subject to some year-on-year random fluctuation as well. The proportions of all materials between 2006 and 2021 are shown in Table 15.

Table 15. Material of revised heads

Head	Frequency	Percent
Alumina	1 817	35.5
CoCr	1 416	27.7
Steel	1 340	26.2
Zirconia	407	8.0
Other	104	2.0
Titanium	28	0.6
Oxynium	3	0.1

Part II-B: Type of implant, fixation and cups used for revision

In about one fifth of all acetabular revisions the implant was supported by a reinforcement ring. Another quarter of acetabular revisions were cemented, and slightly more than the half were uncemented (Figure 11). Femoral revisions were equally split between cemented and uncemented stems (Figure 12). In cases with cementation, an antibiotic-impregnated cement was used in over 93% of cases (Figure 13).

Figure 11. Implant fixation of acetabular revisions

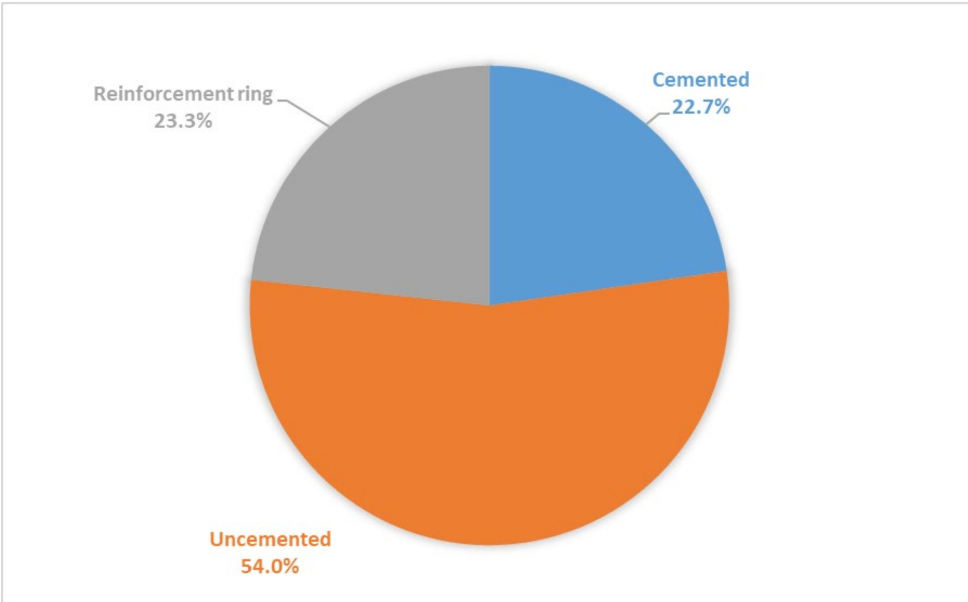


Figure 12. Use of cement in femoral revisions

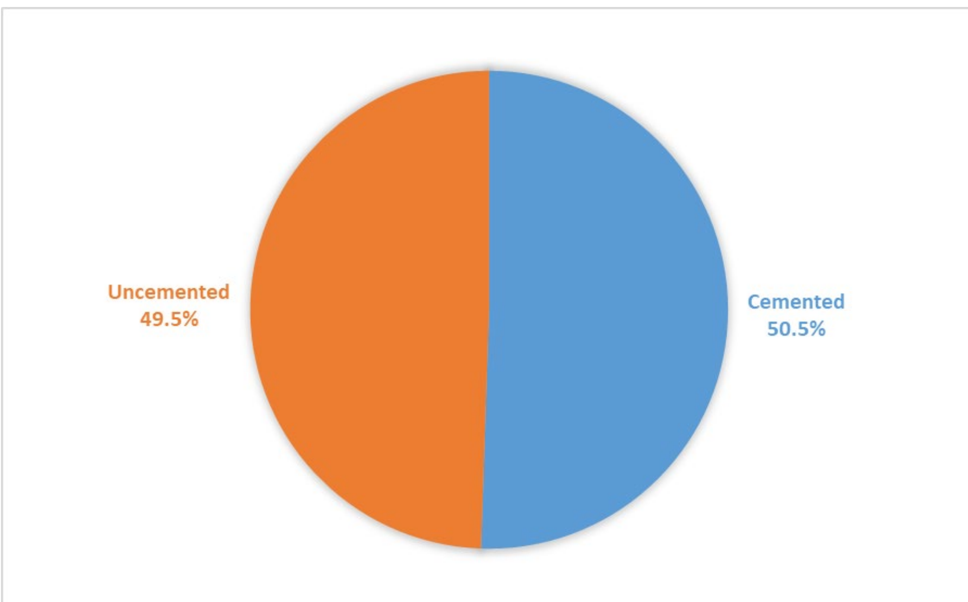
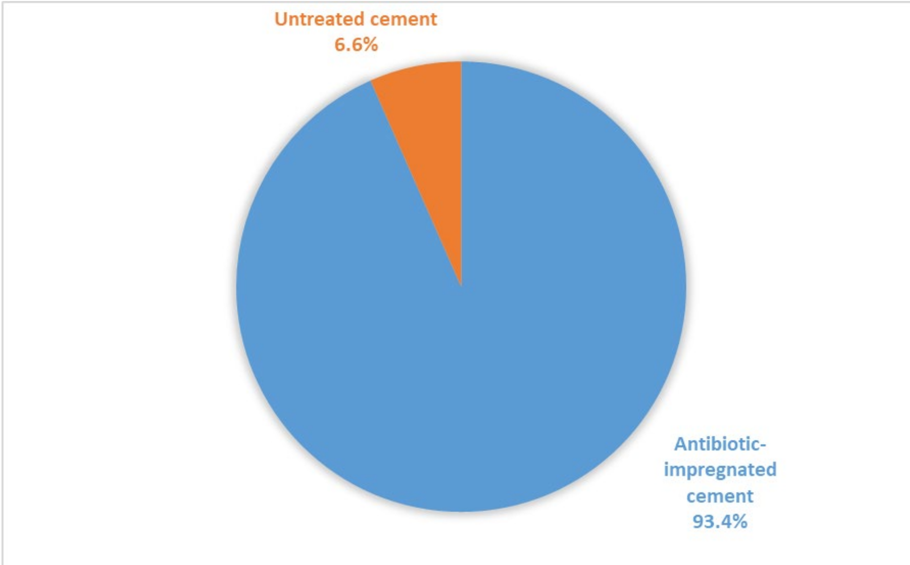
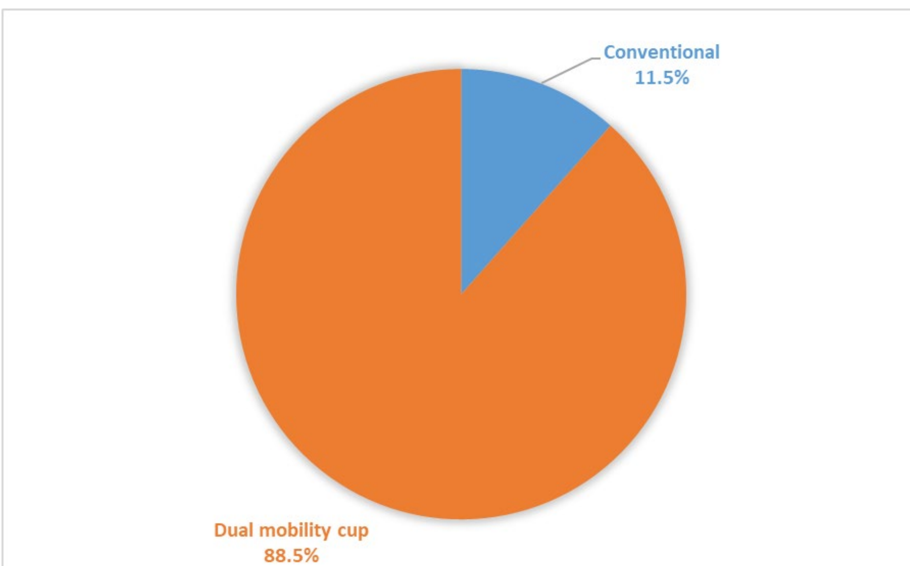


Figure 13. Cemented revisions with and without antibiotics



The vast majority (88.5%) of cups used in revisions since 2017 were of the dual mobility type, which, perhaps, is not surprising given the increasing use of DMC in primary procedures, but still exceeds the share of DMC in recent primary THAs by a large margin.

Figure 14. Type of cup used in revision (data available since 2017)



Four weight-bearing materials are mainly used in revisions. The classic combination of stainless steel/PE is not the dominant anymore, losing that position to Cobalt-chrome/PE (Figure 15). Figure 16 shows a significant increase of the combination Co-Cr/PE since 2011, mainly at the cost of Stainless steel/PE. Sudden changes from one year to the next in Figure 16 may also be the result of changes in the composition of participants of the registry.

Figure 15. Weight bearing materials used in revisions

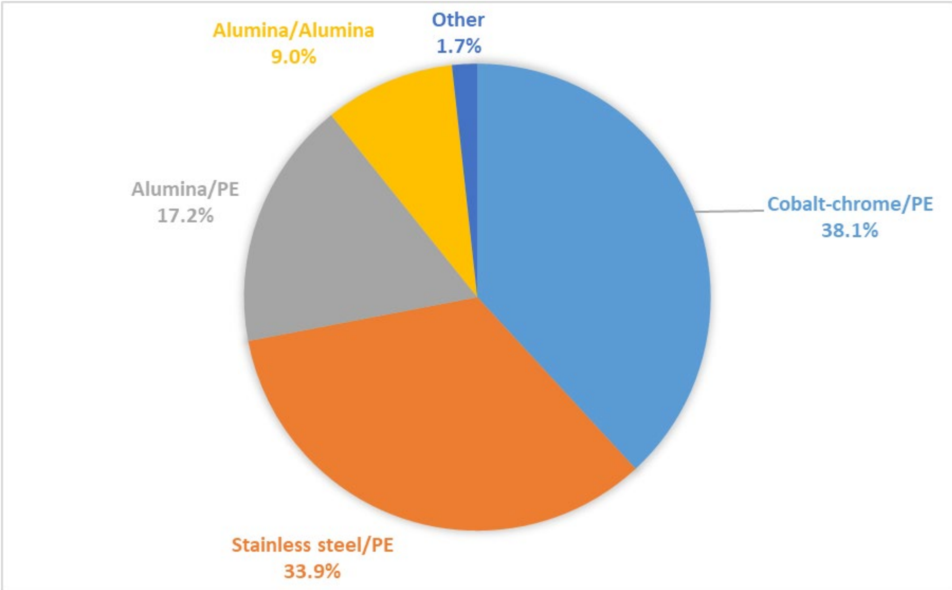
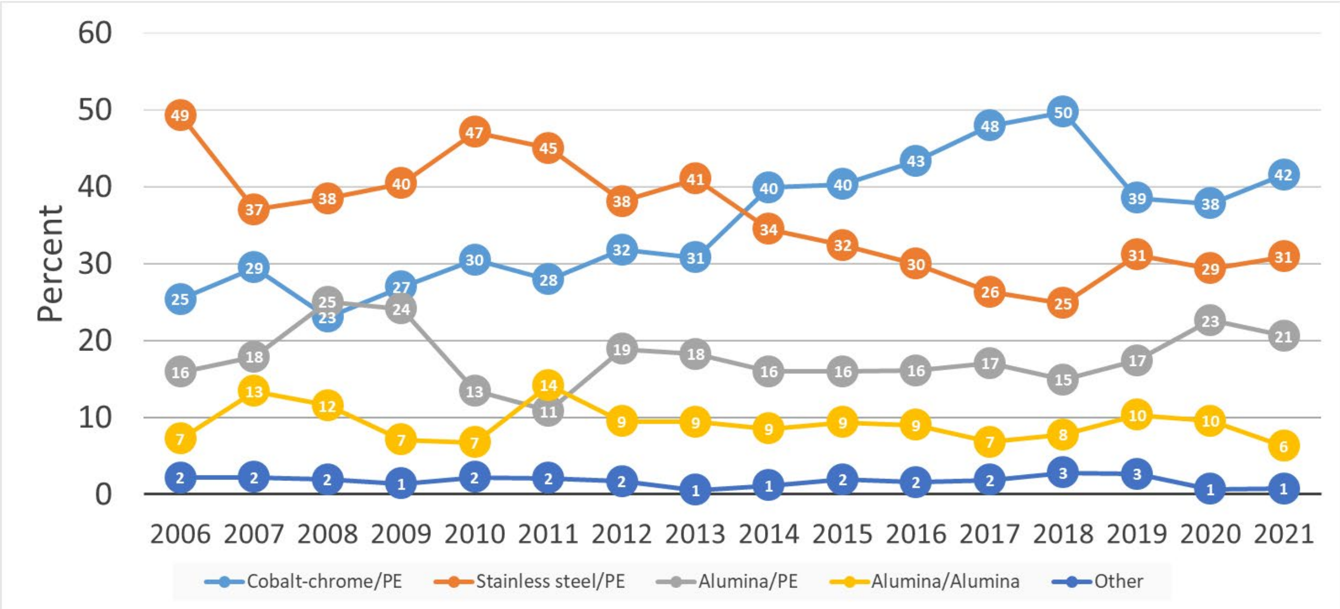


Figure 16. Main weight bearing materials used in revisions: change over 16 years



Part II-C: Analysis of the revision coefficients

The most important group of patients, those requiring a revision due to aseptic loosening, is composed of females in 57% of the cases. In contrast, other revision groups such as “deep infections” or “septic loosening” have more male patients in them. Intra-operative or periprosthetic fractures usually occur in patients of high age. One half of the revised implants due to aseptic loosening was cemented. The vast majority of other revised implants was uncemented (Table 16). Another type of fixation at revision was used in less than 5% of the patients.

Table 16. Patient characteristics and type of fixation in revised THAs

Revision diagnosis	N	Age	% female	% cemented	% uncemented	% hybrid
Aseptic loosening	2 481	72.7	57.2	38.4	37.9	17.7
Deep acute infection	280	72.4	46.1	20.6	59.2	15.5
Dislocation	650	73.2	60.5	24.3	60.0	11.4
Perioperative fracture	23	71.5	56.5	8.7	73.9	13.0
Implant fracture	165	70.7	37.6	17.1	66.5	13.4
Peri-prosthetic fracture	603	78.1	63.7	12.9	74.5	11.3
Septic Loosening - chronic infection	412	69.8	38.6	21.0	38.1	27.8
Wear and/or osteolysis	410	71.8	52.0	14.9	56.6	27.6
Pain	225	65.7	65.3	10.7	76.9	10.7
Calcifications	10	70.8	50.0	10.0	80.0	0.0
Removal of material	4	74.0	50.0	0.0	100.0	0.0
Head and neck resection	19	68.9	47.4	60.0	0.0	20.0
Other	214	68.9	60.7	6.7	80.8	10.1
Total	**5 496**	**72.6**	**55.7**	**26.9**	**51.4**	**16.8**

Table 17 (a,b,c,d,e). Predictors influencing the 8 main causes for revision
(Odds ratio and 95% confidence intervals)

a / Influence of age and gender of the revised patients

Co-variables	Aseptic loosening	Dislocation	Wear and/or osteolysis	Periprosthetic fracture	Pain	Acute deep infection	Septic loosening/ chronic infection	Implant fracture
Age	n.s.	n.s.	n.s.	1.07 (1.05 - 1.08)	0.96 (0.95-0.97)	n.s.	0.98 (0.97-0.99)	n.s.
Female vs male	n.s.	1.27 (1.05 - 1.52)	n.s.	1.24 (1.02 - 1.51)	2.13 (1.55 - 2.92)	0.62 (0.47 - 0.83)	0.54 (0.42 - 0.68)	0.49 (0.35 - 0.70)

- Age is a significant risk factor, influencing the revisions due to periprosthetic fractures and pain: for each additional year of age, the risk of a periprosthetic fracture increases by approx. 7% while the risk of a revision due to pain decreases by approx. 4%.

- Gender significantly influences the risk of revision due to dislocation, pain, acute infection, septic loosening and implant fracture. Females are more prone to experience dislocation, and nearly twice as likely to require a revision due to pain than males, but somewhat less likely than males to require revision due to an acute infection, septic loosening and implant fracture.

b / Fixation of removed THA implants

Co-variables	Aseptic loosening	Dislocation	Wear and/or osteolysis	Periprosthetic fracture	Pain	Acute deep infection	Septic loosening/ chronic infection	Implant fracture
Support ring vs uncemented	2.05 (1.39 - 3.02)	n.s.	n.s.	0.11 (0.039 - 0.31)	n.s.	0.34 (0.12 - 0.96)	7.05 (4.37 - 11.4)	n.s.
Cemented vs uncemented	3.22 (2.73 - 3.80)	0.74 (0.58 - 0.95)	0.21 (0.15 - 0.30)	0.19 (0.14 - 0.27)	0.33 (0.18 - 0.61)	n.s.	2.00 (1.40 - 2.86)	n.s.
Hybrid vs uncemented	1.51 (1.29 - 1.78)	0.60 (0.45 - 0.79)	n.s.	0.43 (0.32 - 0.57)	0.49 (0.31 - 0.79)	n.s.	2.94 (2.20 - 3.95)	n.s.
Reverse hybrid vs uncemented	3.24 (2.18 - 4.81)	n.s.	0.17 (0.054 - 0.56)	0.15 (0.054 - 0.42)	n.s.	n.s.	n.s.	n.s.

- The risk of a revision due to aseptic loosening is more than 3 times higher in primary THAs with cemented fixation compared to uncemented fixation of the implants. However, cemented fixation compared to uncemented fixation reduces the risk for revision due to a dislocation, wear/osteolysis and periprosthetic fracture by factors 0.74, 0.21 and 0.19. It is also less associated with pain.

- Compared to uncemented fixation of both components, the standard hybrid fixation (cup uncemented, stem cemented) presents a 1.5 times higher risk of revision due to an aseptic loosening, while the risk due to periprosthetic fracture is 0.43-times lower.

- Compared to uncemented fixation of both components, the reverse hybrid fixation (cemented cup, uncemented stem) presents 3.2 times higher revision risk due to aseptic loosening, while the risk due to wear/osteolysis and periprosthetic fracture is 0.17 and 0.15-times lower.

- In most cases, the risk of septic loosening follows a similar pattern to aseptic loosening.

c / Type of removed acetabular implant

Co-variables	Aseptic loosening	Dislocation	Wear and/or osteolysis	Periprosthetic fracture	Pain	Acute deep infection	Septic loosening/ chronic infection	Implant fracture
Conventional (std & DM) vs other	2.52 (1.79 - 3.54)	n.s.	2.25 (1.01 - 5.01)	n.s.	n.s.	0.44 (0.26 - 0.73)	n.s.	n.s.
Dual mobility cup vs standard cup	n.s.	0.38 (0.29 - 0.50)	0.35 (0.25 - 0.48)	1.64 (1.31 - 2.07)	2.40 (1.62 - 3.57)	2.75 (1.98 - 3.83)	n.s.	n.s.

- Conventional THAs carry a higher risk of aseptic loosening and wear and/or osteolysis. However, the risk of acute deep infection appears somewhat lower.
- Compared to standard cups, dual-mobility cups reduce the risk of revision for dislocation and for wear and osteolysis by a factor of 0.3-0.4. Conversely, the risk of revision for periprosthetic fracture and pain is 1.6 and 2.4 times higher with dual-mobility cups, as is the risk of acute deep infections.

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d / Type of removed acetabular insert

Co-variables	Aseptic loosening	Dislocation	Wear and/or osteolysis	Periprosthetic fracture	Pain	Acute deep infection	Septic loosening/ chronic infection	Implant fracture
Cross-linked PE (HXLPE) vs conventional PE	0.31 (0.25 - 0.39)	2.17 (1.63 - 2.88)	0.24 (0.13 - 0.45)	2.21 (1.67 - 2.94)	n.s.	1.64 (1.11 - 2.44)	2.74 (2.00 - 3.76)	n.s.
Bulk alumina vs conventional PE	0.43 (0.34 - 0.54)	1.65 (1.19 - 2.29)	0.015 (0.01 - 0.06)	2.60 (1.79 - 3.78)	2.16 (1.31 - 3.54)	1.84 (1.03 - 3.27)	2.28 (1.43 - 3.61)	5.10 (2.74 - 9.47)
Sandwich alumina vs conventional PE	0.44 (0.27 - 0.71)	n.s.	0.057 (0.008 - 0.42)	3.17 (1.68 - 5.97)	n.s.	n.s.	n.s.	8.55 (3.93 - 18.6)
Bulk CoCr vs conventional PE	n.s.	n.s.	n.s.	n.s.	6.25 (1.92-20.4)	n.s.	n.s.	n.s.
Sandwich CoCr vs conventional PE	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	0.35 (0.15-0.78)	n.s.

- Compared to conventional PE liner, cross-linked PE (HXLPE) reduce the risk of revision for Aseptic loosening and wear and osteolysis by a factor of 0.3 and 0.2, respectively, but may approximately double the risk of dislocation, chronic infection and peri-prosthetic fracture.
- Alumina liners are associated with an increased risk of revision due to periprosthetic fractures, pain, implant fractures and dislocation, but they are relatively rarely associated with aseptic loosening and wear and osteolysis. It should be noted that very small odds ratios are also indicative that hardly any revisions with this diagnosis were registered in the group of interest.
- Bulk CoCr liners are particularly associated with pain as a revision reason.
- The picture for removed femoral heads shows that all metal heads are associated with a higher risk of septic loosening and chronic infection, in particular CoCr heads, compared to ceramic heads. Zirconium heads, on the other hand, carry a higher risk of wear/osteolysis and implant fracture compared to alumina heads.

e / Type of removed femoral head

Co-variables	Aseptic loosening	Dislocation	Wear and/or osteolysis	Periprosthetic fracture	Pain	Acute deep infection	Septic loosening/ chronic infection	Implant fracture
Metal vs alumina	0.84 (0.72 - 0.99)	n.s.	n.s.	n.s.	0.57 (0.38 - 0.86)	n.s.	2.24 (1.56 - 3.23)	n.s.
CoCr vs alumina	0.75 (0.62 - 0.89)	n.s.	n.s.	n.s.	0.55 (0.34 - 0.90)	n.s.	3.79 (2.61 - 5.51)	0.37 (0.17 - 0.77)
Titanium vs alumina	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Zirconium vs alumina	n.s.	0.31 (0.18 - 0.53)	3.28 (2.31 - 4.65)	0.54 (0.32 - 0.92)	0.34 (0.13 - 0.88)	0.28 (0.09 - 0.94)	0.18 (0.055 - 0.59)	2.34 (1.22 - 4.49)

PE = polyethylene, n.s. = not significant

NB. The multivariable analyses could only adjust for covariates that were recorded in the SoFCOT registry. Other important co-factors may exist. The precision of some risk estimates needs to be interpreted with care, as the partially wide confidence intervals demonstrate.

Part III: Preliminary analysis of revisions of patients with documented primary THA

The social security number of the patient, gender and operated side allow establishing a link between the primary and revision interventions if a revision occurs in one of the participating hospitals. However, as this register only covers a limited selection of hospitals in France it is very unlikely that documentation (or coverage) of external revisions occurring after included primaries is complete. Please see the methodological notes below.

By 31.12.2021, 707 first revisions could be linked to primary THAs previously registered in SoFCOT. Not surprisingly, the first and most frequent causes of an early revision are hip dislocation, followed by periprosthetic fractures, acute deep infection, aseptic loosening, other causes, cobalt allergy, and implant fracture (Table 18).

Table 18. Characteristics of first revisions of patients with documented primary THA

	Demographics of re-operated patients					Fixation of the revised implants		
Revision cause	**N**	**%**	**Age**	**% female**	**Average interval (years)**	**% Cemented**	**% Uncemented**	**% Hybrid and reverse hybrid**
Aseptic loosening	89	12.6	69.5	55.1	2.6	6.7	77.5	14.6
Deep acute infection	89	12.6	71.5	46.1	0.3	11.2	73.0	14.6
Dislocation	181	25.6	69.7	55.3	0.9	21.0	71.3	7.7
Peri-operative fracture	10	1.4	70.9	60.0	0.2	10.0	80.0	10.0
Implant fracture	19	2.7	63.7	36.8	3.5	15.8	73.7	10.5
Peri-prosthetic fracture	160	22.6	74.7	63.1	0.8	3.1	81.3	15.6
Septic Loosening - chronic infection	37	5.2	69.2	43.2	2.1	5.4	62.2	29.7
Wear and/or osteolysis	6	0.9	71.6	33.3	6.3	16.7	83.3	0.0
Pain	45	6.4	66.0	55.6	1.9	2.2	88.9	8.9
Calcifications	2	0.3	68.7	50.0	1.2	0.0	100.0	0.0
Other	69	9.8	67.4	55.1	1.6	2.9	92.8	4.4
Total	**707**	**100**	**70.4**	**54.6**	**1.3**	**9.8**	**77.7**	**12.2**

Revision risk can be assessed by different means. Kaplan-Meier estimates of cumulative revision risk have become an internationally accepted method for reporting and comparing revision risks for different groups, especially if documentation rates are high and mortality information is available to improve the quality of reporting in the presence of so-called censoring (e.g. if a group of older patients due to their higher mortality risk are less and less at risk of implant revision over time).

An alternative way of expressing revision rates is to set them in relation to 100 observed component years (Rp100ocy).

The formula for the calculation of rp100ocy is:

$$\frac{\text{Number of cases of revision surgery for any reason x 100}}{\text{Number of observed components x observation time in years}}$$

The calculation of this index allows for some basic comparison of different implants even in the absence of more sophisticated survival-type analyses. A systematic review of reports from national registers and clinical studies analysed with respect to revision rates has established that, after primary hip replacement, a mean of 1.3 revision per 100 observed component years may be expected as a norm value[1].

Table 19. Cumulative annual revisions per 100 observed component years (Rp100ocy)

Year (t)	Total THAs (up to year t)	Number Revised (up to year t)	Observed component Years (up to year t) (adjusted)*	For comparison: unadjusted component years	Rp100ocy	Exact 95% Confidence interval	
2008	3754	26	4869	5029	0.53	0.36	0.78
2009	4840	36	8319	9307	0.43	0.31	0.60
2010	6507	58	13112	14936	0.44	0.34	0.57
2011	8317	85	19506	22282	0.44	0.35	0.54
2012	11282	128	27959	32028	0.46	0.39	0.54
2013	14319	186	39386	44747	0.47	0.41	0.54
2014	18507	223	54294	60959	0.41	0.36	0.47
2015	24170	294	73586	81994	0.40	0.36	0.45
2016	29724	377	97823	108815	0.39	0.35	0.43
2017	35356	447	125655	141025	0.36	0.32	0.39
2018	40442	524	154564	178449	0.34	0.31	0.37
2019	45677	589	184519	221012	0.32	0.29	0.35
2020	49461	645	216459	268071	0.30	0.28	0.32
2021	53119	707	251989	318749	0.28	0.26	0.30

Note: Wilson score intervals were used to calculate the limits of 95% Confidence Intervals.
* Observations are assumed censored in certain situations. See methodological notes below.

At the end of 2021, after 16 years of observation, the average follow-up of the 53 119 primary THAs registered is 4.7 years.

[1] *G. Labek,M. Thaler,W. Janda,M. Agreiter,B. Stöckl. Revision rates after total joint replacement. CUMULATIVE RESULTS FROM WORLDWIDE JOINT REGISTER DATASETS. J Bone Joint Surg [Br] 2011;93-B:293-7.*

Table 20 presents the various Rp100ocy that can be calculated by creating different implant strata by type of implant and type of implant fixation. The difference between standard cups and dual mobility cups has been narrowing and is now statistically insignificant. All-cemented fixation THAs show slightly better Rp100ocy than all uncemented ones and this difference is statistically significant. Hybrid fixation performs best.

Table 20. Overall Rp100ocy by implant type and fixation used in primary THA

By type of implant	Total THAs	Number revised	Observed component years (adjusted)*	For comparison: unadjusted component years	Average FU (years)	Rp100ocy	Exact 95% Confidence interval	
Conventional THA	47208	636	230119	289887	4.9	**0.28**	0.26	0.30
Femoral prosthesis with mobile cup (bipolar)	2434	38	10387	12477	4.3	**0.37**	0.27	0.50
Full resurfacing	350	0	882	3315	2.5	**0.00**	0.00	0.43
By type of cup								
Standard cup	28222	421	148288	192073	5.3	**0.28**	0.26	0.31
Dual mobility cup	22663	249	94299	115336	4.2	**0.26**	0.23	0.30
By type of implant fixation	**Total THAs**	**Number revised**	**Observed component years (adjusted)***	**For comparison: unadjusted component years**	**Average FU (years)**	**Rp100ocy**	**Exact 95% Confidence interval**	
Cemented	4255	69	28769	36918	6.8	**0.24**	0.19	0.30
Uncemented	38200	549	165014	212152	4.3	**0.33**	0.31	0.36
Hybrid (uncemented cup, stem cemented)	9949	80	54608	65248	5.5	**0.15**	0.12	0.18
Reverse hybrid (cemented cup, stem uncemented)	594	6	2942	3733	5.0	**0.20**	0.09	0.44

* Observations are assumed censored in certain situations. See methodological notes below.

Table 21 shows the Rp100ocy by type of the five most common bearing combinations in primary THA. Note that Metal-Metal bearings (either conventional THA with 28 or 32mm head size and resurfacing) show a lower Rp100ocy than the other categories, despite the longer follow-up. This is likely due to a mixture of “survivor effect” and “censoring effect”. As the average follow-up time in years shows, these are rather old implants and many of the patients may not actually be at risk of revision anymore. Furthermore, as the cumulative risk curve is rather flat after a few years, the rp100ocy index tends to be considerably depressed compared to relatively young implants (as observation years are added much faster than additional revisions).

Table 21. Overall Rp100ocy by bearings used in primary THA by number of inclusions

By bearing type	Total THAs	Number revised	Observed component years (adjusted)*	For comparison: unadjusted component years	Average FU (years)	Rp100ocy	Exact 95% Confidence interval	
Alumina / alumina	15610	234	71234	92840	4.6	**0.33**	0.29	0.37
Alumina / PE	14213	172	66430	79333	4.7	**0.26**	0.22	0.30
Stainless steel / PE	10296	133	56663	68332	5.5	**0.23**	0.20	0.28
Cobalt-chrome / PE	11414	152	49559	64088	4.3	**0.31**	0.26	0.36
Metal / metal	954	7	5352	10352	5.6	**0.13**	0.06	0.27

* Observations are assumed censored in certain situations. See methodological notes below.

A different perspective can be gained by comparing cumulative revision risks.

Figure 15 shows that the risk of revision is initially very similar for dual mobility cups and standard cups. However, from the second year after implantation onwards standard cups show a steeper increase in cumulative revision risk, leading to a relatively pronounced difference by year six after primary implantation.

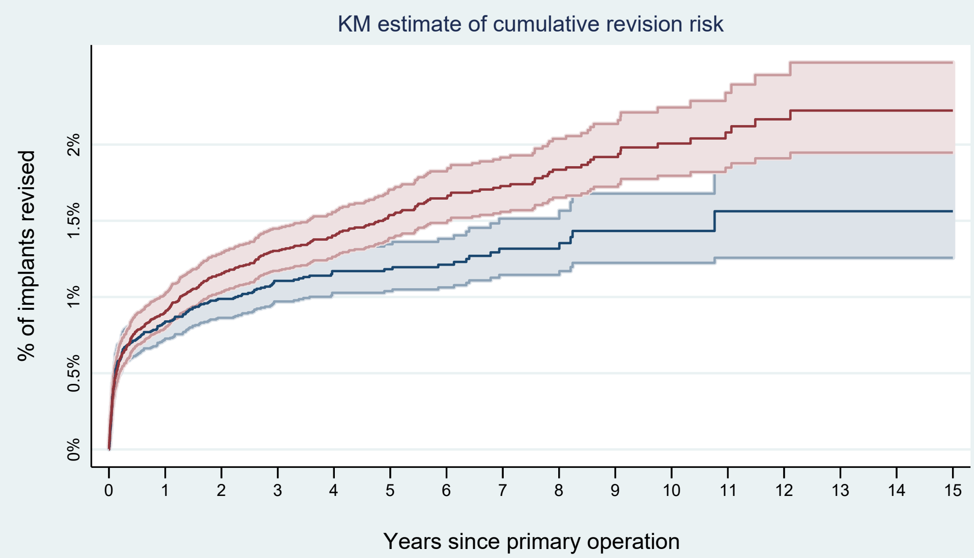
In Figure 16, we see that the revision risk of bipolar femoral prostheses (hemi-arthroplasties) in acute fractures appears to be initially much higher than that of conventional THAs in acute fractures. By year 5, however, this difference has shrunk considerably as conventional THAs appear to catch up, rendering the initial difference entirely statistically insignificant.

However, caution must be applied to the interpretation of both figures as the groups differ in their age distribution. Both DM cups and bipolar cups are used in older patients than conventional cups. In the absence of group-specific mortality data, the “older” groups will show an increasing downward bias due to the disproportionate loss of members that are not at risk of revision anymore at some point. In other words, if a patient dies, his or her implant cannot be revised anymore.

Figure 17 highlights that there is no apparent difference in the revision risk associated with conventional PE liners versus cross-linked (HXLPE) PE. In terms of raw figures, HXLPE liners are slightly above conventional PE liners, but the difference is not statistically significant at any time point after primary operation.

Table 22 contains the relevant point estimates at selected time points.

Figure 15. KM estimate of cumulative revision risk for standard cups vs. dual mobility cups



Number at risk	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Dual-mobility cup	22663	19474	16369	12820	9816	7594	5670	3988	2692	1774	1065	668	380	237	140	46
Standard cup	28222	25306	22085	18360	15243	12639	10495	8393	6629	4829	3338	2453	1769	1275	776	210

Figure 16. KM estimate of cumulative revision risk for THA vs. Hemi-arthroplasty with mobile cups in acute fractures

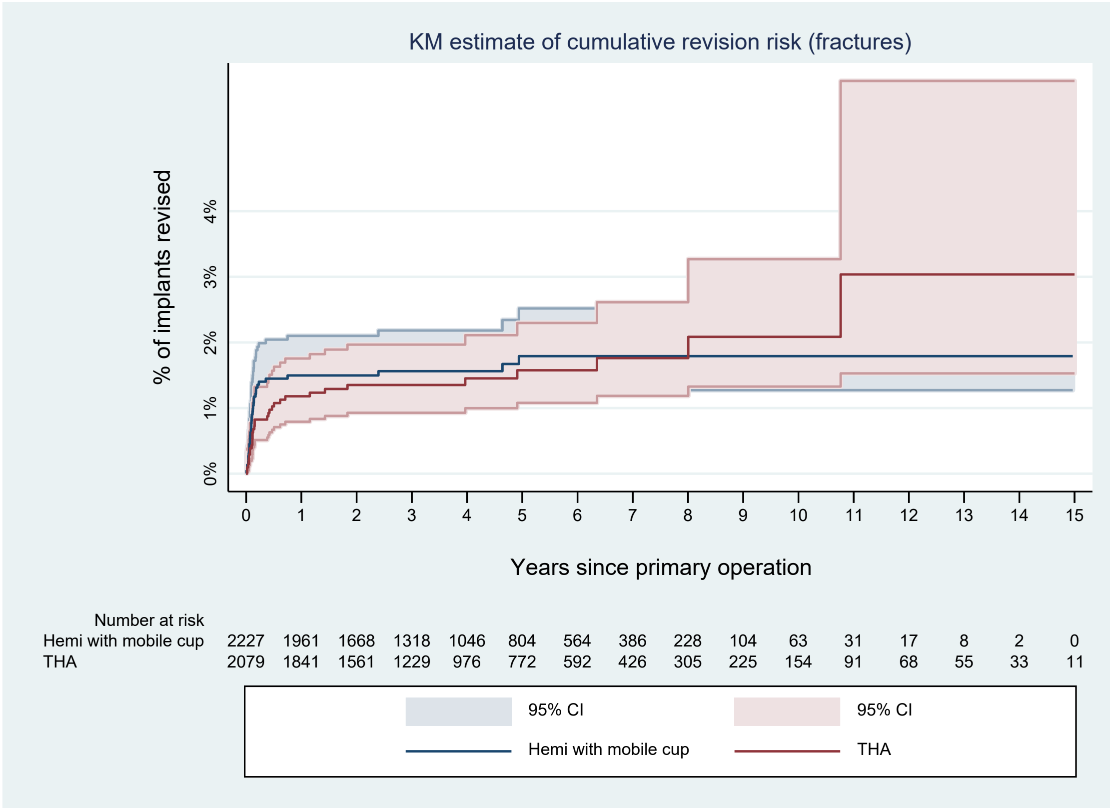
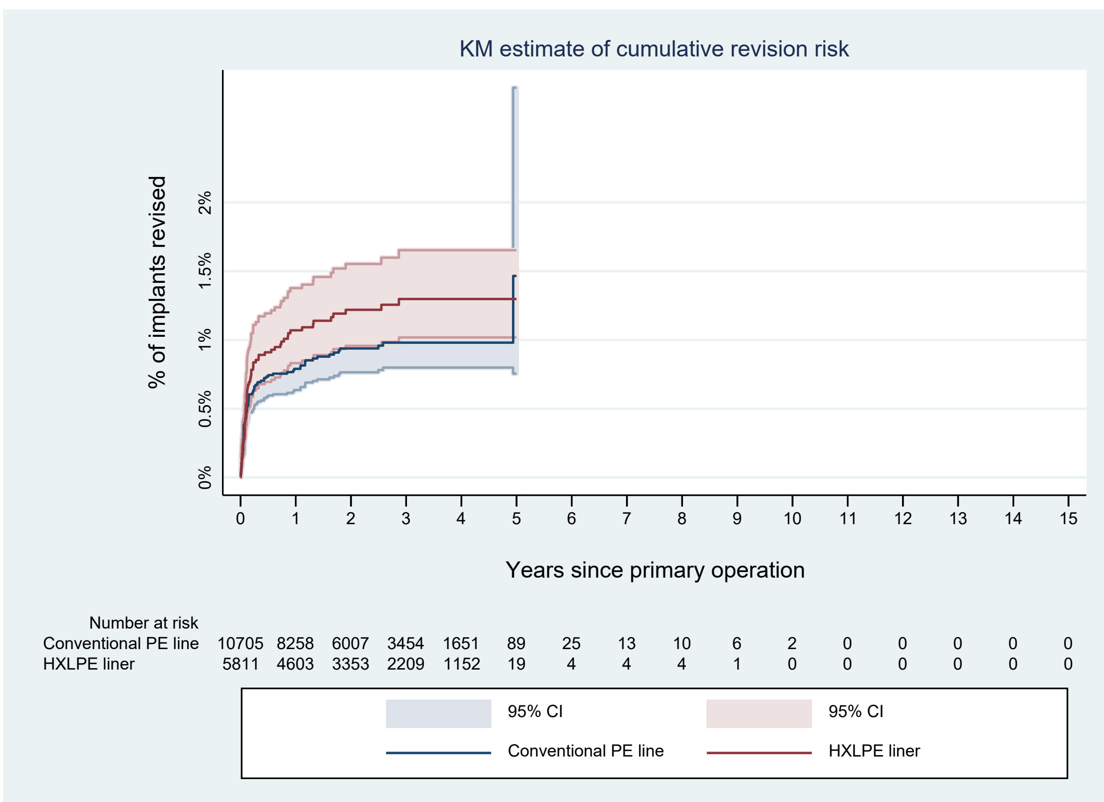


Figure 17. KM estimate of cumulative revision risk for different types of acetabular inserts (liner material)*



* Data available since 2016

Table 22. Kaplan-Meier estimates

Estimated cumulative revision rates	1-year	2-year	3-year	5-year	10-year	15-year
Standard cup	0.9 (0.8-1.0)	1.2 (1.0-1.3)	1.3 (1.2-1.4)	1.5 (1.4-1.7)	2.0 (1.8-2.2)	2.2 (1.9-2.5)
Dual mobility cup	0.8 (0.7-1.0)	1.0 (0.9-1.1)	1.1 (1.0-1.3)	1.2 (1.0-1.3)	1.4 (1.2-1.7)	1.6 (1.3-1.9)
THA	1.2 (0.8-1.8)	1.4 (0.9-2.0)	1.4 (0.9-2.0)	1.6 (1.1-2.3)	2.1 (1.3-3.3)	3.0 (1.5-6.0)
Hemi with mobile cup	1.5 (1.0-2.0)	1.5 (1.0-2.0)	1.5 (1.1-2.1)	1.7 (1.2-2.4)	1.7 (1.2-2.4)	
Conventional PE liner	0.8 (0.6-1.0)	0.9 (0.8-1.2)	1.0 (0.8-1.2)	1.5 (0.8-2.8)		
HXLPE liner	1.1 (0.8-1.4)	1.2 (1.0-1.6)	1.3 (1.0-1.7)	1.3 (1.0-1.7)		

We conducted an analysis for all implant brands used in primary THA. Components with less than 50 primary implantations were excluded from the Rp100ocy calculation.

Considering the aforementioned Rp100ocy norm value of 1.3, all corresponding implants showing an Rp100ocy above this value might raise concern.

Table 23. Rp100ocy of standard acetabular implants used in primary THA by decreasing order

Standard CUP cemented	Total THAs	Number revised	Observed component years (adjusted)*	For comparison: unadjusted component years	Average FU (years)	Rp100ocy	Exact 95% Confidence interval	
Kerboull MKIII	862	11	6546	9825	7.6	0.17	0.09	0.30
Original Mueller	404	3	2060	3896	5.1	0.15	0.05	0.43
Initiale PE	333	4	2964	2964	8.9	0.13	0.05	0.35
Chirulen	244	7	801	801	3.3	0.87	0.42	1.79
Ceraver cotyle PE	125	5	1247	1291	10.0	0.40	0.17	0.93
Exafit	79	1	513	823	6.5	0.19	0.03	1.09
Oceane	58	2	580	580	10.0	0.35	0.09	1.25

Standard CUP uncemented	Total THAs	Number revised	Observed component years (adjusted)*	For comparison: unadjusted component years	Average FU (years)	Rp100ocy	Exact 95% Confidence interval	
Pinnacle	4089	35	18484	24467	4.5	0.19	0.14	0.26
Cerafit	1595	26	9312	11828	5.8	0.28	0.19	0.41
RM pressfit vitamys	1438	12	7005	7141	4.9	0.17	0.10	0.30
Allofit	1293	15	6671	9284	5.2	0.22	0.14	0.37
Versafitcup trio/ccl.	1247	18	4744	6297	3.8	0.38	0.24	0.60
RM pressfit	1219	27	6987	8277	5.7	0.39	0.27	0.56
Trident	1018	8	7225	8655	7.1	0.11	0.06	0.22
Continuum	890	13	3072	3169	3.5	0.42	0.25	0.72
Hype	808	10	2343	2397	2.9	0.43	0.23	0.78
Exclusif	755	11	3144	3466	4.2	0.35	0.20	0.63
April ceramic	570	10	1739	1873	3.1	0.57	0.31	1.06
ABG II	510	31	3742	4746	7.3	0.83	0.58	1.17
HNG	456	0	959	972	2.1	0.00	0.00	0.40
Horizon II	414	6	1309	1605	3.2	0.46	0.21	1.00
Cotyle xlfit	413	6	1320	1356	3.2	0.45	0.21	0.99
Dynacup	361	6	1201	1878	3.3	0.50	0.23	1.09
RM classic	352	1	760	1461	2.2	0.13	0.02	0.74
Exceed	294	5	1583	1966	5.4	0.32	0.14	0.74
Must	258	7	1441	1484	5.6	0.49	0.24	1.00
Atlas IV	234	9	1120	1709	4.8	0.80	0.42	1.52
Atlas III	228	6	964	1202	4.2	0.62	0.29	1.35
Selene	226	6	1914	3014	8.5	0.31	0.14	0.68
Eternity	222	8	1416	2058	6.4	0.56	0.29	1.11
Xlfit	218	11	573	573	2.6	**1.92**	1.08	3.40

Delta PF	187	1	546	1296	2.9	0.18	0.03	1.03
Alloclassic	186	5	2183	2183	11.7	0.23	0.10	0.54
X.Cup	177	1	298	824	1.7	0.34	0.06	1.88
Symbol NA	169	2	327	728	1.9	0.61	0.17	2.20
Plasmafit	163	5	424	646	2.6	1.18	0.50	2.73
Pavi	147	2	777	780	5.3	0.26	0.07	0.93
Trident II	139	2	164	164	1.2	1.22	0.34	4.34
Delta motion	128	2	577	826	4.5	0.35	0.10	1.26
Lagoon	100	0	958	1498	9.6	0.00	0.00	0.40
Quartz	94	0	740	779	7.9	0.00	0.00	0.52
Fixa	92	2	128	470	1.4	**1.56**	0.43	5.51
Atlante	91	0	1273	1273	14.0	0.00	0.00	0.30
Cargos	91	2	764	776	8.4	0.26	0.07	0.95
Plasmacup	89	0	400	662	4.5	0.00	0.00	0.95
Freeliner	80	2	228	234	2.9	0.88	0.24	3.14
Horizon	79	0	525	712	6.6	0.00	0.00	0.73
Mixt	72	1	353	477	4.9	0.28	0.05	1.59
Tritanium	64	1	173	181	2.7	0.58	0.10	3.21
Jump system/JS tracer	62	0	220	424	3.5	0.00	0.00	1.72
Maxera	62	0	198	272	3.2	0.00	0.00	1.90
MBA	53	1	88	292	1.7	1.13	0.20	6.14

* Observations are assumed censored in certain situations. See methodological notes below.

Table 24. Rp100ocy of Dual Mobility acetabular components used in primary THA by decreasing order

Double mobility CUP cemented	Total THAs	Number revised	Observed component years (adjusted)*	For comparison: unadjusted component years	Average FU (years)	Rp100ocy	Exact 95% Confidence interval	
Novae stick	229	3	963	1046	4.2	0.31	0.11	0.91
Saturne	113	4	566	632	5.0	0.71	0.28	1.80
Tregor	90	3	933	951	10.4	0.32	0.11	0.94
Symbol DM cem	51	0	125	143	2.5	0.00	0.00	2.97
Double mobility CUP uncemented	**Total THAs**	**Number revised**	**Observed component years (adjusted)***	**For comparison: unadjusted component years**	**Average FU (years)**	**Rp100ocy**	**Exact 95% Confidence interval**	
Novae TH/Bi-Mentum	4873	40	15951	20040	3.3	0.25	0.18	0.34
Quattro	2861	15	13257	14458	4.6	0.11	0.07	0.19
Avantage	2037	52	8699	10874	4.3	0.60	0.46	0.78
Saturne	1619	16	8534	10728	5.3	0.19	0.12	0.30
Saturne II	1076	5	1693	1787	1.6	0.30	0.13	0.69
Restoration ADM	1074	17	4705	5402	4.4	0.36	0.23	0.58
Gyros	870	16	6301	6542	7.2	0.25	0.16	0.41
Tregor	813	4	7285	7780	9.0	0.05	0.02	0.14
Symbol DMHA/DS evo.	691	4	1688	2658	2.4	0.24	0.09	0.61
Liberty	690	14	2912	3389	4.2	0.48	0.29	0.81
Ades DM	653	7	3039	3423	4.7	0.23	0.11	0.47
Capitole	589	5	1628	2375	2.8	0.31	0.13	0.72
Corin DM	414	3	1585	1663	3.8	0.19	0.06	0.55
Cerafit DM	376	4	1175	1311	3.1	0.34	0.13	0.87
X.Cup MOB	337	5	574	1349	1.7	0.87	0.37	2.02
Stafit	322	3	2703	2876	8.4	0.11	0.04	0.33
Evora	315	1	1217	2018	3.9	0.08	0.01	0.46
Polarcup	303	4	645	1834	2.1	0.62	0.24	1.58
Novae evolution	205	2	847	2103	4.1	0.24	0.06	0.86
Versafitcup DM	194	0	369	458	1.9	0.00	0.00	1.03
Isis II	167	2	288	288	1.7	0.69	0.19	2.50
Mpact DM	160	0	421	522	2.6	0.00	0.00	0.91
HNG DM	107	2	281	527	2.6	0.71	0.20	2.55
Selexys DS	106	1	587	881	5.5	0.17	0.03	0.96

* Observations are assumed censored in certain situations. See methodological notes below.

Table 25. Rp100ocy of Femoral components used in primary THA by decreasing order

STEM cemented	Total THAs	Number revised	Observed component years (adjusted)*	For comparison: unadjusted component years	Average FU (years)	Rp100ocy	Exact 95% Confidence interval	
Initiale modular	1475	6	8992	9095	6.1	0.07	0.03	0.15
Legend V40	1203	8	11018	12850	9.2	0.07	0.04	0.14
Avenir (cem)	1083	3	4251	4478	3.9	0.07	0.02	0.21
Exafit	925	6	4450	9141	4.8	0.13	0.06	0.29
PF	748	3	6063	7491	8.1	0.05	0.02	0.15
ABG II (cem)	732	8	3871	3897	5.3	0.21	0.10	0.41
Sterwen	723	6	7550	7574	10.4	0.08	0.04	0.17
Amistem-C	525	7	2028	2586	3.9	0.35	0.17	0.71
Lemovice	474	6	834	834	1.8	0.72	0.33	1.56
Oceane+	421	2	2491	3143	5.9	0.08	0.02	0.29
Osteal	397	4	2203	3312	5.5	0.18	0.07	0.47
Excia	386	11	1288	1318	3.3	0.85	0.48	1.52
CCA	326	7	1998	2090	6.1	0.35	0.17	0.72
Generic	302	7	1103	1108	3.7	0.63	0.31	1.30
CMK	298	3	1218	1321	4.1	0.25	0.08	0.72
Dedicace V40	289	6	1147	3090	4.0	0.52	0.24	1.14
Hype (cem)	271	0	866	886	3.2	0.00	0.00	0.44
Institution	226	0	745	1653	3.3	0.00	0.00	0.51
Valmer	173	3	1040	1070	6.0	0.29	0.10	0.84
Corail (cem)	130	2	363	434	2.8	0.55	0.15	1.99
Exception (cem)	114	3	506	564	4.4	0.59	0.20	1.73
Kerboull MKIII	110	2	1342	1355	12.2	0.15	0.04	0.54
Harmony (cem)	105	0	350	355	3.3	0.00	0.00	1.08
Amis-K	100	0	266	266	2.7	0.00	0.00	1.43
Original Mueller	99	2	777	779	7.8	0.26	0.07	0.93
Naos	91	3	82	428	0.9	**3.64**	1.24	10.16
Centris	77	1	344	593	4.5	0.29	0.05	1.63
Polarstem (cem)	77	1	154	455	2.0	0.65	0.11	3.58
Twinsys (cem)	75	0	312	409	4.2	0.00	0.00	1.22
Pavi	62	1	220	226	3.5	0.46	0.08	2.53
Silene	61	0	130	136	2.1	0.00	0.00	2.88
Meije Duo	54	0	145	153	2.7	0.00	0.00	2.58

* Observations are assumed censored in certain situations. See methodological notes below.

STEM uncemented	Total THAs	Number revised	Observed component years (adjusted)*	For comparison: unadjusted component years	Average FU (years)	Rp100ocy	Exact 95% Confidence interval	
Corail collared	4611	35	18273	25559	4.0	0.19	0.14	0.27
Avenir	3964	65	19306	22140	4.9	0.34	0.26	0.43
Corail	2575	45	9734	13093	3.8	0.46	0.35	0.62
Exception	2401	43	13339	15763	5.6	0.32	0.24	0.43
Cerafit	1915	30	10118	12712	5.3	0.30	0.21	0.42
Targos	1896	11	11588	11660	6.1	0.09	0.05	0.17
Targos mini	1497	10	8071	8081	5.4	0.12	0.07	0.23
Hype	1429	22	4363	4966	3.1	0.50	0.33	0.76
Optimys	1423	13	4221	5018	3.0	0.31	0.18	0.53
Integrale	1130	13	4453	4875	3.9	0.29	0.17	0.50
Thelios HAP	1124	11	5094	8736	4.5	0.22	0.12	0.39
HNG	742	6	2304	2647	3.1	0.26	0.12	0.57
Amistem-H	625	12	2800	3672	4.5	0.43	0.25	0.75
Accolade II	616	20	1486	1486	2.4	**1.35**	0.87	2.07
Hactiv HAC	597	7	2352	3230	3.9	0.30	0.14	0.61
Meije Duo	595	4	1707	2054	2.9	0.23	0.09	0.60
Alloclassic	570	9	5042	5043	8.8	0.18	0.09	0.34
Linea	527	12	3029	5496	5.7	0.40	0.23	0.69
Silene	517	10	1786	1981	3.5	0.56	0.30	1.03
Twinsys	420	6	2268	2436	5.4	0.26	0.12	0.58
Valmer	358	7	1679	2034	4.7	0.42	0.20	0.86
Naos	341	1	543	1437	1.6	0.18	0.03	1.04
ABG II	337	35	2206	2966	6.5	**1.59**	1.14	2.20
SPS evolution	313	5	856	864	2.7	0.58	0.25	1.36
Symbol	310	5	557	1312	1.8	0.90	0.38	2.08
Libra	251	0	1455	1785	5.8	0.00	0.00	0.26
Pavi	236	4	1151	1227	4.9	0.35	0.14	0.89
H-Max	231	0	776	1368	3.4	0.00	0.00	0.49
Esop	228	11	812	1443	3.6	**1.35**	0.76	2.41
Evok	218	2	329	329	1.5	0.61	0.17	2.19
Excia plasmapore	212	5	804	1263	3.8	0.62	0.27	1.45
Louxor	195	0	844	1142	4.3	0.00	0.00	0.45
Harmony	193	3	685	699	3.6	0.44	0.15	1.28
SL-plus/SL-plus	187	4	1272	1709	6.8	0.31	0.12	0.81
Optimum	186	7	1078	1078	5.8	0.65	0.31	1.33
Avenir complete	177	0	149	149	0.8	0.00	0.00	2.52
ACOR modular	175	3	513	799	2.9	0.58	0.20	1.71
Aura	160	6	815	1272	5.1	0.74	0.34	1.60

Cineos	158	2	282	611	1.8	0.71	0.19	2.55
Hype mini	157	1	189	233	1.2	0.53	0.09	2.93
Fitmore	153	0	317	1028	2.1	0.00	0.00	1.20
Amistem-P	147	3	220	295	1.5	**1.36**	0.46	3.93
ACOR monobloc	139	1	251	314	1.8	0.40	0.07	2.23
Polarstem	130	1	347	865	2.7	0.29	0.05	1.61
Rhino	125	2	421	451	3.4	0.48	0.13	1.72
OK baby	123	3	213	490	1.7	**1.41**	0.48	4.06
Respect	121	1	488	886	4.0	0.20	0.04	1.15
Quadra-H	93	0	76	84	0.8	0.00	0.00	4.81
BHS	86	1	523	553	6.1	0.19	0.03	1.08
Hagap	81	1	272	337	3.4	0.37	0.06	2.05
Stellaris	66	3	287	602	4.4	1.04	0.36	3.02
Individual/custo	64	0	205	217	3.2	0.00	0.00	1.84
Stemsys MI	55	0	117	307	2.1	0.00	0.00	3.18
Anato	51	1	97	125	1.9	1.03	0.18	5.61

* Observations are assumed censored in certain situations. See methodological notes below.

Methodological notes

Register coverage/documentation rate: The SoFCOT THA register covers a relatively small fraction of all hip arthroplasties done in France each year. However, its participants represent a relatively stable group of mostly very experienced orthopaedic surgeons in currently 61 hospitals (2021/2022) that have made a commitment to entering all relevant primary and revision procedures.

Implant library: Implants are registered as individual components, e.g. femoral stems, acetabular cups/inserts etc., allowing for detailed analyses of relevant components or component combinations (e.g. a stem/cup combination). Since 2020, the SwissRDL implant library, which the SoFCOT registry contributes to, has only allowed entering (or scanning) implants that are already recognised by the data entry system. If an implant is unknown, it directs the user to a formal procedure for registering new implants. Prior to this new arrangement, entering new implants was a much more flexible business that led to an abundance of individual implant entries that were often inconsistent and incomplete. This made grouping and analysing implants a more difficult task and especially the implants registered in the earlier days of the register suffer from relatively low recognition rates, by which we mean that they could not be reliably assigned to named brands as analysed in SoFCOT report. However, building the SwissRDL implant library is an ongoing project and we keep adding manufacturers' catalogue information to the library and we write ever more refined "implant recognition scripts" to pick out previously unrecognised implants. Therefore, recognition rates could still improve even for older implants.

Estimation of revision rates: The first requirement for estimating revision rates is that revision procedures are actually captured by the register. Revisions undertaken by the same orthopaedic surgeon who did the primary implant should generally find their way into the SoFCOT register. We do not know, however, how likely it is in the case of the participating surgeons that a patient will undergo a revision procedure elsewhere. From the Swiss hip and knee register SIRIS we do know that on average 78% of revisions are undertaken in the same hospital that provided the primary operation. In the absence of national coverage of all hip arthroplasties, we can thus be certain that the revision rates reported in this report represent a certain underestimate of unknown extent. It should be noted that a general underestimation bias in revision rates does not necessarily invalidate relative comparisons between procedures and implants, as all observations are most likely affected to the same degree by this bias. However, cross-register comparisons should be made with great caution. Another factor affecting revision rates is patient mortality. If a patient dies, a revision of his or her implant cannot be observed anymore. If mortality data is not linked to a register, observed long-term revision rates of a cohort of patients will become increasingly underestimates of the true revision rate because the denominator (number of patients in cohort) will increasingly be made up of individuals that are not at risk of revision anymore. When using Kaplan-Meier estimates of cumulative revision risk this can result in misleading comparisons between patient groups with different age distributions, unless death or other reasons for loss-to-follow-up are entered as censoring events into the analysis (and even then, high mortality figures may require so-called competing risk analyses). We do not currently link mortality data to the SoFCOT register, but we do draw on the Swiss SIRIS data for comparison purposes. This allows us to make informed choices on whether to present or not to present certain group comparisons and for which time spans. It also allows us to make informed choices on assuming or "imputing" certain censoring events.

Imputed censoring events: As the population captured in the SoFCOT registry is ageing it is reasonable to assume that a growing share of that population has in fact passed away by the time reports are produced. Based on known demographic data we know that it is of course relatively unlikely for patients to reach the age of 100. From known registry data we also know that it is exceedingly unlikely to still undergo revision surgery at the age of 100 or above (not unheard of, but rare). We therefore censor all observations at the end of the calendar year in which a registered patient reaches the age of 100 (except if still revised at a later point). We also censor all observations from a particular hospital one year after the last procedure of that hospital was registered. This is necessary because over the years, several hospitals have dropped out of the registry. Revisions therefore cannot be registered anymore, and it would be quite wrong to assume that the primary implants from such hospitals never get revised. By early 2022, approx. 28% percent of all previously captured primary implants were considered censored (= not anymore under observation) for either reason.

The steering group of the SoFCOT THA register would like to extend its sincere gratitude to all French orthopedic surgeons who are collaborating or have collaborated regularly to keep this register updated.

To join the register, please find more information on the SoFCOT web page

http://www.sofcot.fr/Pages/Registre-des-protheses-de-hanche

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