A

REPORT of R.I.P.O.

Regional Register of Orthopaedic Prosthetic Implantology

OVERALL DATA

HIP, KNEE AND SHOULDER ARTHROPLASTY

IN EMILIA-ROMAGNA REGION (ITALY)

2000-2019

VERSION 1 - MAY 2022

SERVIZIO SANITARIO REGIONALE
EMILIA-ROMAGNA

Foreword

During 2017, with Regional Law n.9 of 1st June 2017, RIPO was recognized as a significant regional interest Register, with the aim of guaranteeing an active and systematic collection of demographic, health and epidemiological data.
According to these aims, we are now presenting the 19th report, elaborated by the Register of Orthopaedic Prosthetic Implantology (RIPO). It presents the most significant results of the descriptive and survival statistical analyses performed on hip, knee and shoulder arthroplasty surgeries carried out in the Emilia-Romagna region, in Italy, **between 1st January 2000 and 31st December 2019**.

This report presents the overall regional data for the following orthopaedic surgeries:

- hip: total arthroplasty, hemiarthroplasty, resurfacing, revision and removal operations;
- knee: uni-, bi- and tricompartmental arthroplasty, revision and removal operations;
- shoulder (since July 2008): anatomical and reverse arthroplasty, resurfacing, partial, revision and removal operations.

Altogether, data of approx. 200.000 hip, 124.000 knee and 9.000 shoulder prostheses have been reported from 69 Orthopaedic Units in 63 Hospitals, either public or private.

Data collection from the orthopaedic wards was made through the use of paper forms. Registry staff then transferred the data electronically to the databank run by CINECA (Interuniversity Consortium of North-East Italy), which was responsible for computer management and security aspects of the data. Statistical analyses were performed by Registry statistics staff.
When necessary RIPO representatives in each surgical unit gave support to clarify and integrate the data.
The dissemination of the results of the statistical analysis is carried out through: this report (available on the web at http://ripo.cineca.it/authzssl/index.htm), scientific publications and reports required by surgeons and health departments. In addition, the authorized parties (responsible of Units and Health Management) have access to a system of self-made on-line analysis.

Objectives of the Registry

The Registry has some fundamental objectives:

- determine the demographic characteristics and the diagnostic categories of the patients who have undergone replacement surgery;
- gather detailed information on the use of the different prostheses used in primary and revision surgery;
- assess the effectiveness of the different types of prostheses;
- supply orthopaedic surgeons with a very useful tool to give the patient timely information;
- collaborate in a post-marketing surveillance, allowing surgeons to easily identify patients implanted with a recalled implant; in particular, during 2016, a post-marketing surveillance of Metal-on-Metal hip prostheses was set up in Emilia Romagna Region;
- compare the regional results against similar national and international studies; the present edition was designed to facilitate a comparison with the data presented by the Swedish and Australian registers, which were the models that inspired the RIPO analysis;
- inform the Regional Orthopaedic Commission about those implants that show an abnormal failure rate;
- answer to questions coming from the Regional Orthopaedic Commission or from other National or European Institutions.

Methodological notes

Descriptive analyses are done on all cases, while survival analyses are performed only on patients living in the Emilia-Romagna region, in order to avoid the bias resulting from the 'loss' of non-resident patients.
Therefore, all survival analyses presented in this report are based on primary operations in patients resident in Emilia-Romagna region and on revisions of same prostheses, wherever performed.
It is not always possible to known reasons for revision if they are carried out outside the region.

The validity of the data reported in the present report is based on the **complete** adhesion to the register and degree of **reliability** of the information given.
The assessment of the **completeness** is made by comparison with the data from the Hospital Discharge database; in the last year the Register has 'captured' 96% of hip, knee and shoulder operations. Through merging with other databases missing data is spotted and filled appropriately. This causes delays in the completion of these analyses.
During 2019, missing data about previous arthroplasty interventions was requested, looking for possible revisions. Nevertheless, for this report, not all missing data requested was received. As a consequence, we have an uncertainty about final results, equal or lower than other registers.
Registry is under constant update. This implies data-entry about surgeries of recent years.

Concerning the **reliability** of the data presented, RIPO handles two types of data: incontrovertible data, that RIPO checks by comparison with other data banks (labels of the components implanted, demographic data of the patients, dates of admission, date of death), and not verifiable data such as disease that led to replacement or revision or the complications that arose during hospitalization. Reliability is checked by sampling the data and by asking for confirmation of some information.

Explanatory guide for the survival analysis

The survival of the prosthesis is illustrated by tables and graphs.
The **survival curves** are calculated only on patients living in Emilia-Romagna region; on the x-axis is the time expressed in years, on the y-axis the percentage of survival of the prosthesis. The curve starts, by definition, at 100% survival at the moment where the period of follow-up begins. The prosthesis is considered to be 'surviving' up to when it was necessary to replace even a single component.
The revision is, thus, the end-point. Each curve is flanked by a pair of curves symmetrical to it that are the 95% Confidence Interval, which delimits the interval of values where at 95% the possibility falls that a patient with prosthesis in place is found. The range of the interval is closely dependent on the number of operations considered in the analysis. If the number of operations is low, the uncertainty of the analysis is high, which is shown by a wide confidence interval.
Each graph is preceded by a table showing the number of prostheses considered and the number of failed prostheses.
The survival curves are preceded by the **multivariate analysis** performed according to the **Cox** method.
This analysis enables us to check what, if any, independent variables among them may influence the event, in our case the removal of at least one prosthetic component.
In the report both complete hip, knee and shoulder prostheses and single components were compared, if there was a sufficient number of implants (at least 300 cases). The comparison tables show the number of implants and survival rate at 5 and 10 years.

Summary of the main results presented

Hip

During 2019, data on 9.204 primary THAs, 12 resurfacing, 2.266 hemiarthroplasties and 953 partial or total revisions were registered.

If the trend does not change in the next two years, in the 20th report we will have doubled the number of THA in the last twenty years with an average annual increase of 5%.
If we extrapolate up to 2050, when we assume that the aging of the population will start to reverse, we expect about 15.000 THA per year.

Compared to the previous year, the THA are slightly increasing (+545 cases) while the resurfacing are slightly decreasing (-6 cases). The latter have been implanted in four private structures in 2019.

During 2019 primary THA was performed to treat well known pathologies, following a distribution percentage unchanged over the years except for a slightly decrease of implants in developmental dysplasia and an slight increase in primary coxarthrosis.
Mean age at surgery is stable (70 yrs for women and 66 yrs for men).

In 2019, as in past years, 100 different types of cup and stem were used, a lot of them are 'new', never implanted in previous years. 14% of the implanted stems had a modular neck, slightly decreasing compared to past years (the highest was 42% in 2011).
Uncemented prostheses were 62% in year 2000 and 96% in year 2019, whilst hybrid fixation was 22% and now it is 3,6%.
The implant of completely cemented prostheses is virtually a discontinued practice decreasing to 0,2% (compared to 15% in past years).

The survival of the hip prostheses is confirmed at very high levels: 87,5% of THA implanted in Emilia-Romagna region on resident patients are still in place 19 years after the operation.
A large part (75%) of 4.632 revisions are major ones, where at least one component interfacing with bone has been revised. The remaining are minor revisions (liner, head, and modular neck). Revisions carried out outside Emilia-Romagna region were considered separately since the causes of failure are not always known.
High incidence of prosthesis breakage was observed among causes of failure; this phenomenon, lower than the result of other international registries, is partially related to the extensive use of ceramic components and exchangeable necks.
In all analyses, met-met articular couplings, for all head diameters, were included. For large diameter met-met (> 32 mm), with official regional decree, a specific monitoring procedure has been initiated for all patients.

Partially confirming past years results, multivariate analysis demonstrated that survival is lower for males (risk of failure 1,2x than females) and young patients. Survival is influenced also from diagnosis: implants done to treat rare pathology and femoral fracture or its sequelae and septic coxitis sequelae have high survival.

At maximum 19 years of follow up, failure seems to be affected by fixation and articular coupling, but these variables cannot be introduced in the Cox multivariate analysis as they are not independent from other variables, such as age at surgery. Survival curves for fixation and coupling are traced without adjusting.
Multivariate analysis demonstrated that survival is higher for types of prostheses more frequently implanted compared to less implanted ones. Only a couple of models, no longer in use, have a survival below the regional average.

Survival of met-met articular couplings with head diameter >=36mm is lower than met-met <36mm.
Survival of resurfacing, at 16 years, is slightly lower than THA (84,8%, statistically significant). This datum is affected by the recall of a particular model of prostheses, the ASR Depuy.
Total revisions are not revised the second time in 80,9% of cases at 19 yrs.
Hemiarthroplasty has an optimal survival of the implant (94,8% at 19 yrs) even if the data is greatly influenced by a high rate of patient's deaths due to age and general conditions of the patients.

Knee

During 2019, data on 8.606 primary knee prostheses and 650 partial or total revision were registered, with increase of 7% of primary knee prostheses and 8% of revisions from the past year. High percentage of knee prostheses is implanted in private structures: 71% in 2019 of primary knee prostheses (vs 43% in 2000) and 59% in 2019 of revision (vs 25% in 2000).

In 2019, 12% of implanted prostheses are unicompartmental, 56% are bicompartmental with no patella resurfacing and the remaining 31% have patella resurfacing. The number of prostheses with patella are increasing, in particular in public hospital. Female patients are about twice as many as men.
In 2019, 98% of implants are cemented, in the half of them cement is antibiotic loaded. Hybrid fixation is almost completely absent. Mobile insert are decreasing (13% in 2019). 58% of Insert are in Standard Poly and the remainig are in Crosslinked Poly with or without antioxidant. Femoral component with Co-Cr are decreasing, Ceramicised Zirconium alloy and Cobalt alloy treated are preferable.

Types of implanted prostheses are fewer and more stable during years compared to hip implants. Survival of bicompartmental is 92,5% at 18 yrs, survival of tricompartmental is 92,8% and survival of unicompartmental is significantly lower (78,6%). In these analyses patella resurfacing after primary TKA is not considered as a failure.

The incidence of revisions due to infection in the prosthesis is high, in particular in total implants, where it represents approximately a quarter of the causes of failure (25%). In total implants, septic loosening represents one-third of causes of failure. Total revisions are not revised the second time in 79,3% of cases at 18 yrs.

Cox multivariate analysis shows that the survival of bi-tricompartmental knee prostheses is negatively influenced by age of the patient (the expectancy of prosthesis survival is lower for patient less than 60 yrs), by gender (survival is lower for male patients) and by type of insert (mobile insert is worse than fixed insert).
In unicompartmental implants, age of the patient influences negatively survival, while gender and type of tibial component (monoblock vs metal-back) seems to be irrelevant. Some models of prosthetic have survival slightly below the regional average, as in previous report.

Shoulder

Data refers to a short follow-up (11 years and half).
During 2019, 1.119 new shoulder total implants were carried out (1.054 were reverse prostheses).
Similar to knee prostheses, high percentage of primary shoulder prostheses is implanted in private structures (51% in 2019 vs 26% in 2008).

Women are more affected than men, either for fracture and for elective surgery.
Mean age at surgery for reverse prostheses is 74 for women and 71 for men. Patients are younger in anatomic prostheses (respectively 65 and 60). In hemiarthroplasty women are much older than men (72 vs 58).

Reverse prosthesis is implanted mainly in arthrosis (eccentric osteoarthritis in particular) and in fracture (20%).
Anatomic prosthesis is implanted in concentric arthrosis (81%), while hemiarthroplasties treat both fractures (61% of implants) and arthrosis.
Fixation is mainly cementless for reverse and anatomic prosthesis, while 33% of hemiarthroplasties are cemented.

Survival of reverse prosthesis at 10 yrs is 93,5%. Instability, glenoid loosening and septic loosening represent the most frequent causes of failure.

Units participating in RIPO, Head of Orthopaedic Surgery Department or Health Manager in the case of Private Hospitals and RIPO representatives inside the unit are listed in the Table below

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Pres. Val Tidone, Castel San Giovanni	Dr. Giuseppe Leddi	Dr. Claudio Gheduzzi Sig.ra Raffaella Sorsi
Ospedale privato 'Casa di cura Piacenza'	Dir. San. Prof. Mario Sanna	Sig.ra Laurence Girier

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Ospedale Borgo Val di Taro	f.f. Dr. Riccardo Cepparulo	Dr.ssa Maria Cristina Cardinali Dr. Alberto Guardoli
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Ospedale privato "Hospital Piccole Figlie"	Dir. San. Dr. Giorgio Bordin	Sig.ra Nadia Zabelli

Province of Reggio-Emilia

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Ospedale Cervesi Cattolica	Dr. Paolo Paladini	Dr. Paolo Paladini
Ospedale privato "Domus Nova"	Dir. San. Dr. Eugenio De Liberali	Dr. Massimo De Zerbi
Ospedale privato "San Francesco"	Dir. San. Dr. Eugenio De Liberali	Sig.ra Patrizia Bonoli
Ospedale privato "Maria Cecilia Hospital"	Dir. San. Dr.ssa Silvia Rapuano	Dr.ssa Silvia Rapuano
Ospedale privato "San Pier Damiano"	Dir. San. Dr. Roberto Nonni	Sig. Anna Pini
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Technological partner for computer management of the database is CINECA of Bologna.

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PART ONE: HIP PROSTHESES

January 2000 – December 2019

1. RIPO data collection

1.1 Percentage of R.I.P.O. data collection

Percentage of R.I.P.O. data collection, calculated versus hospital discharge data (S.D.O. – Schede di Dimissione Ospedaliera), is **95,1%** in the year 2019. Since the early years of the Register, adhesion has been at excellent levels, never falling below 95%. Data are referred to primary total hip replacements (Major Procedure Related – MPR - 8151;74;75;76;77;85;86;87), hemiarthroplasties (8152), revision (8153;70;71;72;73) and prosthesis removal (8005).

1.2 Ratio public/private treatment

Percentage of primary total arthroplasties, hemiarthroplasties and revision surgeries of the hip performed in public hospitals.

% of operations performed in public hospitals (AUSL, AOSP, IRCCS)			
Year of surgery	**Total hip arthroplasties**	**Hemiarthroplasties**	**Revisions**
2000	77,0	97,0	78,0
2001	81,0	97,3	77,0
2002	78,0	97,5	79,0
2003	75,1	98,4	76,1
2004	75,3	97,6	76,1
2005	72,9	98,3	77,7
2006	74,8	99,0	74,5
2007	70,8	98,6	73,6
2008	71,6	98,9	76,0
2009	70,9	99,3	76,3
2010	71,8	99,3	76,8
2011	69,9	99,3	78,8
2012	68,1	99,2	75,8
2013	67,4	99,5	74,9
2014	66,8	99,3	77,0
2015	63,3	99,4	77,4
2016	62,7	99,6	75,9
2017	63,3	99,4	75,4
2018	59,2	99,8	74,5
2019	53,3	99,8	71,1

From SDO database

2. Types of surgery

Number of hip surgeries carried out on patients with admission date between 1st January 2000 and 31st December 2019, according to **type of surgery**.

Type of surgery	Number of surgeries	Percentage
Primary THA	129.910	64,9
Hemiarthroplasty	46.340	23,1
Total and partial revision*	18.575	9,3
Resurfacing	2.824	1,4
Prosthesis removal	1.676	0,8
Hemiarthroplasty with buffer°	121	0,1
Other**	834	0,4
Total	**200.280**	**100,0**

° acetabular buffer

***** 4.960 total revision, 7.201 cup revisions, 3.816 stem revisions, 2.598 revisions of other components

****** 200 reduction of dislocation, 170 debridement, 160 spacer exchange, 24 hematoma drainage, 40 heterotopic ossification removal.

Number of hip operations carried out with **resurfacing prostheses** by year

Year of operation	N.
2000	3
2001	8
2002	34
2003	79
2004	114
2005	190
2006	229
2007	212
2008	174
2009	177
2010	130
2011	183
2012	337
2013	312
2014	263
2015	197
2016	121
2017	31
2018	18
2019	12

The table below shows the year-to-year percentage increase of the number of primary and revision operations.

Year of operation	Primary THA		Revision (total + partial)	
	N.	Increase %	N.	Increase %
2000	4.420	-	758	-
2001	4.637	4,9	877	15,7
2002	4.671	0,7	881	0,5
2003	5.083	8,8	874	-0,8
2004	5.395	6,1	880	0,7
2005	5.584	3,5	837	-4,9
2006	5.866	5,1	959	14,6
2007	6.276	7,0	1.042	8,7
2008	6.363	1,4	1.001	-3,9
2009	6.714	5,5	1.004	0,4
2010	6.595	-1,8	1.045	4,0
2011	6.433	-2,5	932	-10,8
2012	6.591	2,5	1.023	9,8
2013	6.736	2,2	949	-7,2
2014	7.193	6,8	891	-6,1
2015	7.556	5,0	929	4,3
2016	7.671	1,5	924	-0,5
2017	8.263	7,7	884	-4,3
2018	8.659	4,8	931	5,3
2019	9.204	6,3	953	2,4

3. Descriptive statistics of patients

3.1 Age

Number of hip operations carried out on patients with admission date between 1st January 2000 and 31st December 2019, according to **type of operation** and **age group** of patients at the time of surgery.

Type of operation	<40		40-49		50-59		60-69		70-79		≥80		Total
	N.	%	N.	%	N.	%	N.	%	N.	%	N.	%	
Primary THA	3.672	2,8	8.290	6,4	19.273	14,8	37.096	28,6	46.376	35,7	15.193	11,7	**129.900**
Hemiarthroplasty	23	0,0	76	0,2	237	0,5	1.269	2,7	9.463	20,4	35.271	76,1	**46.339**
Revision	348	1,9	791	4,3	1.997	10,8	4.437	23,9	7.121	38,3	3.879	20,9	**18.573**
Resurfacing	329	11,7	716	25,4	1.006	35,6	640	22,7	127	4,5	6	0,2	**2.824**
Prosthesis removal	54	3,2	99	5,9	185	11,0	395	23,6	588	35,1	355	21,2	**1.676**
Hemiarthroplasty with buffer	-	0,0	2	1,7	3	2,5	15	12,4	38	31,4	63	52,1	**121**
Other	38	4,6	62	7,4	113	13,5	200	24,0	271	32,5	150	18,0	**834**
Total*	**4.464**	**2,2**	**10.036**	**5,0**	**22.814**	**11,4**	**44.052**	**22,0**	**63.984**	**31,9**	**54.917**	**27,4**	**200.267**

*13 missing data

In 2019 percentage of Hemiarthroplasty carried out on patients older than ninety is 22,2%.

Mean age of patients at surgery

Type of operation	Mean age	Range
Primary THA	66,8	11-101
Hemiarthroplasty	83,8	14-109
Resurfacing	52,7	15-83
Revision	70,2	15-100

Mean age of patients, per type of operation: comparison 2000-2019 for THA and 2003-2019 for Resurfacing

	Year 2000		Year 2019	
Type of operation	**Mean age**	**Range**	**Mean age**	**Range**
Primary THA	66,0	16-99	67,0	11-98
Hemiarthroplasty	82,4	35-104	85,6	50-104
Revision	68,5	22-97	70,9	23-99

	Year 2003		Year 2019	
Type of operation	**Mean age**	**Range**	**Mean age**	**Range**
Resurfacing	49,9	18-72	52,2	34-70

Mean age at surgery of patients affected by coxarthrosis according to gender: comparison 2000-2019

	THA			
	Year 2000		Year 2019	
Gender	**Mean age**	**Range**	**Mean age**	**Range**
Males	67,2	34-92	66,0	26-91
Females	68,9	31-93	69,9	28-95

3.2 Gender

Number of hip operations carried out on patients with admission date between 1st January 2000 and 31st December 2019, according to **type of operation** and **gender of patient**

Type of operation	Males		Females		Total
	N.	%	N.	%	N.
Primary THA	53.600	41,3	76.310	58,7	129.910
Hemiarthroplasty	12.178	26,3	34.162	73,7	46.340
Revision	6.570	35,4	12.005	64,6	18.575
Resurfacing	2.136	75,6	688	24,4	2.824
Prosthesis Removal	747	44,6	929	55,4	1.676
Hemiarthroplasty with buffer	27	22,3	94	77,7	121
Other	373	44,7	461	55,3	834
Total	**75.631**	**37,8**	**124.649**	**62,2**	**200.280**

3.3 Side of surgery

Coxarthrosis more often affects right hip (57,9%) than left hip (42,1%). The percentage has been calculated on patients affected by primary coxarthrosis, on first side operated. The difference is more accentuated for females.

Percentage of operations carried out on the right or left side, by gender

Side	Males	Females
Right	52,9	61,9
Left	47,1	38,1

The difference is statistically significant (Chi – squared p<0,001).

3.4 Bilateral prosthesis

Between 1st January 2000 and 31st December 2019, 11.400 patients underwent bilateral operations for Coxarthrosis.

9.230 (80,9%) chose to undergo the second operation at the same hospital where the first one was performed;
656 (5,8%) chose to undergo the second operation at a different hospital, to follow the surgeon;
1.517 (13,3%) chose to undergo the second operation at a different hospital with a different surgeon.

In bilateral operations, it was observed that the first hip to be treated was the right one in 54,1%.

3.5 Diseases treated with total hip arthroplasty and hemiarthroplasty

Number of **primary total hip arthroplasty** operations carried out on patients with admission date between 1st January 2000 and 31st December 2019, according to **diagnosis**

Diagnosis in primary arthroplasty	Number	Percentage
Primary arthritis	89.729	69,4
Femoral neck fracture	11.891	9,2
Sequelae of LCA and DCA	11.596	9,0
Femoral head necrosis (idiopathic, due to dialysis, due to steroids)	7.633	5,9
Post traumatic arthritis	2.701	2,1
Post traumatic necrosis	1.459	1,1
Femoral neck fracture sequelae	1.319	1,0
Rheumatic arthritis	1.229	1,0
Epiphysiolysis sequelae	335	0,3
Perthes disease sequelae	308	0,2
Tumor	230	0,2
Septic coxitis sequelae	184	0,1
Paget disease	103	0,1
TBC coxitis sequelae	65	0,1
Acetabulum fracture	64	0,0
Other	404	0,3
Total**	**119.878**	**100,0**

**660 missing data (0,5%)

Prostheses for bone tumor resection are not registered by R.I.P.O.

Diagnosis in 96,8% of hemiarthroplasties was femoral neck fracture.

Percentage distribution of diseases leading to THA according to **range-year of operation**

Diagnosis in primary arthroplasty	Percentage		
	2000-2013	2014-2016	2017-2019
Primary arthritis	67,5	71,4	73,6
Femoral neck fracture	9,0	9,7	9,5
Sequelae of LCA and DCA	10,5	7,4	5,6
Femoral head necrosis (idiopathic, due to dialysis, due to steroids)	5,9	5,9	5,9
Post traumatic arthritis	2,4	1,8	1,5
Post traumatic necrosis	1,3	0,7	0,9
Femoral neck fracture sequelae	0,9	1,2	1,3
Rheumatic arthritis	1,2	0,7	0,5
Other	1,4	1,1	1,2
Total	**100,0**	**100,0**	**100,0**

Percentage distribution of diseases leading to THA according to **age group** of patients at time of surgery

Diagnosis in primary arthroplasty	Age group					
	<40	40-49	50-59	60-69	70-79	≥80
Primary arthritis	18,1	44,0	62,0	74,0	75,9	74,2
Femoral neck fracture	1,9	3,2	5,9	8,4	11,9	12,2
Sequelae of LCA and DCA	27,7	26,6	16,9	8,1	4,0	2,1
Femoral head necrosis (idiopathic, due to dialysis, due to steroids)	19,5	11,7	7,1	4,7	4,3	6,0
Post traumatic arthritis	8,8	5,7	3,0	1,7	1,2	1,1
Post traumatic necrosis	6,8	2,2	1,3	0,8	0,7	1,2
Femoral neck fracture sequelae	1,6	1,3	0,8	0,7	0,9	2,2
Rheumatic arthritis	4,6	1,7	1,1	0,8	0,7	0,5
Epiphysiolysis sequelae	3,3	1,1	0,3	0,1	0,0	0,0
Perthes disease sequelae	3,1	0,9	0,3	0,1	0,0	0,0
Tumor	0,4	0,3	0,3	0,2	0,1	0,1
Septic coxitis sequelae	1,6	0,2	0,2	0,1	0,1	0,0
Paget disease	0,0	0,0	0,0	0,1	0,1	0,1
TBC coxitis sequelae	0,2	0,1	0,1	0,1	0,0	0,0
Acetabulum fracture	0,0	0,0	0,1	0,0	0,0	0,1
Other	2,4	0,8	0,5	0,2	0,1	0,1
Total	**100,0**	**100,0**	**100,0**	**100,0**	**100,0**	**100,0**

Diagnosis in primary arthroplasty	Age group						Total
	<40	40-49	50-59	60-69	70-79	≥80	
Primary arthritis	0,7	4,0	13,3	30,4	39,0	12,5	**100,0**
Femoral neck fracture	0,6	2,2	9,5	26,0	46,2	15,5	**100,0**
Sequelae of LCA and DCA	8,7	19,0	27,9	25,8	15,9	2,8	**100,0**
Femoral head necrosis (idiopathic, due to dialysis, due to steroids)	9,3	12,6	17,8	22,5	25,8	11,9	**100,0**
Post traumatic arthritis	12,0	17,5	21,2	23,4	20,0	6,0	**100,0**
Post traumatic necrosis	16,9	12,7	17,7	19,5	20,8	12,4	**100,0**
Femoral neck fracture sequelae	4,5	8,4	11,8	18,6	31,5	25,2	**100,0**
Rheumatic arthritis	13,6	11,6	17,7	25,0	26,3	5,9	**100,0**
Epiphysiolysis sequelae	36,1	27,5	18,8	11,3	5,7	0,6	**100,0**
Perthes disease sequelae	37,0	23,7	17,2	14,3	6,2	1,6	**100,0**
Tumor	6,5	11,7	23,9	30,9	23,5	3,5	**100,0**
Septic coxitis sequelae	31,5	10,9	23,4	16,3	15,8	2,2	**100,0**
Paget disease	0,0	0,0	6,8	28,2	49,5	15,5	**100,0**
TBC coxitis sequelae	9,2	16,9	26,2	30,8	15,4	1,5	**100,0**
Acetabulum fracture	1,6	1,6	17,2	14,1	34,4	31,3	**100,0**
Other	21,8	15,8	25,5	20,0	13,1	3,7	**100,0**

Number of **resurfacing** operations carried out on patients with admission date between 1st January 2000 and 31st December 2019, according to **diagnosis**

Diagnosis in resurfacing	Number	Percentage
Primary arthritis	2.346	83,4
Sequelae of LCA and DCA	189	6,7
Femoral head necrosis (idiopathic, due to dialysis, due to steroids)	96	3,4
Post traumatic arthritis	91	3,2
Rheumatic arthritis	29	1,0
Post traumatic necrosis	13	0,5
Epiphysiolysis sequelae	13	0,5
Perthes disease sequelae	11	0,4
Femoral neck fracture sequelae	8	0,3
Septic coxitis sequelae	3	0,1
Paget disease	3	0,1
Femoral neck fracture	1	0,04
TBC coxitis sequelae	1	0,04
Other	9	0,3
Total*	**2.813**	**100,0**

* 11 missing data (0,4%)

3.6 Causes for revision

Number of revision operations carried out on patients admitted between 1st January 2000 and 31st December 2019 according to **diagnosis.**

In the Table are reported **all revisions of primary THA** performed in the Region, without taking care of site, date of primary implant and follow-up time.

Diagnosis in revision of primary THA	Number	Percentage
Cup aseptic loosening	4.985	30,3
Total aseptic loosening	2.903	17,6
Stem aseptic loosening	2.201	13,4
Prosthesis dislocation	1.533	9,3
Bone fracture	1.215	7,4
Two steps prosthesis removal	869	5,3
Prosthesis breakage*	850	5,2
Poly wear	711	4,3
Pain without loosening	301	1,8
Septic loosening	177	1,1
Metallosis	174	1,1
Primary instability	118	0,7
Heterotopic bone	85	0,5
Trauma	38	0,2
Acetabulum fracture	25	0,2
Other	294	1,8
Total°	**16.479**	**100,0**

° 446 missing data (2,6%)

* Failure of 286 modular necks, 189 liners, 121 heads, 112 stems, 108 cups, 14 liner and head . 20 failures not specified.

In the Table are reported **all revisions of resurfacing** performed in the Region, without considering site, date of primary implant and follow-up time.

Diagnosis in revision of resurfacing	Number	Percentage
Aseptic loosening	88	45,8
Bone fracture	51	26,6
Metallosis	33	17,2
Pain without loosening	13	6,8
Instability	4	2,1
Breakage of prosthesis	3	1,6
Total°	**192**	**100,0**

° 2 missing data (1,0%)

In the Table are reported **all revisions of hemiarthroplasty** performed in the Region, without considering site, date of primary implant and follow-up time.

Diagnosis in revision of hemiarthroplasty	Number	Percentage
Prosthesis dislocation	498	34,7
Cotiloiditis	372	25,9
Stem aseptic loosening	289	20,1
Periprosthetic bone fracture	156	10,9
Septic loosening	31	2,2
Two steps prosthesis removal	25	1,7
Breakage of prosthesis	8	0,6
Poly wear	7	0,5
Instability	7	0,5
Heterotopic bone	5	0,3
Other	37	2,6
Total*	**1.435**	**100,0**

* 21 missing data (1,4%)

4. Types of prostheses

The following tables show the types of prostheses (cups, stems) commonly used in the Emilia-Romagna region, according to primary and revision surgery.

4.1 Cups used in primary surgery

In 369 cases model or cup fixation was not communicated to RIPO.

Cemented cups	2000-2013		2014-2016		2017-2019	
	N.	%	N.	%	N.	%
PE (Muller Protek) Sulzer	497	9,9	35	16,3	19	11,3
CUPULE AVANTAGE CEMENTED Biomet	89	1,8	5	2,3	18	10,7
REFLECTION ALL-POLY Smith and Nep.	292	5,8	24	11,2	11	6,5
PE Adler-Ortho	167	3,3	9	4,2	6	3,6
CONTEMPORARY Stryker Howmedica	814	16,2	14	6,5	5	3,0
ZCA Zimmer	650	13,0	12	5,6	4	2,4
MULLER Lima	249	5,0	9	4,2	3	1,8
MULLER Citieffe	110	2,2	11	5,1	2	1,2
MULLER Smith and Nephew	159	3,2	2	0,9	-	-
MULLER Wright Cremascoli	961	19,2	-	-	-	-
MULLER Samo	441	8,8	-	-	-	-
LUNA Amplitude	88	1,8	-	-	-	-
CCB Mathys	58	1,2	-	-	-	-
MULLER Groupe Lepine	57	1,1	-	-	-	-
Other (< 50 cases)	378	7,5	94	43,7	100	59,5
Total	**5.010**	**100,0**	**215**	**100,0**	**168**	**100,0**

Cementless cup	2000-2013		2014-2016		2017-2019	
	N.	%	N.	%	N.	%
FIXA Ti-POR Adler-Ortho	9.531	12,5	7.255	32,8	7.779	30,0
R3 THREE-HOLE Smith and Nephew	1.660	2,2	2.090	9,4	2.947	11,4
VERSAFITCUP CC TRIO Medacta	248	0,3	867	3,9	1.757	6,8
CONTINUUM Zimmer	1.003	1,3	892	4,0	1.622	6,3
JUMP Permedica	167	0,2	791	3,6	1.260	4,9
DELTA TT Lima	819	1,1	776	3,5	1.197	4,6
G7 PPS Biomet	-	-	493	2,2	987	3,8
PINNACLE SECTOR II POROCOAT DePuy	1.844	2,4	979	4,4	678	2,6
PINNACLE SECTOR GRIPTION DePuy	36	0,0	323	1,5	563	2,2
JUMP SYSTEM TRASER Permedica	-	-	26	0,1	518	2,0
TRIDENT PSL HA CLUSTER Stryker Howmedica	2.121	2,8	398	1,8	492	1,9
EP-FIT PLUS Endoplus	4.922	6,5	779	3,5	454	1,8
ALLOFIT S IT Zimmer	573	0,8	503	2,3	331	1,3
I1CUP Link	-	-	21	0,1	331	1,3
MPACT Medacta	35	0,0	107	0,5	317	1,2
DELTA PF Lima	1.814	2,4	484	2,2	314	1,2
GYROS DePuy	6	0,0	143	0,6	266	1,0
EXCEED ABT Biomet	1.167	1,5	615	2,8	231	0,9
ADAPTIVE WINGS Samo	220	0,3	251	1,1	147	0,6
MAXERA Zimmer	247	0,3	198	0,9	131	0,5
PINNACLE BANTAM POROCOAT DePuy	109	0,1	73	0,3	119	0,5
FIN II Bioimpianti	202	0,3	177	0,8	114	0,4
TRIDENT PSL HA SOLID Stryker Howmedica	185	0,2	102	0,5	108	0,4
RM Mathys	179	0,2	126	0,6	88	0,3
TOP Link	612	0,8	137	0,6	80	0,3
AGILIS TI-POR Adler-Ortho	56	0,1	199	0,9	68	0,3
TRABECULAR METAL Zimmer	562	0,7	36	0,2	62	0,2
FITMORE Sulzer	2.856	3,8	136	0,6	51	0,2
MALLORY Biomet	301	0,4	67	0,3	40	0,2
DELTAMOTION Finsbury	261	0,3	241	1,1	28	0,1
CUPULE RELOAD AVANTAGE Biomet	346	0,5	94	0,4	23	0,1
BS Citieffe	416	0,5	62	0,3	18	0,1
TRILOGY Zimmer	1.130	1,5	12	0,1	15	0,1
BETA CUP Link	275	0,4	53	0,2	8	0,0
CUPULE APRIL Symbios	316	0,4	146	0,7	3	0,0
SPARKUP Samo	525	0,7	116	0,5	3	0,0
CLS Zimmer	3.376	4,4	-	-	1	0,0
REFLECTION Smith and Nephew	1.810	2,4	258	1,2	-	-
EXPANSYS Mathys	1.536	2,0	89	0,4	-	-
BICON PLUS Endoplus	1.325	1,7	37	0,2	-	-
ABG II Howmedica	2.744	3,6	35	0,2	-	-
FIXA Adler-Ortho	7.489	9,8	10	0,0	-	-
HILOCK LINE Symbios	711	0,9	5	0,0	-	-
DUOFIT PSF Samo	1.376	1,8	2	0,0	-	-
VERSAFITCUP CC Medacta	874	1,1	1	0,0	-	-
AnCA FIT Wright Cremascoli	6.720	8,8	-	-	-	-
STANDARD CUP Protek Sulzer	1.306	1,7	-	-	-	-
RECAP RESURFACING Biomet	895	1,2	-	-	-	-
SELEXYS TH Mathys	583	0,8	-	-	-	-

TRABECULAR METAL MONOBLOCK Zimmer	417	0,5	-	-	-	-
TRILOGY AB Zimmer	378	0,5	-	-	-	-
DUROM HIP RESURFACING Zimmer	330	0,4	-	-	-	-
EASY Hit Medica	313	0,4	-	-	-	-
CUPULE AVANTAGE Biomet	300	0,4	-	-	-	-
Other (< 300 cases)	8.881	11,7	1.935	8,7	2.749	10,6
Total	**76.108**	**100,0**	**22.140**	**100,0**	**25.900**	**100,0**

Table reports models of cup designed for resurfacing prostheses but implanted in traditional THA.

4.2 Cups used in total revision surgery

In 253 cases model or cup fixation was not communicated to RIPO

Cemented cups	2000-2013		2014-2016		2017-2019	
	N.	%	N.	%	N.	%
POLARCUP CEMENTED Smith and Nephew	4	0,6	4	7,8	7	10,6
MULLER Protek-Sulzer-Centerpulse-Zimmer	179	25,9	3	5,9	7	10,6
REFLECTION ALL-POLY Smith and Nephew	8	1,2	4	7,8	4	6,1
CUPULE AVANTAGE CEMENTED Biomet	30	4,3	1	2,0	3	4,5
CONTEMPORARY Stryker Howmedica	133	19,2	6	11,8	2	3,0
MULLER Lima	54	7,8	3	5,9	2	3,0
MULLER PCR Samo	12	1,7	1	2,0	1	1,5
Muller Adler-Ortho	8	1,2	1	2,0	1	1,5
ZCA Zimmer	41	5,9	3	5,9	-	-
MULLER Wright Cremascoli	58	8,4	-	-	-	-
MULLER Samo	53	7,7	-	-	-	-
CCB Mathys	20	2,9	-	-	-	-
Other (< 10 cases)	91	13,2	25	49,0	39	59,1
Total	**691**	**100,0**	**51**	**100,0**	**66**	**100,0**

Cementless cups	2000-2013		2014-2016		2017-2019	
	N.	%	N.	%	N.	%
FIXA Ti-POR Adler-Ortho	169	5,7	90	19,7	104	21,8
DELTA ONE TT Lima	93	3,1	66	14,4	80	16,7
DELTA TT Lima	62	2,1	37	8,1	52	10,9
CONTINUUM Zimmer	55	1,9	41	9,0	42	8,8
OMNIA Ti-POR Adler-Ortho	24	0,8	37	8,1	26	5,4
DELTA REVISION TT Lima	43	1,5	22	4,8	25	5,2
HERMES BS REV Citieffe	62	2,1	20	4,4	15	3,1
PINNACLE REVISION DP GRIPTION DePuy	-	-	9	2,0	12	2,5
R3 THREE-HOLE Smith and Nephew	13	0,4	8	1,8	11	2,3
TRABECULAR METAL Zimmer	171	5,8	21	4,6	7	1,5
TRIDENT PSL HA CLUSTER Stryker Howmedica	162	5,5	6	1,3	7	1,5
EP-FIT PLUS Endoplus	38	1,3	5	1,1	6	1,3
TRILOGY IT Zimmer	14	0,5	5	1,1	5	1,0
TRITANIUM HEMISPHERICAL Stryker Howmedica	10	0,3	12	2,6	3	0,6
TRIDENT TRITANIUM Stryker Howmedica	10	0,3	9	2,0	3	0,6
PINNACLE MULTIHOLE GRIPTION DePuy	16	0,5	21	4,6	1	0,2
TRILOGY Zimmer	142	4,8	-	-	1	0,2

TRABECULAR METAL REVISION Zimmer	30	1,0	5	1,1	-	-
MC MINN Link	92	3,1	2	0,4	-	-
DELTA PF Lima	43	1,5	1	0,2	-	-
PINNACLE MULTIHOLE II DePuy	32	1,1	1	0,2	-	-
AnCA FIT Cremascoli	301	10,2	-	-	-	-
STANDARD CUP Protek Sulzer	132	4,5	-	-	-	-
FIXA Adler-Ortho	131	4,4	-	-	-	-
OMNIA Adler-Ortho	52	1,8	-	-	-	-
LOR ALLOPRO Protek Sulzer	48	1,6	-	-	-	-
DUOFIT PSF Samo	48	1,6	-	-	-	-
OSTEOLOCK Stryker Howmedica	47	1,6	-	-	-	-
FITMORE Sulzer	44	1,5	-	-	-	-
CLS Zimmer	43	1,5	-	-	-	-
REGENEREX RINGLOC+ Biomet	41	1,4	-	-	-	-
TRIDENT ARC2F Stryker Howmedica	37	1,2	-	-	-	-
PROCOTYL-E Wright Cremascoli	36	1,2	-	-	-	-
REFLECTION Smith and Nephew	30	1,0	-	-	-	-
BICON PLUS Endoplus	25	0,8	-	-	-	-
CONICAL SCREW CUP Protek Sulzer	25	0,8	-	-	-	-
SECUR-FIT Osteonics Howmedica	25	0,8	-	-	-	-
BOFOR Endoplus	22	0,7	-	-	-	-
ABGII Stryker Howmedica	21	0,7	-	-	-	-
PROCOTYL-Z-PIVOT Wright Cremascoli	21	0,7	-	-	-	-
Other (< 20 cases)	554	18,7	39	8,5	78	16,3
Total	**2.964**	**100,0**	**457**	**100,0**	**478**	**100,0**

4.3 Stems used in primary surgery

In 434 cases model or stem fixation was not communicated to RIPO.

Cemented stem	2000-2013		2014-2016		2017-2019	
	N.	%	N.	%	N.	%
EXETER V40 Stryker Howmedica	1.311	10,7	170	20,1	144	16,8
VERSYS HERITAGE Zimmer	53	0,4	2	0,2	129	15,1
POLARSTEM CEM Endoplus	24	0,2	81	9,6	97	11,3
KORUS Bioimpianti	-	-	18	2,1	73	8,5
PAVI CEM Groupe Lepine	8	0,1	59	7,0	63	7,4
APTA Adler-Ortho	1.135	9,3	61	7,2	59	6,9
EXACTA PLUS Permedica	4	0,0	-	-	46	5,4
CORAIL DePuy	22	0,2	37	4,4	33	3,9
HYDRA Adler-Ortho	43	0,4	41	4,8	29	3,4
TAPERLOC CEM Biomet	75	0,6	17	2,0	23	2,7
DUOFIT CKA Samo	53	0,4	5	0,6	21	2,5
LUBINUS SP2 Link	305	2,5	12	1,4	12	1,4
CORAE Adler-Ortho	12	0,1	69	8,2	3	0,4
AB Citieffe	204	1,7	28	3,3	3	0,4
CPCS Smith and Nephew	37	0,3	21	2,5	3	0,4
MS 30 Zimmer	187	1,5	-	-	3	0,4
VERSYS ADVOCATE Zimmer	246	2,0	7	0,8	2	0,2
SL Lima	104	0,9	2	0,2	2	0,2
BASIS Smith and Nephew	974	8,0	71	8,4	1	0,1
C-STEM AMT DePuy	195	1,6	34	4,0	-	-
CCA Mathys	231	1,9	6	0,7	-	-
SPECTRON Smith and Nephew	728	6,0	2	0,2	-	-
ABGII Stryker Howmedica	57	0,5	1	0,1	-	-
JVC Wright Cremascoli	728	6,0	-	-	-	-
P507 Samo	658	5,4	-	-	-	-
MRL Wright Cremascoli	469	3,8	-	-	-	-
LC Samo	412	3,4	-	-	-	-
AD Samo	388	3,2	-	-	-	-
DEFINITION Stryker Howmedica	347	2,8	-	-	-	-
VERSYS CEMENTED Zimmer	335	2,7	-	-	-	-
ANCA-FIT CLU Wright Cremascoli	314	2,6	-	-	-	-
C STEM DePuy	313	2,6	-	-	-	-
AHS Wright Cremascoli	306	2,5	-	-	-	-
ABG Stryker Howmedica	231	1,9	-	-	-	-
ULTIMA Johnson e Johnson	197	1,6	-	-	-	-
VERSYS CEMENTED LD Zimmer	133	1,1	-	-	-	-
MERCURIUS Adler-Ortho	112	0,9	-	-	-	-
ANCA Wright Cremascoli	89	0,7	-	-	-	-
MBA Groupe Lepine	88	0,7	-	-	-	-
DUOFIT CFS Samo	75	0,6	-	-	-	-
FULLFIX Mathys	69	0,6	-	-	-	-
ARCAD SO Symbios	66	0,5	-	-	-	-
PERFECTA RA Wright Cremascoli	60	0,5	-	-	-	-
MULLER AUTOBLOCCANTE Sulzer	57	0,5	-	-	-	-
SL STREAKES Hitmedica	50	0,4	-	-	-	-
Other (< 50 cases)	707	5,8	102	12,1	109	12,7
Total	**12.212**	**100,0**	**846**	**100,0**	**855**	**100,0**

Cementless stem	2000-2013		2014-2016		2017-2019	
	N.	%	N.	%	N.	%
POLARSTEM Endoplus	487	0,7	710	3,3	1.824	7,2
HYDRA Adler-Ortho	2.020	2,9	1.592	7,4	1.773	7,0
HYDRA-FIX Adler-Ortho	-	-	50	0,2	1.507	6,0
AMISTEM-H Medacta	233	0,3	505	2,3	1.447	5,7
APTA Adler-Ortho	7.687	11,2	2.017	9,4	1.295	5,1
APTA-FIX Adler-Ortho	-	-	384	1,8	1.139	4,5
EXACTA - Permedica	44	0,1	318	1,5	1.062	4,2
CORAIL DePuy	1.479	2,1	790	3,7	867	3,4
SL PLUS MIA STEM Smith and Nephew	1.052	1,5	880	4,1	701	2,8
TRI-LOCK DePuy	348	0,5	756	3,5	642	2,5
H-MAX S Lima	175	0,3	535	2,5	610	2,4
TAPERLOC COMPLETE Biomet	16	0,0	552	2,6	607	2,4
MINIMAX Medacta	484	0,7	389	1,8	590	2,3
KORUS Bioimpianti	2	0,0	151	0,7	567	2,2
PULCHRA-FIX Adler-Ortho	-	-	1	0,0	562	2,2
ACCOLADE II Osteonics Howmedica	24	0,0	200	0,9	556	2,2
CLS Sulzer	4.353	6,3	519	2,4	522	2,1
RECTA Adler-Ortho	4.713	6,8	752	3,5	518	2,1
TAPERLOC COMPLETE MICROPLASTY Biomet	-	-	198	0,9	511	2,0
FITMORE B EXT. Zimmer	216	0,3	303	1,4	509	2,0
LCU - Link	7	0,0	212	1,0	435	1,7
SYNTHESIS Permedica	9	0,0	403	1,9	426	1,7
CORAE Adler-Ortho	259	0,4	1.810	8,4	353	1,4
NANOS Endoplant Gmbh	569	0,8	273	1,3	349	1,4
ALATA ACUTA S Adler-Ortho	846	1,2	305	1,4	330	1,3
AVENIR MULLER Zimmer	3	0,0	186	0,9	309	1,2
CONUS Centerpulse	4.887	7,1	554	2,6	292	1,2
MINIMA S Lima	10	0,0	32	0,1	288	1,1
ADR Endoplus	795	1,2	335	1,6	270	1,1
EXACTA S Permedica	-	-	71	0,3	259	1,0
MODULUS Lima	780	1,1	224	1,0	249	1,0
FITMORE B Zimmer	481	0,7	285	1,3	220	0,9
RECTA-FIX Adler-Ortho	96	0,1	217	1,0	220	0,9
SUMMIT DePuy	342	0,5	186	0,9	191	0,8
SL PLUS Endoplus	4.190	6,1	315	1,5	181	0,7
MISTRAL Samo	90	0,1	197	0,9	114	0,5
TWINSYS Mathys	220	0,3	93	0,4	91	0,4
PLS Lima	232	0,3	95	0,4	82	0,3
GTS Biomet	254	0,4	119	0,6	77	0,3
FIT STEM Lima	311	0,5	56	0,3	73	0,3
C2 Lima	998	1,4	126	0,6	66	0,3
VERSYS FIBER METAL TAPER Zimmer	1.246	1,8	48	0,2	64	0,3
ALLOCLASSIC SL Zimmer	353	0,5	12	0,1	63	0,2
SAM-FIT Lima	312	0,5	163	0,8	53	0,2
QUADRA-H Medacta	267	0,4	3	0,0	48	0,2
PROXIPLUS Endoplant	1.368	2,0	191	0,9	40	0,2
QUADRA-S Medacta	310	0,5	115	0,5	39	0,2
DUOFIT RKT Samo	324	0,5	35	0,2	34	0,1
MULTIFIT Samo	337	0,5	77	0,4	33	0,1
CFP Link	1.052	1,5	39	0,2	28	0,1
PARVA Adler-Ortho	345	0,5	90	0,4	24	0,1
TAPERLOC Biomet	2.609	3,8	366	1,7	14	0,1
Z1 Citieffe	344	0,5	55	0,3	11	0,0
TAPERLOC MICROPLASTY Biomet	426	0,6	70	0,3	8	0,0

DUOFIT RTT Samo	283	0,4	39	0,2	7	0,0
PBF Permedica	415	0,6	21	0,1	1	0,0
SYNERGY Smith and Nephew	683	1,0	218	1,0	-	-
CBC Mathys	2.139	3,1	170	0,8	-	-
ABGII Stryker Howmedica	3.423	5,0	109	0,5	-	-
ACCOLADE Osteonics Howmedica	454	0,7	75	0,3	-	-
PROFEMUR Z Wright Cremascoli	713	1,0	2	0,0	-	-
SPS MODULAR Symbios	330	0,5	2	0,0	-	-
HIPSTAR Stryker Howmedica	336	0,5	1	0,0	-	-
CONELOCK SHORT Biomet	300	0,4	1	0,0	-	-
ANCA FIT Wright Cremascoli	4.506	6,5	-	-	-	-
BHS Smith and Nephew	438	0,6	-	-	-	-
ABG Stryker Howmedica	332	0,5	-	-	-	-
EHS Wright Cremascoli	313	0,5	-	-	-	-
PROXILOCK FT Stratec	304	0,4	-	-	-	-
Other (< 300 cases)	5.878	8,5	1.896	8,8	2.066	8,2
Total	**68.852**	**100,0**	**21.494**	**100,0**	**25.217**	**100,0**

4.4 Stems used in total revision surgery

In 291 cases model or stem fixation was not communicated to RIPO.

Cemented stem	2000-2013		2014-2016		2017-2019	
	N.	%	N.	%	N.	%
EXETER V40 Stryker Howmedica	20	4,0	6	14,0	7	12,7
VERSYS REVISION CALCAR Zimmer	79	16,0	3	7,0	5	9,1
APTA Adler-Ortho	35	7,1	1	2,3	4	7,3
JVC Wright Cremascoli	29	5,9	-	-	1	1,8
AD Samo	32	6,5	-	-	-	-
ANCA Wright Cremascoli	25	5,1	-	-	-	-
Other (< 20 cases)	275	55,6	33	76,7	38	69,1
Total	**495**	**100,0**	**43**	**100,0**	**55**	**100,0**

Cementless stem	2000-2013		2014-2016		2017-2019	
	N.	%	N.	%	N.	%
REVISION HIP Lima	185	5,9	110	23,8	134	27,2
SL REVISION Sulzer Centerpulse Zimmer	593	19,0	60	13,0	75	15,2
ALATA AEQUA REVISION Adler-Ortho	199	6,4	77	16,7	69	14,0
ALATA ACUTA S Adler-Ortho	77	2,5	35	7,6	20	4,1
RECLAIM DePuy	15	0,5	24	5,2	14	2,8
MP RECONSTRUCTION PROSTHESIS Link	64	2,0	7	1,5	10	2,0
RESTORATION Stryker Howmedica	272	8,7	34	7,4	9	1,8
MODULUS HIP SYSTEM Lima	43	1,4	16	3,5	9	1,8
APTA Adler-Ortho	29	0,9	2	0,4	7	1,4
CONUS Sulzer Centerpulse Zimmer	87	2,8	6	1,3	6	1,2
ADR Endoplus	20	0,6	5	1,1	4	0,8
CLS Sulzer Centerpulse Zimmer	42	1,3	4	0,9	3	0,6
C2 Lima	65	2,1	-	-	2	0,4
SLR PLUS Endoplus	30	1,0	1	0,2	1	0,2
MGS Samo	120	3,8	3	0,6	-	-
CONELOCK REVISION Biomet	135	4,3	2	0,4	-	-
ZMR REVISION TAPER CONE Zimmer	50	1,6	2	0,4	-	-
CBC Mathys	19	0,6	1	0,2	-	-
PROFEMUR R VERS. 4 Wright Cremascoli	414	13,3	-	-	-	-
S. ROM Johnson e Johnson	147	4,7	-	-	-	-

RESTORATION T3 Stryker Howmedica	74	2,4	-	-	-	-
ANCA FIT Wright Cremascoli	59	1,9	-	-	-	-
SL PLUS Endoplus	40	1,3	-	-	-	-
ZMR REVISION TAPER Zimmer	30	1,0	-	-	-	-
EMPERION Smith and Nephew	23	0,7	-	-	-	-
VERSYS FIBER METAL TAPER Zimmer	22	0,7	-	-	-	-
CBK REVISION STEM Mathys	20	0,6	-	-	-	-
Other (< 20 cases)	248	7,9	73	15,8	129	26,2
Total	**3.122**	**100,0**	**462**	**100,0**	**492**	**100,0**

4.5 Number of different types of implant

Number of **different types of cups and stems** implanted in primary surgery, according to year of operation.

Year of operation	Primary THA	
	Cups	Stems
2000	87	93
2001	92	98
2002	90	94
2003	94	110
2004	84	99
2005	90	110
2006	87	98
2007	100	113
2008	105	114
2009	95	115
2010	91	109
2011	100	107
2012	90	109
2013	100	125
2014	97	125
2015	100	125
2016	110	140
2017	110	130
2018	100	130
2019	106	130

During 2019 15 new types of cup and 20 new types of stem were implanted.

Number of **different types** of cups and stems implanted in revision surgery, according to year of operation.

Year of operation	Total revision	
	Cups	Stems
2000	58	48
2001	64	55
2002	59	48
2003	62	60
2004	46	40

2005	45	44
2006	55	55
2007	60	50
2008	50	49
2009	54	42
2010	49	46
2011	49	49
2012	41	41
2013	37	41
2014	39	36
2015	35	35
2016	43	46
2017	43	42
2018	45	40
2019	42	44

The marked dispersion of prosthesis types and the wide variability of the combinations between acetabulum and stems enable the comparison of only some types of prosthesis.

When only the brand has changed as a result of acquisitions of companies, such as Sulzer – Centerpulse - Zimmer or Johnson & Johnson – DePuy, Zimmer – Biomet models were not considered different.

4.6 Dual mobility cups

In the following table percentage of primary THA according to types of cups and year of operation

Year of operation	Primary THA	
	Standard cup	Dual mobility cup
2000	99,6	0,4
2001	98,9	1,1
2002	98,8	1,2
2003	98,8	1,2
2004	98,7	1,3
2005	97,5	2,5
2006	97,4	2,6
2007	96,6	3,4
2008	96,6	3,4
2009	96,3	3,7
2010	96,8	3,2
2011	97,1	2,9
2012	97,7	2,3
2013	97,1	2,9
2014	95,8	4,2
2015	95,4	4,6
2016	95,1	4,9
2017	93,4	6,6
2018	92,7	7,3
2019	95,2	4,8

Table below shows most used types of dual mobility cups.

Types of cups – dual mobility	2000-2013		2014-2016		2017-2019	
	N.	%	N.	%	N.	%
GYROS Depuy	6	0,3	143	14,0	266	16,5
DUALIS Bioimpianti	-	-	27	2,6	216	13,4
QUATTRO VPS PF HAP PNP Groupe Lep.	-	-	23	2,2	190	11,8
FIXA DUPLEX Adler-Ortho	-	-	12	1,2	170	10,5
ACORN Permedica	-	-	8	0,8	117	7,2
POLARCUP TI-PLASMA Ortho-Id	115	5,8	66	6,4	97	6,0
TRIDENT PSL HA CLUSTER Howmedica	30	1,5	110	10,7	95	5,9
JUMP SYSTEM TRASER Permedica	-	-	9	0,9	44	2,7
FIXA Ti-POR Adler-Ortho	-	-	-	-	43	2,7
TRITANIUM HEMISPHERICAL Stryker How.	1	0,1	47	4,6	25	1,5
RELOAD AVANTAGE Biomet	346	17,5	94	9,2	23	1,4
DELTA TT Lima	10	0,5	9	0,9	23	1,4
ADES Dedienne Sante	-	-	26	2,5	21	1,3
AVANTAGE CEMENTED Biomet	89	4,5	5	0,5	19	1,2
VERSAFITCUP DM Medacta	82	4,2	51	5,0	11	0,7
NOVAE E TH Serf	28	1,4	50	4,9	9	0,6
QUATTRO VPS PF HAP Groupe Lepine	1	0,1	80	7,8	8	0,5
POLARCUP CEMENTED Smith and Nep.	11	0,6	23	2,2	5	0,3
DMX Transysteme	39	2,0	83	8,1	2	0,1
DMX CEMENTED Transysteme	13	0,7	19	1,9	1	0,1
AVANTAGE 3P Biomet	127	6,4	17	1,7	1	0,1
STAFIT Zimmer	6	0,3	24	2,3	-	-
POLARCUP Ortho-Id	73	3,7	1	0,1	-	-
POLARCUP TI-PLASMA Endoplus	47	2,4	1	0,1	-	-
EASY HIT Medica	313	15,9	-	-	-	-
AVANTAGE Biomet	300	15,2	-	-	-	-
MOBILIS I Othesio	114	5,8	-	-	-	-
C2M PF Symbios	81	4,1	-	-	-	-
Other (<30 cases)	141	7,1	97	9,5	230	14,2
Total	**1.973**	**100,0**	**1.025**	**100,0**	**1.616**	**100,0**

4.7 Modular neck

Il 29,3% 30,5% of stems implanted in primary surgery have modular neck.

In the following table percentage of standard and modular neck in primary surgery.

Year of surgery	Primary surgery	
	Standard neck	Modular neck
2000	78,2	21,8
2001	74,8	25,2
2002	70,9	29,1
2003	72,5	27,5
2004	69,4	30,6
2005	67,1	32,9
2006	63,9	36,1
2007	65,4	34,6

2008	64,4	35,6
2009	64,2	35,8
2010	60,5	39,5
2011	58,2	41,8
2012	61,1	38,9
2013	65,7	34,3
2014	71,3	28,7
2015	74,1	25,9
2016	76,0	24,0
2017	77,9	22,1
2018	81,4	18,6
2019	85,5	14,5

In the following table types of stems with proximal modularity more present in database.

Types of stems with proximal modularity	2000-2013		2014-2016		2017-2019	
	N.	%	N.	%	N.	%
HYDRA Adler-Ortho	2.021	7,4	1.592	27,2	1.776	37,4
APTA Adler-Ortho	7.694	28,1	2.017	34,4	1.295	27,3
RECTA Adler-Ortho	4.714	17,2	753	12,8	518	10,9
ALATA ACUTA S Adler-Ortho	848	3,1	305	5,2	331	7,0
MODULUS HIP SYSTEM Lima	780	2,8	224	3,8	248	5,2
APTA Cem Adler-Ortho	1.128	4,1	61	1,0	59	1,2
SAM-FIT Lima	312	1,1	163	2,8	54	1,1
H-MAX M Lima	153	0,6	69	1,2	53	1,1
MINIFIT Samo	10	0,0	35	0,6	52	1,1
REVISION HIP Lima	31	0,1	30	0,5	50	1,1
PULCHRA Adler-Ortho	10	0,0	145	2,5	47	1,0
ALATA AEQUA REVISION Adler-Ortho	33	0,1	24	0,4	42	0,9
MULTIFIT Samo	337	1,2	77	1,3	33	0,7
HYDRA Cem Adler-Ortho	42	0,2	41	0,7	26	0,5
PARVA Adler-Ortho	346	1,3	90	1,5	24	0,5
CLS BREVIUS Zimmer	187	0,7	83	1,4	17	0,4
S. ROM Johnson e Johnson	176	0,6	8	0,1	5	0,1
HARMONY Symbios	166	0,6	27	0,5	-	-
VITAE Adler-Ortho	117	0,4	14	0,2	-	-
SMF Smith and Nephew	109	0,4	6	0,1	-	-
SPS MODULAR Symbios	330	1,2	2	0,0	-	-
PROFEMUR L Wright Cremascoli	99	0,4	1	0,0		-
ANCA Fit Wright Cremascoli	4.507	16,5	-	-	-	-
JVC Wright Cremascoli	728	2,7	-	-	-	-
PROFEMUR Z Wright Cremascoli	712	2,6	-	-	-	-
ANCA-Fit CLU Wright Cremascoli	314	1,1	-	-	-	-
EHS Wright Cremascoli	311	1,1	-	-	-	-
STEM Wright Cremascoli	211	0,8	-	-	-	-
G3 Citieffe	179	0,7	-	-	-	-
MBA HAP Groupe Lepine	128	0,5	-	-	-	-
MERCURIUS Adler-Ortho	112	0,4	-	-	-	-
MBA Groupe Lepine	88	0,3	-	-	-	-
PROFEMUR C Wright Cremascoli	87	0,3	-	-	-	-
STELO MODULARE NDS1 Citieffe	77	0,3	-	-	-	-

ABGII MODULAR Stryker Howmedica	66	0,2	-	-	-	-
Other (<50 cases)	228	0,8	94	1,6	122	2,6
Total*	**27.391**	**100,0**	**5.861**	**100,0**	**4.752**	**100,0**

*40 missing data (0,1%)

ANCA-Fit stem was implanted with short necks in 65% of cases and with long necks in 35%. The straight neck is used in 38,4% of surgeries, the anti-retroverted with 8° or 15° in 34,1% and the varus-valgus in 24,7%.
APTA stem, the most used in the region, was implanted with neutral necks in 62,0% of cases and with various degree of correction necks in the remaining 38,0%.

4.8 Resurfacing arthroplasty

In the following table percentage of standard primary arthroplasty and resurfacing are presented.

Year of operation	primary arthroplasty	
	Standard	***Resurfacing***
2000	99,9	0,1
2001	99,8	0,2
2002	99,3	0,7
2003	98,5	1,5
2004	97,9	2,1
2005	96,7	3,3
2006	96,2	3,8
2007	96,7	3,3
2008	97,3	2,7
2009	97,4	2,6
2010	98,1	1,9
2011	97,2	2,8
2012	95,1	4,9
2013	95,6	4,4
2014	96,5	3,5
2015	97,5	2,5
2016	98,4	1,6
2017	99,6	0,4
2018	99,8	0,2
2019	99,9	0,1

Resurfacing arthroplasty used between **01/01/2000** and **31/12/2019**

Type	N.	%
BHR – Smith & Nephew	1.812	64,2
ADEPT – Finsbury	437	15,5
BMHR* – Smith & Nephew	198	7,0
MITCH TRH – Finsbury	89	3,2
ASR – DePuy	77	2,7
RECAP – Biomet	65	2,3
MRS* – Lima	45	1,6
ROMAX – Medacta	33	1,2
CONSERVE PLUS – Wright	31	1,1
ICON – International Orthopaedics	21	0,7

DUROM Hip Resurfacing – Zimmer	8	0,3
WAGNER METASUL - Protek	3	0,1
CORMET – Corin	1	0,0
ACCIS - Implantcast	1	0,0
TRIBOFIT – Active Implants	1	0,0
Total**	**2.822**	**100,0**

** 2 missing data (0,1%).
* considered similar to resurfacing.

In 2019 were implanted 12 BHR - Smith and Nephew and 1 CONSERVE PLUS – Wright.

4.9 Articular couplings and head diameters

Number of primary total hip arthroplasty operations carried out on patients with admission date between 1st January 2000 and 31st December 2019, according to the **type of operation** and **articular coupling**. **Dual mobility cups are excluded.**

Polyethylene has been called cross-linked (XLPE) from Manufacturer Company directions.

Articular coupling (head-liner)	Primary		Total revision	
	N.	%	N.	%
Composite Ceramic - Composite Ceramic	43.776	35,1	769	16,8
Composite Ceramic - XLPE	15.118	12,1	587	12,8
Metal - UHMWPE	12.759	10,2	770	16,8
Alumina - Alumina	11.035	8,8	327	7,1
Alumina - UHMWPE	9.784	7,8	670	14,6
Metal – XLPE	8.172	6,5	589	12,9
Composite Ceramic - XLPE+Vit.E	4.546	3,6	87	1,9
Metal - Metal	3.316	2,7	65	1,4
Metal - UHMWPE+Metal	3.037	2,4	55	1,2
Ceramicised Metal - XLPE	2.736	2,2	33	0,7
Alumina - XLPE	1.844	1,5	128	2,8
Alumina - Composite Ceramic	1.817	1,5	58	1,3
Composite Ceramic - UHMWPE	1.768	1,4	89	1,9
Metal - undefined Poly*	790	0,6	53	1,2
Alumina - UHMWPE+Alumina	791	0,6	13	0,3
Revision Composite Ceramic - Composite Ceramic	485	0,4	11	0,2
Composite Ceramic - Alumina	466	0,4	11	0,2
Alumina- undefined Poly*	403	0,3	29	0,6
Ceramicised Metal - UHMWPE	396	0,3	20	0,4
Alumina - Metal+Alumina	302	0,2	60	1,3
Composite Ceramic - Metal+XLPE+Vit.E	346	0,3	-	-
Composite Ceramic - Metal	221	0,2	-	-
Zirconia Ceramic - UHMWPE	175	0,1	13	0,3
Other (< 100 cases)	761	0,6	139	3,0
Total^	**124.844**	**100,0**	**4.576**	**100,0**

* missing label did not allow classification of poly.
^0,4% missing data in primary surgery and 4,4% in total revision.

Percentage of total hip arthroplasty interventions between 2001 and 2019, according to the **type of polyethylene** used. All types of poly (with or without **anti-luxation lip**, constrained) are considered.

Year of surgery	Primary surgery		
	Standard poly	Crosslinked poly	Undefined poly
2001	76,4	18,3	5,3
2002	82,1	15,7	2,3
2003	81,3	17,3	1,4
2004	77,9	21,5	0,6
2005	74,8	24,1	1,1
2006	75,2	24,6	0,2
2007	71,6	28,2	0,2
2008	64,5	35,3	0,1
2009	50,9	49,1	-
2010	39,8	60,2	-
2011	33,3	66,7	-
2012	22,7	77,3	-
2013	20,8	79,2	-
2014	16,5	83,5	-
2015	12,6	87,4	-
2016	10,9	89,1	-
2017	10,5	89,5	-
2018	8,8	91,2	-
2019	8,8	91,2	-

Sometimes, missing label did not allow classification of poly.

The following table shows percentage of Primary surgery with Alumina o Composite ceramic **liner**

Year of surgery	Primary surgery	
	Alumina liner	Composite ceramic liner
2000	100,0	-
2001	100,0	-
2002	100,0	-
2003	99,1	0,9
2004	96,9	3,1
2005	90,6	9,4
2006	85,3	14,7
2007	67,4	32,6
2008	22,2	77,8
2009	14,9	85,1
2010	7,0	93,0
2011	3,4	96,6
2012	0,8	99,2
2013	1,1	98,9
2014	1,1	98,9
2015	0,2	99,8
2016	0,2	99,8
2017	-	100,0
2018	-	100,0
2019	-	100,0

The following table shows percentage of Primary surgery with Alumina o Composite ceramic **head**

Year of surgery	Primary surgery	
	Alumina head	Composite ceramic head
2001	100,0	-
2002	100,0	-
2003	100,0	-
2004	99,8	0,2
2005	99,2	0,8
2006	96,4	3,6
2007	88,6	11,4
2008	46,0	54,0
2009	27,3	72,7
2010	10,3	89,7
2011	5,3	94,7
2012	4,3	95,7
2013	4,4	95,6
2014	2,5	97,5
2015	1,0	99,0
2016	1,1	98,9
2017	0,9	99,1
2018	1,0	99,0
2019	1,2	98,8

Number of hip arthroplasty operations on patients admitted between 1st January 2000 and 31st December 2019, according to **material** and **diameter of the head**

Head material	Diameter of the head (mm) in THA											
	22		26		28		32		36		>=38	
	N.	%	N.	%	N.	%	N.	%	N.	%	N.	%
Composite ceramic	-	-	-	-	5.122	11,1	24.928	73,2	31.875	80,3	5.447	63,8
Cr-Co	786	85,0	24	80,0	18.986	41,1	2.694	7,9	2.285	5,8	2.495	29,2
Alumina	1	0,1	-	-	17.604	38,1	5.344	15,7	3.512	8,8	-	-
Stainless steel	134	14,5	5	16,7	3.487	7,6	199	0,6	30	0,1	-	-
Ceramicised Metal	3	0,3	-	-	656	1,4	779	2,3	1.847	4,7	107	1,2
Revision ceramic	-	-	-	-	6	0,0	20	0,1	12	0,0	484	5,7
Zirconia	1	0,1	1	3,3	311	0,7	80	0,2	142	0,4	-	-
Total*	**925**	**100,0**	**30**	**100,0**	**46.172**	**100,0**	**34.044**	**100,0**	**39.703**	**100,0**	**8.533**	**100,0**

*449 missing data (0,3%)

Year of surgery	Diameter of the head (mm) in THA								
	<=28 cer	<=28 met	<=28 other	32 cer	32 met	32 other	>=36 cer	>=36 met	>=36 other
2000	45,5	49,8	1,1	1,1	1,4	0,0	0,0	1,1	0,0
2001	49,8	46,6	1,1	0,7	0,3	0,0	0,0	1,4	0,0
2002	51,7	45,7	0,8	0,9	0,1	0,0	0,0	0,8	0,0
2003	50,5	46,4	0,7	0,9	0,1	0,0	0,3	1,2	0,0
2004	50,7	41,3	0,8	3,2	0,6	0,0	1,3	2,2	0,0
2005	33,9	38,0	0,5	16,5	1,6	0,0	5,5	4,0	0,0
2006	23,1	33,5	0,5	18,9	2,0	0,1	14,8	7,2	0,0
2007	15,7	28,2	0,9	20,5	3,8	0,1	21,6	9,1	0,0
2008	14,3	21,7	0,4	20,4	3,8	0,1	29,6	9,8	0,0
2009	11,5	17,6	0,1	21,7	3,1	0,0	36,7	9,1	0,1
2010	8,6	10,0	0,1	23,8	4,6	0,2	44,2	7,7	0,9
2011	6,3	8,0	0,2	27,0	4,7	0,5	45,6	4,9	2,8
2012	6,8	5,4	0,1	28,2	3,7	0,3	50,0	3,0	2,7
2013	6,0	5,0	0,2	29,6	2,8	0,6	50,3	2,7	2,8
2014	6,1	5,3	0,3	32,5	2,6	0,8	47,7	2,6	2,2
2015	5,6	4,7	0,5	33,1	2,4	0,7	49,0	2,2	2,0
2016	6,5	4,2	0,6	33,9	2,0	1,3	46,5	1,9	3,1
2017	7,0	4,8	0,6	36,2	1,5	1,9	43,0	1,6	3,3
2018	7,6	3,9	0,7	37,1	1,3	1,8	43,1	1,2	3,3
2019	9,0	3,7	0,5	35,6	0,7	1,6	45,0	1,1	2,7

Cer: alumina, zirconia and composite (alumina+zirconia)
Met: cobalt-based alloy and stainless steel
Other: Surface-treated metal and ceramicised metal.

4.10 Prosthesis fixation

Number of hip arthroplasty operations on patients admitted between 1st January 2000 and 31st December 2019, according to **type of operation** and **fixation**

Fixation	Primary THA	%	Total revision	%
Cementless	114.827	92,8	3.532	78,6
Hybrid (cemented stem and cementless cup)	9.269	4,8	371	7,2
Cemented	4.664	1,9	232	4,0
Reverse hybrid (cementless stem and cemented cup)	736	0,5	581	10,2
Total*	**129.496**	**100,0%**	**4.716**	**100,0**

* 414 primary THA and 244 total revision missing data.

Percentage of total hip arthroplasties **according to fixation** during the years 2000–2019

Year of surgery	Primary THA			
	Cemented	Cementless	Hybrid	Reverse hybrid
2000	15,2	61,8	22,1	1,0
2001	14,3	66,5	18,5	0,8
2002	12,1	71,3	15,8	0,8
2003	11,0	73,3	15,0	0,7
2004	8,6	78,3	12,4	0,7
2005	7,0	80,5	11,6	0,8
2006	6,1	83,1	10,2	0,6
2007	4,3	87,1	8,0	0,6
2008	2,5	90,4	6,5	0,6
2009	2,0	91,4	5,8	0,8
2010	1,2	94,1	4,1	0,6
2011	0,8	95,1	3,5	0,6
2012	0,6	95,3	3,3	0,7
2013	1,0	95,5	3,0	0,5
2014	0,8	95,5	3,3	0,5
2015	0,5	95,5	3,6	0,4
2016	0,5	96,5	2,7	0,3
2017	0,3	96,4	2,9	0,4
2018	0,3	96,6	2,5	0,3
2019	0,2	95,8	3,6	0,4

Percentage of total hip arthroplasties for coxarthrosis according to **fixation**, by **age of patient**.

Age class	Primary THA for coxarthrosis 2000-2019			
	Cemented	Cementless	Hybrid	Reverse hybrid
<40	0,0	99,5	0,2	0,3
40-49	0,2	99,4	0,4	0,1
50-59	0,2	98,4	1,3	0,1
60-69	0,7	94,3	4,8	0,2
70-79	3,8	85,6	10,3	0,4
≥80	10,8	74,6	13,6	1,1

Percentage of total hip arthroplasties for coxarthrosis according to **fixation and class of age** – year 2000.

Age class	Primary THA for coxarthrosis year 2000			
	Cemented	Cementless	Hybrid	Reverse hybrid
<40	0,0	100,0	0,0	0,0
40-49	0,0	96,2	3,8	0,0
50-59	1,5	86,7	11,5	0,3
60-69	6,0	67,5	26,2	0,3
70-79	20,6	44,3	34,1	1,0
≥80	53,7	26,3	18,0	2,0

Percentage of total hip arthroplasties for coxarthrosis **according to fixation and class of age** - year 2019

Age class	Primary THA for coxarthrosis year 2019			
	Cemented	Cementless	Hybrid	Reverse hybrid
<40	0,0	100,0	0,0	0,0
40-49	0,0	99,7	0,0	0,3
50-59	0,0	99,5	0,5	0,0
60-69	0,0	98,1	1,7	0,1
70-79	0,0	96,1	3,7	0,1
≥80	0,2	88,9	9,8	1,1

Percentage of total revision surgery according to **fixation** and **year**

Year	Total revision			
	Cemented	Cementless	Hybrid	Reverse hybrid
2000	9,4	62,5	9,4	18,8
2001	7,9	64,0	8,5	19,6
2002	6,0	66,0	7,3	20,7
2003	7,2	69,1	6,8	16,9
2004	7,1	68,8	7,9	16,2
2005	7,5	68,3	8,4	15,9
2006	6,2	73,0	9,9	10,9
2007	4,0	74,1	9,5	12,4
2008	3,1	78,2	8,4	10,2
2009	1,8	82,1	7,2	9,0
2010	1,7	84,0	5,9	8,4
2011	5,0	80,1	7,2	7,7
2012	1,3	88,2	3,5	7,0
2013	2,3	82,6	7,8	7,3
2014	0,6	88,5	4,2	6,7
2015	3,5	85,9	5,9	4,7
2016	4,1	83,1	5,2	7,6
2017	3,8	82,3	3,8	10,1
2018	4,3	80,8	5,8	6,3
2019	2,2	77,8	9,4	10,6

Percentage of total revision surgery according to **fixation** and **class of age.**

Age class	Total revision			
	Cemented	Cementless	Hybrid	Reverse hybrid
<40	1,2	94,2	1,2	3,5
40-49	2,6	89,4	3,7	4,2
50-59	1,9	87,7	3,2	7,2
60-69	2,7	79,7	6,1	11,5
70-79	4,6	72,6	8,6	14,2
≥80	11,8	59,6	13,5	15,2

4.11 Bone cement

Type of cement used in primary surgery, in hemiarthroplasty, with at least one cemented component, and in resurfacing (information recorded in RIPO from 30st September 2001). In **bold** cements with antibiotics

Cement	% in THA	% in Hemi	% in Resurf
Surgical Simplex P - Howmedica	34,8	35,4	34,3
Cemex System - Tecres	10,6	21,3	1,1
Smartset Hv - Depuy	6,5	8,1	2,4
Antibiotic Simplex - Howmedica	**6,1**	**2,7**	**54,5**
Palacos R - Biomet	5,0	1,0	0,9
Amplicem 3 - Amplimedical	3,1	2,5	0,0
Smartset Mv - Depuy	2,2	5,6	0,0
Cmw 3 - Depuy	2,2	0,7	0,0
Cemex Rx - Tecres	1,9	4,0	0,1
Cemex + Cemex System - Tecres	1,7	0,0	0,0
Palacos R - Heraeus Medical	1,6	3,1	0,1
Cemex - Tecres	1,6	1,2	0,1
Exolent High - Elmdown	1,4	0,5	0,0
Cemfix 1 - Teknimed	1,3	2,2	0,0
Cemex Rx + Cemex System - Tecres	1,3	0,0	0,0
Amplicem 1 + Amplicem 3 - Amplimedical	1,2	0,0	0,0
Cemex Sys. -Tecres+Surgical Simplex P-How	1,2	0,0	0,0
Amplicem1-Amplim.+Smartset Hv-Depuy	1,1	0,0	0,0
Versabond - Smith and Nephew	1,1	0,0	2,1
Vacu Mix Plus Cmw 3 - Depuy	1,0	2,7	0,0
Sulcem 3 - Centerpulse	0,9	0,8	0,0
Cemex Genta + Cemex Genta Sys.- Tecres	**0,9**	**0,0**	**0,0**
Cemfix 3 - Teknimed	0,7	0,2	0,0
Aminofix 1 - Groupe Lepine	**0,7**	**0,0**	**0,0**
Palacos R+G - Heraeus Medical	**0,7**	**0,8**	**0,0**
Bone Cement R - Biomet	0,6	0,1	0,8
Cemex Genta - Tecres	**0,6**	**0,3**	**0,0**
Palacos R 40 - Sp Europe	0,5	0,1	0,0
Refobacin Bone Cement R - Biomet	**0,5**	**0,0**	**0,0**
Hi-Fatigue - Zimmer	0,5	0,0	0,5
Cemex Genta System - Tecres	**0,4**	**1,7**	**1,0**
Smartset GMV - Depuy	**0,4**	**0,0**	**0,0**
A. Simplex + S. Simplex P - Howmedica	**0,3**	**0,0**	**0,1**
Cemsys 1 - Mathys	0,3	0,0	0,0
Amplicem 1 - Amplimedical	0,3	0,0	0,0
Hi-Fatigue G - Zimmer	**0,2**	**0,0**	**0,1**
Amplicem 3G - Amplimedical	**0,2**	**0,0**	**0,0**
Cemex XL - Tecres	0,2	0,5	0,0
Palamed G - Heraeus Medical	**0,2**	**0,1**	**0,0**
Osteobond - Zimmer	0,2	0,0	0,8
Smartset GHV - Depuy	**0,2**	**0,0**	**0,0**
Refobacin Revision - Biomet	**0,2**	**0,0**	**0,0**
Other without antibiotic	1,8	2,9	0,6
Other with antibiotic	**1,4**	**1,3**	**0,2**
Total	**100,0**	**100,0**	**100,0**

Antibiotic-loaded cement was chosen in 13,1% of THA, in 7,1% of hemi and in 56,1% of resurfacing.
Surgical Simplex P – Howmedica in 2018-2019 was chosen in 24,4% of THA and in 27,0% of hemi with at least one cemented component

5. Types of hemiarthroplasty

5.1 Hemiarthroplasty cup and stem

Monoblock	2000-2013		2014-2016		2017-2019	
	N.	%	N.	%	N.	%
THOMPSON - Corin	76	67,9	-	-	-	-
AUSTIN MOORE - Amplimedical	16	14,3	-	-	-	-
THOMPSON - Amplimedical	14	12,5	-	-	-	-
THOMPSON - Stryker Howmedica	4	3,6	-	-	-	-
THOMPSON - Bioimpianti	1	0,9	-	-	-	-
THOMPSON - Surgival	1	0,9	-	-	-	-
Total	**112**	**100,0**	**-**	**-**	**-**	**-**

Monoarticular	2000-2013		2014-2016		2017-2019	
	N.	%	N.	%	N.	%
TESTA ELLITTICA - Samo	422	99,3	-	-	-	-
Other	3	0,7	-	-	-	-
Total	**425**	**100,0**	**-**	**-**	**-**	**-**

Biarticular	2000-2013		2014-2016		2017-2019	
	N.	%	N.	%	N.	%
JANUS Bioimpianti	2.146	6,9	2.621	36,1	2.702	39,0
TESTA BIPOLARE Samo	176	0,6	208	2,9	1.428	20,6
TESTA BIARTICOLARE LOCK Lima	2.056	6,6	519	7,2	1.101	15,9
CUPOLA MOBILE BIARTICOLARE - Permedica	724	2,3	-	-	441	6,4
CUPOLA MOBILE MODULARE-Wright Cremascoli	1.296	4,1	394	5,4	431	6,2
UHR Osteonics Stryker Howmedica	3.128	10,0	350	4,8	276	4,0
CUPOLA MOBILE Medacta	192	0,6	2	0,0	86	1,2
BI-POLAR DePuy	1.775	5,7	253	3,5	80	1,2
TESTA BIPOLARE Smith and Nephew	108	0,3	93	1,3	79	1,1
C1 - Citieffe	5.570	17,8	1.834	25,3	64	0,9
SPHERI-LOCK LSM-MED	2	0,0	147	2,0	63	0,9
BI-POLAR Biomet	470	1,5	66	0,9	55	0,8
CUPOLA NEMAUSUS Transysteme	864	2,8	61	0,8	21	0,3
TANDEM INTL BIPOLAR Smith and Nephew	59	0,2	27	0,4	17	0,2
SPHERI-LOCK Lima	5.533	17,7	611	8,4	13	0,2
CUPOLA BIPOLARE Zimmer	454	1,4	11	0,2	12	0,2
CUPOLA MOBILE BIBOP Symbios	56	0,2	46	0,6	8	0,1
TESTA BIARTICOLARE - Lima	630	2,0	-	-	1	0,0
CUPOLA BIPOLARE Mathys	713	2,3	4	0,1	-	-
ULTIMA MONK DePuy	1.004	3,2	-	-	-	-
CUPOLA MOBILE Zimmer	882	2,8	-	-	-	-
CUPOLA SEM - D.M.O.	731	2,3	-	-	-	-
MODULAR BIPOLAR - Protek	612	2,0	-	-	-	-

CENTRAX - Stryker Howmedica	543	1,7	-	-	-	-
SPHERIC Amplitude	352	1,1	-	-	-	-
RETENTIVE MOBILE CUP - Cedior	292	0,9	-	-	-	-
BICENTRIC - Stryker Howmedica	236	0,8	-	-	-	-
TESTA BIPOLARE - Amplimedical	193	0,6	-	-	-	-
CORON Tantum	190	0,6	-	-	-	-
Other (< 100 cases)	334	1,1	4	0,1	45	0,7
Total*	**31.321**	**100,0**	**7.251**	**100,0**	**6.923**	**100,0**

*308 missing data (0,7%)

In 274 cases model or stem fixation was not communicated to RIPO.

Cemented stem	2000-2013		2014-2016		2017-2019	
	N.	%	N.	%	N.	%
DUOFIT CKA Samo	220	0,8	190	3,7	1.264	29,2
KORUS Bioimpianti	-	-	1.172	23,0	1.195	27,6
SL Lima	1.300	5,0	483	9,5	448	10,3
PROFEMUR GLADIATOR Wright	98	0,4	373	7,3	404	9,3
SL Permedica	680	2,6	-	-	356	8,2
EXETER V40 Stryker Howmedica	927	3,5	302	5,9	268	6,2
H-MAX C Lima	-	-	11	0,2	153	3,5
VERSYS ADVOCATE Zimmer	96	0,4	60	1,2	50	1,2
AB Citieffe	5.026	19,2	1.698	33,3	38	0,9
CORAIL DePuy	402	1,5	175	3,4	38	0,9
SL STREAKES LSM-MED	1	0,0	96	1,9	12	0,3
LOGICA MIRROR Lima	530	2,0	13	0,3	10	0,2
SL STREAKES Hit Medica	1.729	6,6	213	4,2	-	-
SPHERI-SYSTEM II Lima	2.367	9,1	115	2,3	-	-
S-TAPER Bioimpianti	387	1,5	47	0,9	-	-
C-STEM AMT DePuy	143	0,5	28	0,5	-	-
MERCURIUS Adler-Ortho	95	0,4	4	0,1	-	-
CCA Mathys	644	2,5	3	0,1	-	-
APTA Adler-Ortho	1.034	4,0	2	0,0	-	-
QUADRA-C Medacta	176	0,7	1	0,0	-	-
VERSYS HERITAGE Zimmer	139	0,5	1	0,0	-	-
G2 DePuy	1.507	5,8	-	-	-	-
ORTHO-FIT Zimmer	830	3,2	-	-	-	-
STANDARD STRAIGHT Zimmer	778	3,0	-	-	-	-
SL - Hit Medica	737	2,8	-	-	-	-
SEM II DMO	638	2,4	-	-	-	-
RELIANCE HOWMEDICA	623	2,4	-	-	-	-
VERSYS LD/FX- Zimmer	546	2,1	-	-	-	-
FIN Bioimpianti	526	2,0	-	-	-	-
JVC Wright Cremascoli	481	1,8	-	-	-	-
LC - Samo	423	1,6	-	-	-	-
ULTIMA LX Johnson And Johnson	317	1,2	-	-	-	-
AHS Wright Cremascoli	312	1,2	-	-	-	-
MRL Wright Cremascoli	270	1,0	-	-	-	-
LOGICA Lima	249	1,0	-	-	-	-
DEFINITION Stryker Howmedica	240	0,9	-	-	-	-
SL Amplimedical	158	0,6	-	-	-	-
ULTIMA STRAIGHT DePuy	156	0,6	-	-	-	-

ALBI PTC Wright Cremascoli	149	0,6	-	-	-	-
Other (< 100 cases)	1.180	4,5	113	2,2	96	2,2
Total	**26.114**	**100,0**	**5.100**	**100,0**	**4.332**	**100,0**

Cementless stem	2000-2013		2014-2016		2017-2019	
	N.	%	N.	%	N.	%
KORUS Bioimpianti	156	2,7	1.074	49,7	1.377	52,9
SL Lima	314	5,5	97	4,5	353	13,6
LOGICA CS Lima	260	4,5	204	9,4	183	7,0
POLARSTEM Endoplus	62	1,1	81	3,7	85	3,3
Z1 Citieffe	80	1,4	73	3,4	67	2,6
TAPERLOC Biomet	93	1,6	55	2,5	55	2,1
CORAIL De Puy	47	0,8	15	0,7	41	1,6
HYDRA Adler-Ortho	61	1,1	32	1,5	39	1,5
APTA Adler-Ortho	126	2,2	22	1,0	38	1,5
S-TAPER Bioimpianti	941	16,4	285	13,2	11	0,4
RECTA Adler-Ortho	135	2,3	3	0,1	3	0,1
ACCOLADE Osteonics Stryker Howmedica	1.772	30,8	34	1,6	-	-
HIP FRACTURE - Howmedica	283	4,9	-	-	-	-
PPF Biomet	266	4,6	-	-	-	-
ENDON Tantum	188	3,3	-	-	-	-
Other (< 100 cases)	971	16,9	186	8,6	352	13,5
Total	**5.755**	**100,0**	**2.161**	**100,0**	**2.604**	**100,0**

5.2 Other characteristics of hemiarthroplasties

Number of surgeries according to **hemihead type**

Hemihead type	N.	%
Bipolar head – to be assembled in the operating theatre	44.701	96,5
Bipolar head – preassembled	1.102	2,4
Monoarticular	425	0,9
Monoblock prosthesis	112	0,2
Total	**46.340**	**100,0**

Stem was cemented in 60,0% of total and stem had a modular neck in 8,7% of total.
In year 2019 3,0% of hemi has ceramic heads, the others have metal head.

6. Complications occurred during hospitalization

RIPO registers all kind of complications occurred during hospitalization. In the following tables only intra-operative and post-operative local complications are presented.

The rate of complications in **primary surgery** carried out on patients hospitalized between between 1st January 2000 and 31st December 2019.

Complications observed during hospitalization					
Intra-operative			**Post-operative local**		
	N.	**%**		**N.**	**%**
Calcar fracture	570	0,4	Deep vein thromb	117	*0,1*
Diaphysis fracture	407	0,3			
Greater troch. fracture	283	0,2			
Acetabulum fracture	183	0,1	Early infection	99	*0,1*
Anaesthesiolog. complications	160	0,1			
Hemorragia	61	0,05			
Instability	26	0,02			
Other	139	0,1			
Total	**1.829**	**1,4**	**Total**	**216**	***0,2***

The rate of complications in **revision surgery** carried out on patients hospitalized between 1st January 2000 and 31st December 2019.

Complications observed during hospitalization					
Intra-operatorie			**Post-operatorie locali**		
	N.	**%**		**N.**	**%**
Diaphysis fracture	260	*1,4*	Early infection	64	*0,3*
Calcar fracture	90	*0,5*			
Greater troch. fracture	66	*0,4*			
Anaesthesiolog. complications	60	*0,3*	Deep vein thromb	28	*0,2*
Acetabulum fracture	28	*0,2*			
Hemorragia	33	*0,2*			
Other	40	*0,2*			
Total	**577**	***3,1***	**Total**	**92**	***0,5***

The rate of complications in **hemiarthroplasty** carried out on patients hospitalized between 1st January 2000 and 31st December 2019.

Complications observed during hospitalization					
Intra-operatorie			**Post-operatorie locali**		
	N.	**%**		**N.**	**%**
Calcar fracture	239	*0,5*	Deep vein thromb	80	*0,2*
Anaesthesiolog. complications	162	*0,3*			
Greater troch. fracture	149	*0,3*			
Diaphysis fracture	80	*0,2*	Early infection	70	*0,2*
Hemorragia	24	*0,1*			
Acetabulum fracture	6	*0,01*			
Other	65	*0,1*			
Total	**725**	***1,6***	**Total**	**150**	***0,3***

Complications recorded are those that occurred during hospitalization.

6.1 Deaths during hospitalization

Number of deaths in prosthetic surgery on patients hospitalized between 1st January 2000 and 31st December 2019.
Only deaths occurred during hospitalization are recorded.

Years 2000-2019			
Type of surgery	**Deaths**	**n. of operations**	**Percentage**
Primary THA	289	129.910	0,2
Hemiarthroplasty	2.055	46.340	4,4
Partial and total Revision	132	18.575	0,7
Resurfacing prostheses	1	2.824	-
Prosthesis removal	45	1.676	2,7

Number of deaths occurred **within 90 days** from the date of intervention. This data is known thanks merging RIPO data with other database. Only patients living in Emilia Romagna are considered. Following table describes by year and gender deaths of the previous table.

% of Deaths occurred within 90 days after Hemiarthroplasty, by gender		
Year of surgery	**Females**	**Males**
2000	10,7	24,3
2001	10,2	22,3
2002	9,6	19,3
2003	10,4	23,3
2004	9,7	20,7
2005	10,1	22,1
2006	9,3	20,1
2007	9,6	20,8
2008	10,4	22,0
2009	10,8	18,9
2010	11,0	21,6
2011	12,8	21,5
2012	9,0	21,1
2013	9,0	21,8
2014	9,5	19,2
2015	11,7	18,5
2016	10,7	21,6
2017	10,1	22,9
2018	9,9	19,8
2019	10,5	21,6

7. Duration of pre-operative hospitalization

Days of pre-operative hospitalization (mean, minimum, maximum) according to type and year of operation

Year 2000			
Type of operation	**N.**	**Mean pre-op.**	**Range**
Primary THA	4.420	2,4	0-61
Hemiarthroplasty	1.787	3,6	0-44
Revision	758	3,9	0-52
Prosthesis removal	50	5,1	1-20
Year 2019			
Type of operation	**N.**	**Mean pre-op.**	**Range**
Primary THA	9.204	1,1	0-36
Hemiarthroplasty	2.266	2,3	0-47
Revision	953	2,8	0-37
Prosthesis removal	114	5,5	0-62

8. Analysis of survival of primary surgery

8.1 Cox multivariate analysis

The Cox multivariate model analyzes if some variables (independent of each other) can influence the event, in our case the removal of at least one prosthetic component. Analysis was performed on three independent variables: sex, age at surgery and pathology.
Other variables that might influence the outcome of surgery, such as the method of fixing the prosthesis, or joint coupling, were not introduced into the analysis because they were not independent (for example, prosthesis fixation depends on the patient's age).
All primary hip arthroplasties performed in the Region between 2000 and 2019 were analysed.
The analysis was limited to patients resident in Emilia-Romagna region. In such a way the bias due to lost to follow up of non-resident patients is avoided.

COX PROPORTIONAL RISK MODEL

Variables

Dependent: Follow-up
Independent: age, gender, diagnosis

Number of valid observations 93.521
Non revised: 83.134
Revised: 4.632

Chi-square: 192,2088 *p*= 0,0001

VARIABLE	SIGNIFICANCE (p)
Gender	**S** (0,001)
Age	**S** (0,001)
Diagnosis	**S** (0,001)

The chi-square test, used to test globally the model applied, was significant. This suggested that, on the whole, the variables inserted in the model influenced the outcome of prosthetic surgery.
The effect of each variable was compared to the others when equal.
At this point we tested how it acts, either by reducing or increasing the risk.

To analyse the influence of the disease, the patients were divided into 7 groups by diagnosis:

- coxarthrosis
- rheumatic arthritis (rheumatoid arthritis, psoriasis, rhizomelic spondylitis)
- femoral fractures and sequelae (necrosis and post-traumatic arthrosis)
- idiopathic necrosis of the femoral head
- sequelae of congenital and infantile diseases (LCA, DCA, Perthes, epiphysiolysis)
- "other" that include sequelae of septic coxitis, coxitis from TBC, ankyloses, and metastasis

The rate of relative risk was expressed with respect to the risk rate presented by the patients affected by coxarthrosis. A relative risk rate below 1 indicated a reduced risk of prosthesis revision, a relative risk rate over 1 indicated an increased risk of prosthesis revision.

Survival analyses are performed only on patients living in the Emilia-Romagna region, in order to avoid the bias resulting from the 'loss' of non-resident patients

Patients of the group 'Other pathologies' had a 1,8-fold greater risk of failure compared to coxarthrosis. In this heterogeneous group, sequelae of congenital and infantile septic coxitis, although the low numerosity, have the higher of failure.
Also patients treated for femoral neck fracture and sequelae have an increased risk of failure (1,4-fold) than patients treated for coxarthrosis.

Conversely, in patients treated by arthroplasty due to necrosis or sequelae of congenital and childhood diseases, the risk of failure was not significantly higher than in patients treated for coxarthrosis.
Concerning gender and age, males have a higher risk of 1,2 compared to women, and with increasing age of the patient the risk of revision surgery decreases.

8.2 Rate of failure

Prosthesis failure is defined as the revision of even one prosthetic component.

As already mentioned in the introduction of this report, the recovery of data of operations not reported to RIPO is in progress. The uncertainty due to 10% of missing reports, over 19 yrs, may lead to an underestimation of the revision rate that is not quantifiable at the moment.

The following table shows in the first column the number of primary joint arthroplasty operations performed in the period from 1st January 2000 to 31st December 2019 **on resident in Emilia-Romagna region;** second, third and fourth columns show the number of revision interventions performed on the same patients.
Some revision operations were performed in the same hospital as the primary operation while others were performed at other hospitals (also outside Emilia Romagna Region).

Type of operation	Number of operations	N. of revisions performed in the same hospital	N. of revisions performed in a different hospital	N. of revisions performed in an Hospital outside Emilia-Romagna region	Mean Follow-up
Primary THA	93.521	2.780	1.607	245	7,4
Hemy*	44.776	774	206	24	3,6
Total revision	3.084	249	114	13	7,7

*hemiarthroplasties with acetabular buffer are not considered

The following table shows the number of resurfacing prostheses performed in Emilia-Romagna. Resurfacing prosthesis has been significantly used only since 2002.

Type of operation	Number of operations	N. of revisions performed in the same hospital	N. of revisions performed in a different hospital	N. of revisions performed in an Hospital outside Emilia-Romagna region	Mean Follow-up
Resurfacing	882	58	24	10	9,5

40,0% of Revisions after primary THA was performed in a different hospital, **22,9%** after Hemiarthroplasty and **33,8%** after total revision.
As for other registries, revision surgery has been classified in two classes: major if one of both bone-fixed components has been revised (cup or stem), and minor if liner, and/or head, and/or modular neck have been exchanged.

Survival analyses are performed only on patients living in the Emilia-Romagna region, in order to avoid the bias resulting from the 'loss' of non-resident patients

The following table shows the rate of revision according to type of surgery:

Type of operation	N° major revisions	N° minor revisions	N° of unclassified revisions^	Revision rate
Primary THA	3.454	933	245	4.632/93.521
Hemiarthroplasty*	705	275	24	1.004/44.776
Resurfacing	81	1	10	92/882
Total revision	296	67	13	376/3.084

* Minor revision included revision of head, while implant of acetabular component is considered major revision.
^ Revisions not classify because performed outside Region.

8.3 Survival curves according to Kaplan Meier

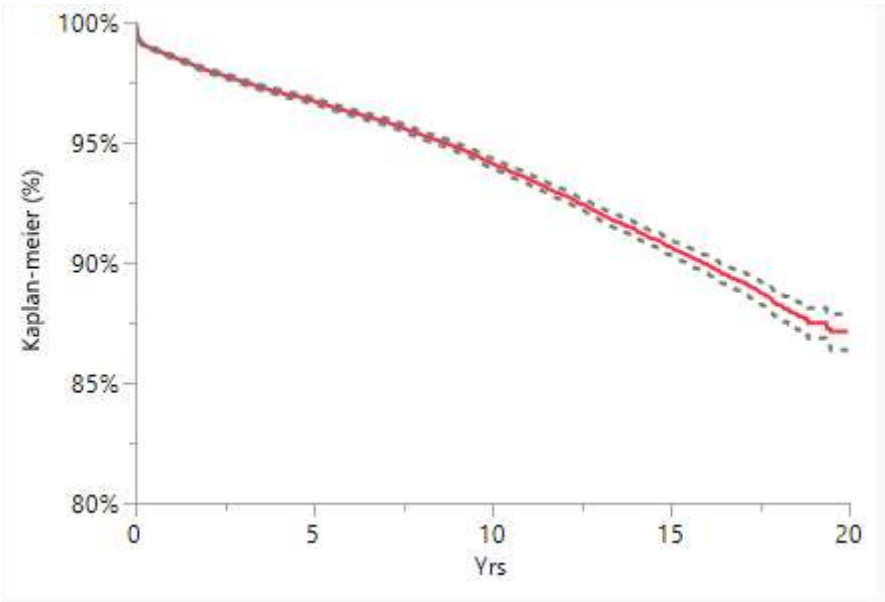
The survival curve calculated by the Kaplan Meier method enables an estimation of the probability that each individual has of maintaining its initial condition (prosthesis in place) over time.
The following paragraphs show the survival curves calculated separately for primary prosthesis, endoprosthesis, and total joint revision.
The influence of fixation and articular coupling was assessed only for primary prosthesis.

8.4 Analysis of survival in primary total hip arthroplasty

93.521 primary arthroprostheses are under observation. On these, 4.632 volte revisions were carried out.

Number of arthroprostheses	n. revisions	% survival at 19 yrs	Confidence Interval 95%	Mean Follow-up
93.521	4.632	87,5	86,9-88,1	7,4

Survival curve



Survival analyses are performed only on patients living in the Emilia-Romagna region, in order to avoid the bias resulting from the 'loss' of non-resident patients

	% Survival (95% CI)					
	1Yr	3Yrs	5Yrs	7Yrs	10Yrs	15Yrs
Primary total hip arthroplasty	98,6 (98,5-98,7)	97,5 (97,4-97,6)	96,7 (96,6-96,9)	95,9 (95,7-96,0)	94,1 (93,9-94,3)	90,7 (90,3-91,0)
implants exposed at risk	84.820	70.248	57.232	45.084	28.878	9.454

The following table shows the rate of revision in total joint arthroplasty according **to cause of revision**: the **% distribution** of the causes of failure is shown

Cause of revision	Rate	%	% Distribution failure causes
Aseptic loosening of the stem	**742**/93.521	0,8	16,0
Aseptic loosening of the cup	**673**/93.521	0,7	14,5
Periprosthetic bone fracture	**673**/93.521	0,7	14,5
Recurrent prosthesis dislocation	**614**/93.521	0,7	13,3
Breakage of prosthesis	**418**/93.521	0,4	9,0
Septic loosening	**281**/93.521	0,3	6,1
Global aseptic loosening	**264**/93.521	0,3	5,7
Poly wear	**112**/93.521	0,1	2,4
Pain without loosening	**95**/93.521	0,1	2,1
Primary instability	**90**/93.521	0,1	1,9
Metallosis	**54**/93.521	0,1	1,2
Heterotopic bone	**40**/93.521	0,0	0,9
Other	**120**/93.521	0,1	2,6
Unknown*	**456**/93.521	0,5	9,8
Total	**4.632/93.521**	**5,0**	**100,0**

*243 unknown because performed outside region

Percentage of causes of revision according to follow-up

Cause of revision	0-2 yrs	3-4 yrs	>=5 yrs
Prosthesis dislocation	25,7	7,3	4,8
Aseptic loosening of the stem	13,8	23,0	14,9
Periprosthetic bone fracture	14,4	10,2	16,6
Aseptic loosening of the cup	10,2	13,9	18,7
Septic loosening	8,1	7,3	3,7
Primary instability	5,0	0,2	0,0
Breakage of prosthesis	4,3	15,5	10,4
Unknown	4,1	3,1	5,7
Global aseptic loosening	2,5	6,2	8,4
Pain without loosening	2,4	2,7	1,4
Heterotopic bone	1,5	0,8	0,4
Poly wear	0,3	0,8	5,0
Metallosis	0,1	0,6	2,4
Unknown (performed outside Emilia Romagna Region)	3,0	6,7	6,6
Other	4,8	1,6	1,1

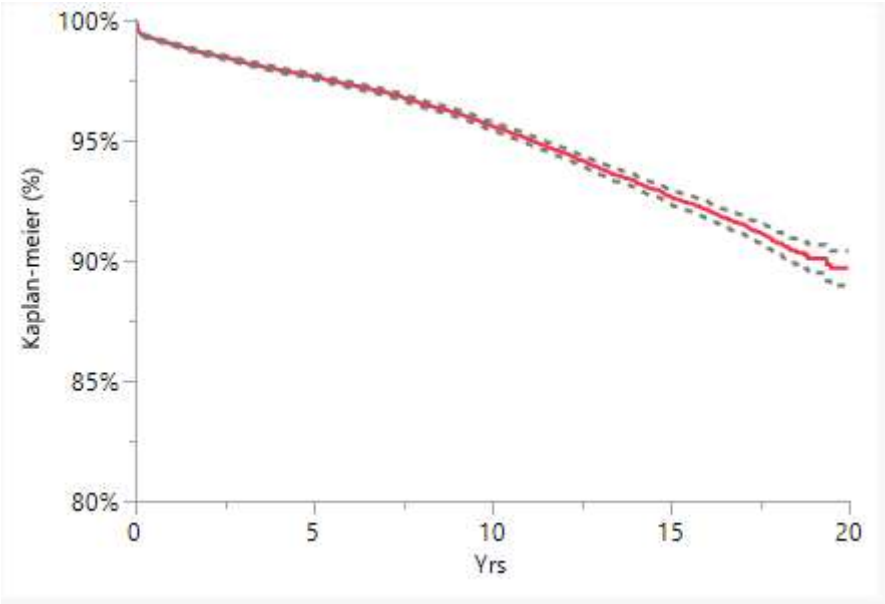
Survival analyses are performed only on patients living in the Emilia-Romagna region, in order to avoid the bias resulting from the 'loss' of non-resident patients

8.5 Analysis of survival in primary total hip arthroplasty – major revisions

93.521 primary arthroprostheses are under observation. Of these, 3.454 revisions were carried out to remove cup and/or stem.

Number of arthroprostheses	N. revisions	% survival at 19 yrs	Confidence Interval 95%	Mean Follow-up
93.521	3.454	90,1	89,5-90,7	7,4

Survival curve



8.6 Analysis of survival according to model of prosthesis

Survival analysis has been calculated either for association of cup and stems.
In the following table the prosthesis is considered 'failed' when even a single component has been revised.
Neither articular coupling nor case mix are considered. These two parameters may be differently distributed among groups.
Cemented cup and stem in bold
Survival analysis was not calculated if prostheses at risk are below 20 cases

Cup (stem) Manufacturer	From years	N.	n. revisions	% survival 5 yrs	N. at risk at 5 yrs	% survival 10 yrs	N. at risk at 10 yrs
Fixa TI-por (Apta) Adler-Ortho	2007	5.202	113	98,2 (97,8-98,6)	3.241	96,6 (95,8-97,3)	603
Fixa TI-por (Hydra) Adler-Ortho	2007	4.003	100	97,3 (96,6-97,8)	1.644	95,7 (94,5-96,7)	137
AnCA Fit (AnCA Fit) Wright	2000	2.875	274	95,9	2.595	93,2	2.262

Survival analyses are performed only on patients living in the Emilia-Romagna region, in order to avoid the bias resulting from the 'loss' of non-resident patients

Cremascoli				(95,1-96,6)		(92,2-94,1)	
FIXA (RECTA) Adler-Ortho	2004	2.727	176	96,4 (95,6-97,0)	2.448	93,5 (92,4-94,4)	1.459
EP-FIT PLUS (SL PLUS) Endoplus	2003	1.981	94	96,7 (95,7-97,4)	1.658	95,0 (93,8-95,9)	866
ABGII (ABGII) Stryker Howmedica	2000	1.964	118	97,7 (96,9-98,3)	1.743	95,1 (94,0-96,0)	1.220
Fixa TI-por (CORAE) Adler-Ortho	2010	1.914	33	98,1 (97,3-98,6)	557	-	-
R3 (SL PLUS MIA) Smith & Nephew	2010	1.906	34	98,1 (97,3-98,7)	825	-	-
Fixa TI-por (RECTA) Adler-Ortho	2007	1.770	63	96,7 (95,7-97,5)	1.065	95,4 (93,9-96,5)	156
FIXA (APTA) Adler-Ortho	2004	1.712	104	96,7 (95,8-97,5)	1.576	94,3 (93,0-95,3)	1.329
CLS (CLS) Sulzer Centerpulse Zimmer	2000	1.516	114	97,5 (96,6-98,2)	1.342	94,5 (93,1-95,6)	1.059
R3 (POLARSTEM) Smith & Nephew	2012	1.446	18	98,6 (97,9-99,2)	89	-	-
Fixa Ti-POR (HYDRA-FIX) Adler-Ortho	2016	1.300	24	-	-	-	-
FITMORE (CONUS) SulzerCenterpulse Zimmer	2000	1.250	63	97,2 (96,1-98,0)	1.019	95,9 (94,5-96,9)	669
EXPANSION (CBC) Mathys	2003	1.200	95	94,7 (93,2-95,8)	990	90,9 (88,9-92,6)	478
Exceed ABT (TAPERLOC) Biomet	2006	1.193	21	98,3 (97,3-98,9)	876	98,0 (96,8-98,7)	136
EP-FIT PLUS (PROXYPLUS) Smith & Nephew	2005	1.099	38	98,2 (97,2-98,9)	917	95,8 (94,1-97)	421
Versafitcup CC (Amistem) Medacta	2011	972	23	97,0 (95,3-98,1)	193	-	-
BICON PLUS (SL PLUS) Smith & Nephew	2000	934	89	95,8 (94,3-96,9)	807	92,9 (91,0-94,5)	624
JUMP SYSTEM (EXACTA) Permedica	2010	880	8	99,0 (98,0-99,5)	29	-	-
FIXA TI-POR (APTA-FIX) Adler-Ortho	2015	797	12	-	-	-	-
FITMORE (CLS) SulzerCenterpulse Zimmer	2000	769	41	96,9 (95,4-98,0)	684	95,2 (93,4-96,6)	549
Ep-fit (Polarstem) Endoplus	2008	730	11	98,7 (97,4-99,3)	430	-	-
PINNACLE SECTOR II (CORAIL) DePuy	2002	708	43	95,9 (94,1-97,2)	540	91,8 (88,9-94,0)	218
DELTA TT (H-MAX S) Lima	2009	696	10	98,2 (96,6-99,1)	124	-	-
REFLECTION (**BASIS**) Smith & Nephew	2001	626	53	96,4 (94,6-97,7)	510	91,8 (88,9-94,0)	294
JUMP SYSTEM (SYNTHESIS) Permedica	2013	617	15	96,4 (93,8-98)	65	-	-
CLS (CONUS) SulzerCenterpulse Zimmer	2000	595	57	97,1 (95,3-98,2)	534	94,0 (91,6-95,7)	445
G7 PPS (TAPERLOC COMPLETE) Biomet	2014	590	9	-	-	-	-
FIXA (**APTA**) Adler-Ortho	2005	573	22	97,1 (95,4-98,2)	479	96,4 (94,4-97,7)	330
TRIDENT PSL HA CLUSTER (**EXETER V40**) Howmedica	2002	567	6	99,5 (98,3-99,8)	292	99,0 (96,9-99,7)	196
VERSAFITCUP CC TRIO (MINIMAX) Medacta	2012	550	15	96,1 (93,1-97,9)	62	-	-
REFLECTION (**SYNERGY**)	2000	537	32	98,2	394	94,2	191

Survival analyses are performed only on patients living in the Emilia-Romagna region, in order to avoid the bias resulting from the 'loss' of non-resident patients

Smith & Nephew				(96,5-99,0)		(91,0-96,4)	
PINNACLE SECTOR II (SUMMIT) DePuy	2003	534	10	97,9 (96,0-98,9)	268	97,9 (96,0-98,9)	96
G7 PPS (TAPERLOC COMPLETE MICROPLASTY) Biomet	2015	532	6	-	-	-	-
TRILOGY (VERSYS FIBER) Zimmer	2000	505	28	96,4 (94,3-97,7)	448	94,9 (92,5-96,6)	358
DELTA TT (MODULUS HIP SYSTEM) Lima	2007	502	16	97,0 (95,0-98,2)	265	96,2 (93,8-97,7)	49
Fixa TI-por (Alata Acuta) Adler-Ortho	2007	501	14	96,9 (94,8-98,2)	233	96,9 (94,8-98,2)	56
TRIDENT PSL HA CLUSTER (ABGII) Stryker Howmedica	2002	499	37	95,4 (93,2-97,0)	436	93,3 (90,6-95,3)	237
CONTEMPORARY (EXETER V40) Stryker Howmedica	2000	497	27	95,8 (93,4-97,3)	372	94,0 (91,2-96,0)	218
DUOFIT PSF (**P507**) Samo	2000	492	33	98,1 (96,3-99,0)	434	96,3 (94,0-97,7)	342
RECAP RESURFACING (TAPERLOC) Biomet	2005	486	34	95,8 (93,6-97,3)	439	93,8 (91,1-95,7)	294
R3 (SL PLUS) Smith & Nephew	2009	458	16	96,5 (94,1-98)	194	-	-
SELEXYS TH (CBC) Mathys	2006	435	56	92,0 (89-94,3)	352	86,6 (82,8-89,7)	248
DELTA PF (MODULUS HIP SYSTEM) Lima	2003	429	15	97,6 (95,6-98,7)	335	96,9 (94,6-98,2)	210
CONTINUUM (CLS) Zimmer	2010	426	6	98,2 (96,0-99,2)	187	-	-
AnCA Fit (PROFEMUR Z) Wright Cremascoli	2002	421	47	93,8 (91,0-95,7)	382	91,7 (88,5-94,0)	327
R3 (ADR) Smith & Nephew	2009	415	18	95,8 (93,1-97,5)	196	-	-
TOP (CFP) Link	2000	403	15	97,7 (95,6-98,8)	366	95,9 (93,2-97,5)	290
Versafitcup CC (Minimax) Medacta	2007	362	20	96,9 (94,5-98,3)	317	91,5 (86,1-94,9)	67
R3 THREE-HOLE Smith and Nephew (NANOS) Endoplant	2010	359	6	97,7 (94,9-99,0)	77	-	-
CUPULE RELOAD AVANTAGE (TAPERLOC) Biomet	2008	354	13	96,8 (94,4-98,2)	289	96,4 (93,8-98,0)	63
TRIDENT PSL HA CLUSTER (ACCOLADE II) Howmedica	2012	340	8	97,7 (95,2-98,9)	24	-	-
MULLER (JVC) Wright Cremascoli	2000	326	15	98,4 (96,2-99,3)	269	96,1 (92,8-97,9)	158
CONTINUUM (AVENIR) Zimmer	2014	324	7	97,1 (93,4-98,7)	20	-	-
EP-FIT PLUS (SL PLUS MIA) Smith & Nephew	2009	324	15	96,4 (93,2-98,1)	169	-	-
STANDARD CUP (CLS) Sulzer Centerpulse Zimmer	2000	322	16	98,4 (96,2-99,3)	296	96,9 (94,2-98,4)	243
CONTINUUM (CONUS) Zimmer	2010	318	9	97,3 (94,7-98,7)	199	-	-
Fixa TI-por (Pulchra-fix) Adler-Ortho	2016	312	8	-	-	-	-
CLS Zimmer (SL PLUS) Smith & Nephew	2001	311	18	96,6 (93,8-98,2)	269	95,0 (91,6-97,0)	212

Survival analyses are performed only on patients living in the Emilia-Romagna region, in order to avoid the bias resulting from the 'loss' of non-resident patients

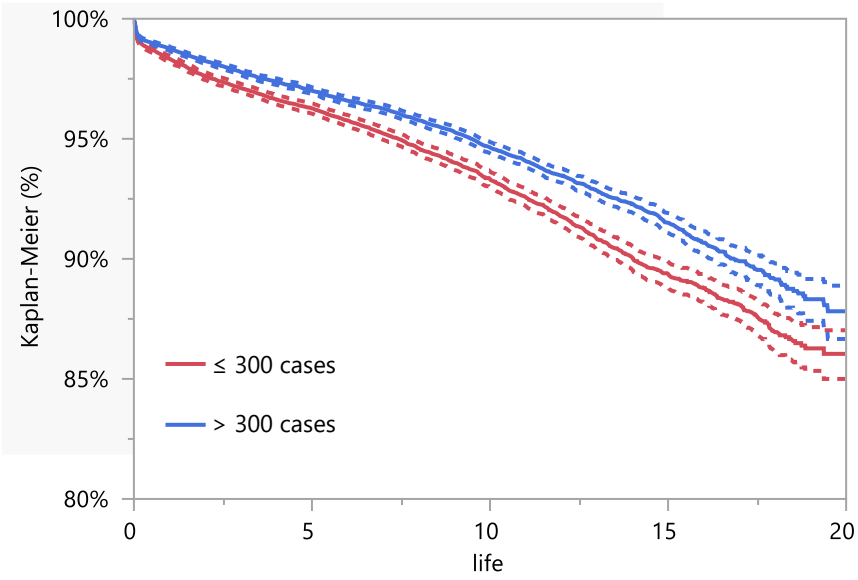
MULLER (MRL) Wright Cremascoli	2000	308	19	96,5 (93,7-98,1)	246	94,8 (91,4-96,9)	173
EP-FIT PLUS Endoplus (NANOS) Endoplant	2005	307	8	97,6 (95,0-98,8)	246	97,0 (94,1-98,5)	76
Other (< 300 cases)	2000	35.063	2.058	96,3 (96,0-96,5)	21.906	93,3 (93,0-93,7)	11.336
Unknow	2000	457	106	-	-	-	-
All models	**2000**	**93.521**	**4.632**	**96,7 (96,6-96,9)**	**57.232**	**94,1 (93,9-94,3)**	**28.878**

The marked dispersion of prosthesis types and the wide variability of the combinations between acetabulum and stems enable the comparison of only some types of prosthesis. To provide, anyway, an indication of the survival of the prosthesis types less represented in databanks, they were grouped together to make a class of prostheses of with less than 300 cases in 2000-2019.

Analysis of the survivorship of the prosthesis according to commercial type (cup + stem)

	Number of implants	n. revisions	% survival at 19 yrs	Confidence Interval 95%	Mean Follow-up
Models > 300 cases	58.458	2.574	88,3	87,4-89,2	7,3
Models < 300 cases	35.063	2.058	86,3	85,3-87,2	7,7

Survival curve



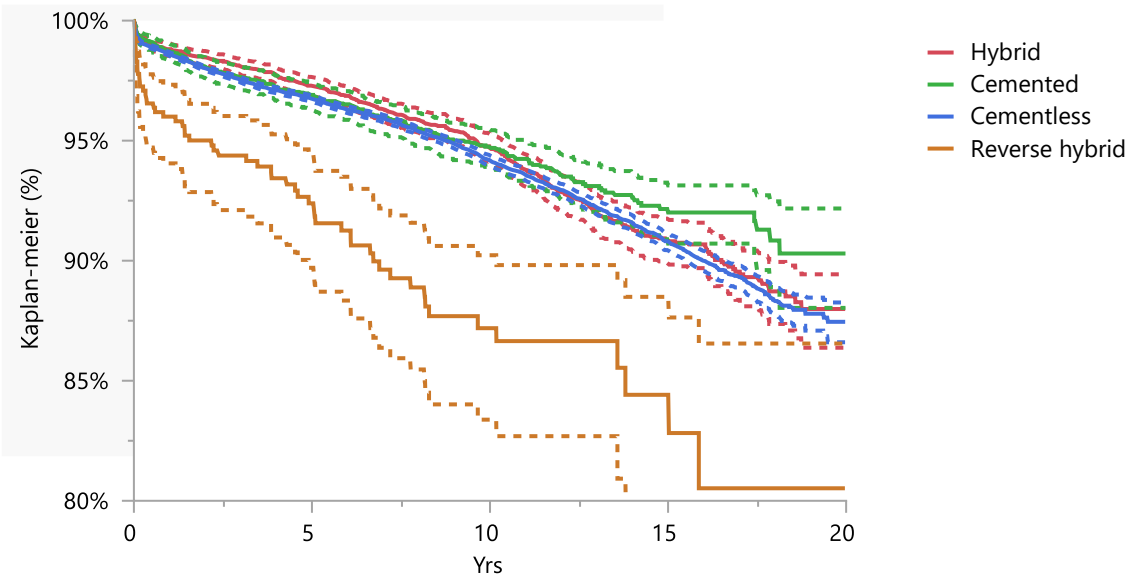
Curves are significantly different (p=0,001, Wilcoxon test)

Survival analyses are performed only on patients living in the Emilia-Romagna region, in order to avoid the bias resulting from the 'loss' of non-resident patients

8.7 Analysis of survival in primary total hip arthroplasty according to fixation

In the following table cemented, cementless and hybrid prosthesis fixation are consiedered separately.

Fixation	N.	Removals	% survival at 19 yrs (c.i. at 95%)	Mean Follow-up
Cementless	81.091	3.836	87,8 (87,1-88,5)	7,2
Hybrid (cemented stem, cementless cup)	7.337	434	88,0 (86,4-89,4)	9,6
Cemented	4.158	211	90,3 (88,0-92,2)	8,9
Reverse hybrid (cementless stem, cemented cup)	591	59	80,5 (72,6-86,5)	6,8



Curves are significantly different (p=0,001, Wilcoxon test).

Survival analyses are performed only on patients living in the Emilia-Romagna region, in order to avoid the bias resulting from the 'loss' of non-resident patients

Cemented			
Cause of revision	**Rate**	**%**	**% distribut. of failure causes**
Aseptic loosening of the cup	**63**/4.158	1,5	29,9
Global aseptic loosening	**39**/4.158	0,9	18,5
Recurrent prosthesis dislocation	**29**/4.158	0,7	13,7
Aseptic loosening of the stem	**20**/4.158	0,5	9,5
Septic loosening	**20**/4.158	0,5	9,5
Periprosthetic bone fracture	**17**/4.158	0,4	8,1
Primary instability	**4**/4.158	0,1	1,9
Breakage of prosthesis	**2**/4.158	0,05	0,9
Other	**1**/4.158	0,02	0,5
Unknown *(7 performed outside region)*	**16**/4.158	0,4	7,6
Total	**211/4.158**	**5,1**	**100,0**
Cementless			
Cause of revision	**Rate**	**%**	**% distribut. of failure causes**
Periprosthetic bone fracture	**594**/81.091	0,7	15,5
Aseptic loosening of the stem	**575**/81.091	0,7	15,0
Aseptic loosening of the cup	**536**/81.091	0,7	14,0
Recurrent prosthesis dislocation	**484**/81.091	0,6	12,6
Breakage of prosthesis	**406**/81.091	0,5	10,6
Septic loosening	**224**/81.091	0,3	5,8
Global aseptic loosening	**160**/81.091	0,2	4,2
Pain without loosening	**94**/81.091	0,1	2,5
Poly wear	**89**/81.091	0,1	2,3
Primary instability	**83**/81.091	0,1	2,2
Metallosis	**51**/81.091	0,1	1,3
Heterotopic bone	**35**/81.091	0,0	0,9
Other	**112**/81.091	0,1	2,9
Unknown *(217 performed outside region)*	**393**/81.091	0,5	10,2
Total	**3.836/81.091**	**4,7**	**100,0**
Hybrid			
Cause of revision	**Rate**	**%**	**% distribut. of failure causes**
Aseptic loosening of the stem	**126**/7.337	1,7	29,0
Recurrent prosthesis dislocation	**78**/7.337	1,1	18,0
Global aseptic loosening	**51**/7.337	0,7	11,8
Periprosthetic bone fracture	**50**/7.337	0,7	11,5
Aseptic loosening of the cup	**36**/7.337	0,5	8,3
Septic loosening	**31**/7.337	0,4	7,1
Poly wear	**16**/7.337	0,2	3,7
Breakage of prosthesis	**7**/7.337	0,1	1,6
Heterotopic bone	**3**/7.337	0,04	0,7
Primary instability	**2**/7.337	0,03	0,5
Pain without loosening	**1**/7.337	0,01	0,2
Other	**7**/7.337	0,1	1,6
Unknown *(9 performed outside region)*	**26**/7.337	0,4	6,0
Total	**434/7.337**	**5,9**	**100,0**
Reverse hybrid			
Cause of revision	**Rate**	**%**	**% distribut. of failure causes**
Aseptic loosening of the cup	**19**/591	3,2	32,2
Recurrent prosthesis dislocation	**9**/591	1,5	15,3

Survival analyses are performed only on patients living in the Emilia-Romagna region, in order to avoid the bias resulting from the 'loss' of non-resident patients

Periprosthetic bone fracture	**7**/591	1,2	11,9
Aseptic loosening of the stem	**7**/591	1,2	11,9
Global aseptic loosening	**5**/591	0,8	8,5
Septic loosening	**3**/591	0,5	5,1
Breakage of prosthesis	**2**/591	0,3	3,4
Metallosis	**1**/591	0,2	1,7
Unknown *(6 performed outside region)*	**6**/591	1,0	10,2
Total	**59/591**	**10,0**	**100,0**

8.8 Analysis of survival in primary total hip arthroplasty according to articular coupling

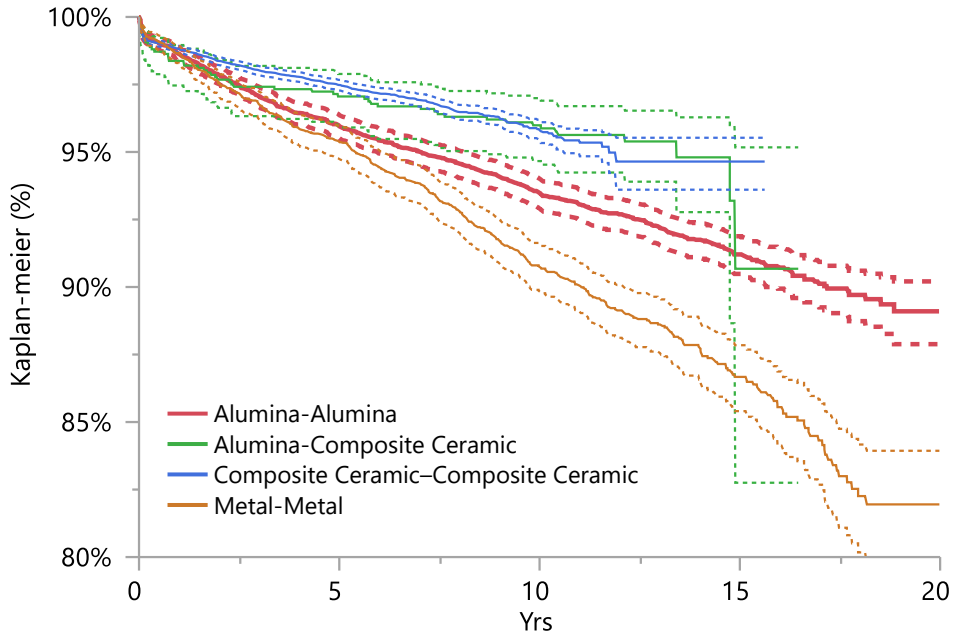
The following table shows survival details of prosthesis according to articular coupling. Only couplings with more than 1000 casese are presented. Dual mobility cups are excluded.
The articular coupling is defined about characteristics of the sliding surface, regardless if insert is made of a single material or two.

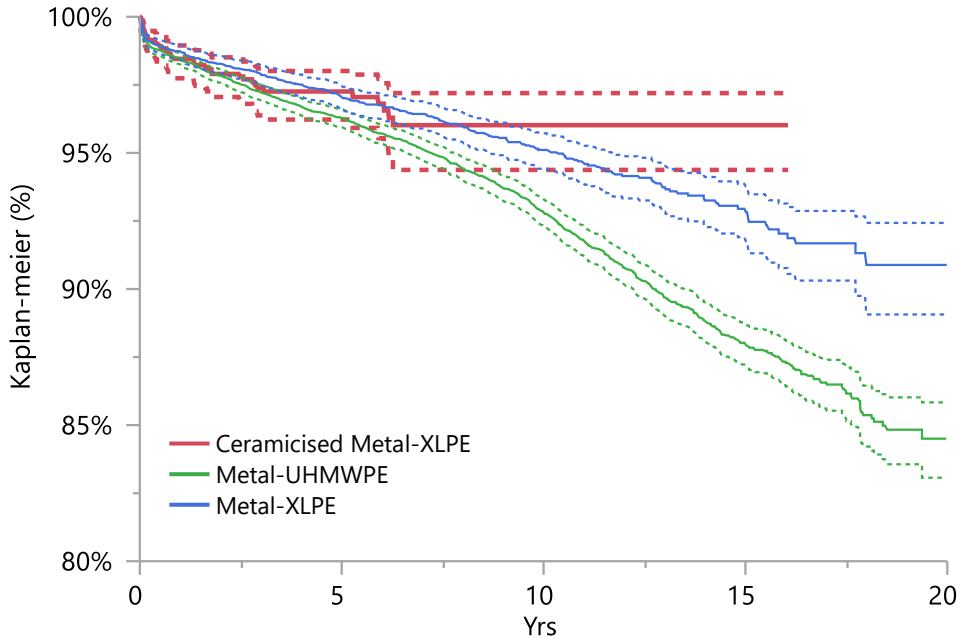
The survival curve are shown in three separate figures, to have better graphics.

Articular coupling	Mean Follow-up	N.	Removals	% survival at 5 yrs	c.i. at 95%	% survival at 10 yrs	c.i. at 95%
Composite ceramic–Composite ceramic	5,2	29.967	789	97,5	97,3-97,7	95,8	95,5-96,2
Metal-UHMWPE	9,7	13.329	1.056	96,3	96,0-96,6	92,9	92,3-93,3
Comp. ceramic-XLPE	3,9	10.930	287	97,0	96,6-97,3	95,3	94,3-96,1
Alumina-UHMWPE	11,2	8.281	577	96,8	96,4-97,2	94,6	94,1-95,1
Alumina-Alumina	12,4	8.158	639	96,0	95,5-96,4	93,5	92,9-94,0
Metal-XLPE	8,0	6.505	279	97,1	96,6-97,5	95,1	94,4-95,7
Metal-Metal	11,3	4.667	514	95,4	94,7-96,0	90,7	89,8-91,6
Comp. ceramic-XLPE + Vit.E	2,8	2.957	61	97,4	96,5-98,0	96,3	93,3-98,0
Ceramicised metal-XLPE	3,7	1.785	44	97,3	96,2-98,0	96,0	94,4-97,2
Comp. ceramic-UHMWPE	5,7	1.566	61	96,6	95,5-97,5	94,4	92,7-95,7
Alumina-XLPE	10,2	1.217	64	96,5	95,2-97,4	95,0	93,5-96,1
Alumina-Composite ceramic	10,6	1.170	52	97,1	95,9-97,9	95,9	94,5-96,9

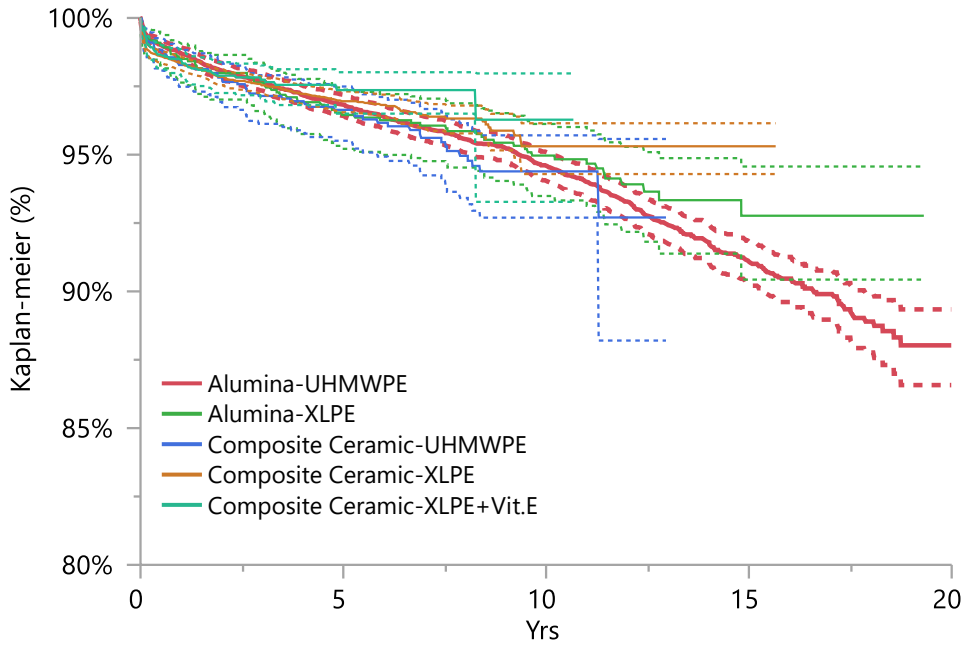
Survival analyses are performed only on patients living in the Emilia-Romagna region, in order to avoid the bias resulting from the 'loss' of non-resident patients

Survival Curve





Survival analyses are performed only on patients living in the Emilia-Romagna region, in order to avoid the bias resulting from the 'loss' of non-resident patients



Curves are significantly different (p=0,010, Wilcoxon test)

Metal - Metal			
Cause of revision	**Rate**	**%**	**% distribut. of failure causes**
Aseptic loosening of the cup	**123**/4.667	2,6	23,9
Aseptic loosening of the stem	**62**/4.667	1,3	12,1
Metallosis	**45**/4.667	1,0	8,8
Global aseptic loosening	**44**/4.667	0,9	8,6
Septic loosening	**39**/4.667	0,8	7,6
Periprosthetic bone fracture	**34**/4.667	0,7	6,6
Breakage of prosthesis *(17 stems and 17 cups)*	**34**/4.667	0,7	6,6
Prosthesis dislocation	**28**/4.667	0,6	5,4
Pain without loosening	**15**/4.667	0,3	2,9
Primary instability	**5**/4.667	0,1	1,0
Heterotopic bone	**3**/4.667	0,1	0,6
Poly wear	**1**/4.667	0,02	0,2
Other	**8**/4.667	0,2	1,6
Unknown *(56 performed outside region)*	**73**/4.667	1,6	14,2
Total	**514/4.667**	**11,0**	**100,0**
Metal - UHMWPE			
Cause of revision	**Rate**	**%**	**% distribut. of failure causes**
Aseptic loosening of the cup	**244**/13.329	1,8	23,1
Aseptic loosening of the stem	**183**/13.329	1,4	17,3
Prosthesis dislocation	**155**/13.329	1,2	14,7
Global aseptic loosening	**108**/13.329	0,8	10,2
Periprosthetic bone fracture	**100**/13.329	0,8	9,5
Poly wear	**67**/13.329	0,5	6,3
Septic loosening	**53**/13.329	0,4	5,0
Pain without loosening	**19**/13.329	0,1	1,8
Breakage of prosthesis *(10 stems, 4 cups,*	**18**/13.329	0,1	1,7

Survival analyses are performed only on patients living in the Emilia-Romagna region, in order to avoid the bias resulting from the 'loss' of non-resident patients

3 inserts and 1unknown)			
Primary instability	**9**/13.329	0,1	0,9
Heterotopic bone	**2**/13.329	0,02	0,2
Other	**9**/13.329	0,1	0,9
Unknown *(45 performed outside region)*	**88**/13.329	0,7	8,3
Total	**1.056/13.329**	**7,9**	**100,0**
Metal - XLPE			
Cause of revision	**Rate**	**%**	**% distribut. of failure causes**
Periprosthetic bone fracture	**89**/6.505	1,4	31,9
Prosthesis dislocation	**42**/6.505	0,6	15,1
Aseptic loosening of the stem	**31**/6.505	0,5	11,1
Aseptic loosening of the cup	**30**/6.505	0,5	10,8
Septic loosening	**20**/6.505	0,3	7,2
Global aseptic loosening	**16**/6.505	0,2	5,7
Pain without loosening	**7**/6.505	0,1	2,5
Primary instability	**7**/6.505	0,1	2,5
Poly wear	**3**/6.505	0,05	1,1
Breakage of stem	**1**/6.505	0,02	0,4
Heterotopic bone	**1**/6.505	0,02	0,4
Other	**13**/6.505	0,2	4,7
Unknown *(10 performed outside region)*	**19**/6.505	0,3	6,8
Total	**279/6.505**	**4,3**	**100,0**
Alumina - Alumina			
Cause of revision	**Rate**	**%**	**% distribut. of failure causes**
Breakage of prosthesis (68 stems, 53 inserts, 52 heads, 2 cups and 7 insert+head)	**182**/8.158	2,2	28,5
Periprosthetic bone fracture	**119**/8.158	1,5	18,6
Aseptic loosening of the stem	**82**/8.158	1,0	12,8
Prosthesis dislocation	**67**/8.158	0,8	10,5
Aseptic loosening of the cup	**50**/8.158	0,6	7,8
Septic loosening	**20**/8.158	0,2	3,1
Global aseptic loosening	**18**/8.158	0,2	2,8
Pain without loosening	**14**/8.158	0,2	2,2
Primary instability	**5**/8.158	0,1	0,8
Heterotopic bone	**5**/8.158	0,1	0,8
Poly wear	**3**/8.158	0,04	0,5
Other	**11**/8.158	0,1	1,7
Unknown *(38 performed outside region)*	**63**/8.158	0,8	9,9
Total	**639/8.158**	**7,8**	**100,0**
Alumina - UHMWPE			
Cause of revision	**Rate**	**%**	**% distribut. of failure causes**
Aseptic loosening of the stem	**109**/8.281	1,3	18,9
Prosthesis dislocation	**88**/8.281	1,1	15,3
Periprosthetic bone fracture	**87**/8.281	1,1	15,1
Aseptic loosening of the cup	**84**/8.281	1,0	14,6
Global aseptic loosening	**41**/8.281	0,5	7,1
Septic loosening	**31**/8.281	0,4	5,4
Breakage of prosthesis *(14 stems, 5 cups,*	**26**/8.281	0,3	4,5

Survival analyses are performed only on patients living in the Emilia-Romagna region, in order to avoid the bias resulting from the 'loss' of non-resident patients

6 heads and 1 insert)			
Poly wear	**24**/8.281	0,3	4,2
Pain without loosening	**9**/8.281	0,1	1,6
Primary instability	**6**/8.281	0,1	1,0
Heterotopic bone	**6**/8.281	0,1	1,0
Metallosis	**3**/8.281	0,04	0,5
Other	**4**/8.281	0,05	0,7
Unknown *(28 performed outside region)*	**59**/8.281	0,7	10,2
Total	**577/8.281**	**7,0**	**100,0**
Alumina - XLPE			
Cause of revision	**Rate**	**%**	**% distribut. of failure causes**
Aseptic loosening of the stem	**15**/1.217	1,2	23,4
Periprosthetic bone fracture	**12**/1.217	1,0	18,8
Aseptic loosening of the cup	**9**/1.217	0,7	14,1
Septic loosening	**5**/1.217	0,4	7,8
Prosthesis dislocation	**5**/1.217	0,4	7,8
Global aseptic loosening	**3**/1.217	0,2	4,7
Primary instability	**3**/1.217	0,2	4,7
Pain without loosening	**1**/1.217	0,1	1,6
Breakage of stem	**1**/1.217	0,1	1,6
Poly wear	**1**/1.217	0,1	1,6
Other	**2**/1.217	0,2	3,1
Unknown *(3 performed outside region)*	**7**/1.217	0,6	10,9
Total	**64/1.217**	**5,3**	**100,0**
Alumina - Composite ceramic			
Cause of revision	**Rate**	**%**	**% distribut. of failure causes**
Breakage of prosthesis *(10 stems e 4 inserts)*	**14**/1.170	1,2	26,9
Prosthesis dislocation	**12**/1.170	1,0	23,1
Aseptic loosening of the stem	**9**/1.170	0,8	17,3
Periprosthetic bone fracture	**4**/1.170	0,3	7,7
Aseptic loosening of the cup	**3**/1.170	0,3	5,8
Septic loosening	**2**/1.170	0,2	3,8
Heterotopic bone	**1**/1.170	0,1	1,9
Other	**2**/1.170	0,2	3,8
Unknown *(4 performed outside region)*	**5**/1.170	0,4	9,6
Total	**52/1.170**	**4,4**	**100,0**
Composite ceramic - Composite ceramic			
Cause of revision	**Rate**	**%**	**% distribut. of failure causes**
Aseptic loosening of the stem	**138**/29.967	0,5	17,5
Breakage of prosthesis *(102 stems, 22 inserts and 3 heads)*	**127**/29.967	0,4	16,1
Periprosthetic bone fracture	**127**/29.967	0,4	16,1
Prosthesis dislocation	**97**/29.967	0,3	12,3
Septic loosening	**62**/29.967	0,2	7,9
Aseptic loosening of the cup	**50**/29.967	0,2	6,3
Primary instability	**35**/29.967	0,1	4,4
Pain without loosening	**19**/29.967	0,1	2,4
Heterotopic bone	**13**/29.967	0,04	1,6

Survival analyses are performed only on patients living in the Emilia-Romagna region, in order to avoid the bias resulting from the 'loss' of non-resident patients

Global aseptic loosening	**7**/29.967	0,02	0,9
Poly wear	**1**/29.967	0,003	0,1
Metallosis	**1**/29.967	0,003	0,1
Other	**44**/29.967	0,1	5,6
Unknown *(37 performed outside region)*	**68**/29.967	0,2	8,6
Total	**789/29.967**	**2,6**	**100,0**
Composite ceramic - UHMWPE			
Cause of revision	**Rate**	**%**	**% distribut. of failure causes**
Prosthesis dislocation	**16**/1.566	1,0	2,0
Aseptic loosening of the stem	**11**/1.566	0,7	1,4
Breakage of prosthesis *(4 stems and 1 unknown)*	**5**/1.566	0,3	0,6
Periprosthetic bone fracture	**4**/1.566	0,3	0,5
Aseptic loosening of the cup	**4**/1.566	0,3	0,5
Septic loosening	**3**/1.566	0,2	0,4
Pain without loosening	**3**/1.566	0,2	0,4
Poly wear	**3**/1.566	0,2	0,4
Global aseptic loosening	**2**/1.566	0,1	0,3
Primary instability	**1**/1.566	0,1	0,1
Metallosis	**1**/1.566	0,1	0,1
Other	**3**/1.566	0,2	0,4
Unknown *(1 performed outside region)*	**5**/1.566	0,3	0,6
Total	**61/1.566**	**3,9**	**7,7**
Composite ceramic - XLPE			
Cause of revision	**Rate**	**%**	**% distribut. of failure causes**
Prosthesis dislocation	**64**/10.930	0,6	22,3
Periprosthetic bone fracture	**48**/10.930	0,4	16,7
Aseptic loosening of the stem	**45**/10.930	0,4	15,7
Aseptic loosening of the cup	**31**/10.930	0,3	10,8
Septic loosening	**23**/10.930	0,2	8,0
Primary instability	**10**/10.930	0,1	3,5
Global aseptic loosening	**5**/10.930	0,05	1,7
Breakage of prosthesis *(3 stems and 2 cups)*	**5**/10.930	0,05	1,7
Heterotopic bone	**5**/10.930	0,05	1,7
Pain without loosening	**3**/10.930	0,03	1,0
Poly wear	**2**/10.930	0,02	0,7
Other	**13**/10.930	0,1	4,5
Unknown *(10 performed outside region)*	**33**/10.930	0,3	11,5
Total	**287/10.930**	**2,6**	**100,0**
Composite ceramic - XLPE + Vit. E			
Cause of revision	**Rate**	**%**	**% distribut. of failure causes**
Periprosthetic bone fracture	**11**/2.957	0,4	18,0
Prosthesis dislocation	**10**/2.957	0,3	16,4
Aseptic loosening of the cup	**9**/2.957	0,3	14,8
Aseptic loosening of the stem	**8**/2.957	0,3	13,1
Septic loosening	**5**/2.957	0,2	8,2
Primary instability	**4**/2.957	0,1	6,6
Pain without loosening	**2**/2.957	0,1	3,3

Survival analyses are performed only on patients living in the Emilia-Romagna region, in order to avoid the bias resulting from the 'loss' of non-resident patients

Breakage of prosthesis *(unknown)*	**1**/2.957	0,03	1,6
Global aseptic loosening	**1**/2.957	0,03	1,6
Heterotopic bone	**1**/2.957	0,03	1,6
Poly wear	**1**/2.957	0,03	1,6
Other	**4**/2.957	0,1	6,6
Unknown *(1 performed outside region)*	**4**/2.957	0,1	6,6
Total	**61/2.957**	**2,1**	**100,0**
Ceramicised metal-XLPE			
Cause of revision	**Rate**	**%**	**% distribut. of failure causes**
Aseptic loosening of the stem	**10**/1.785	0,6	22,7
Periprosthetic bone fracture	**7**/1.785	0,4	15,9
Septic loosening	**6**/1.785	0,3	13,6
Prosthesis dislocation	**4**/1.785	0,2	9,1
Aseptic loosening of the cup	**3**/1.785	0,2	6,8
Pain without loosening	**3**/1.785	0,2	6,8
Heterotopic bone	**2**/1.785	0,1	4,5
Global aseptic loosening	**1**/1.785	0,1	2,3
Other	**3**/1.785	0,2	6,8
Unknown *(1 performed outside region)*	**5**/1.785	0,3	11,4
Total	**44/1.785**	**2,5**	**100,0**

Breakage of stem group includes breackage of modular neck and proximal parts.

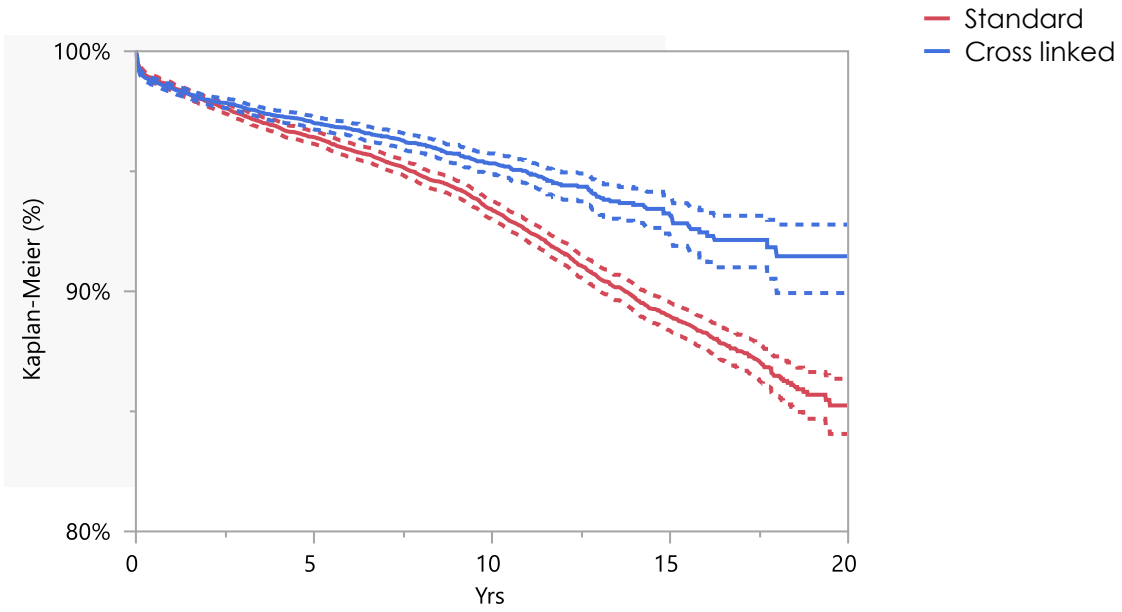
Survival analyses are performed only on patients living in the Emilia-Romagna region, in order to avoid the bias resulting from the 'loss' of non-resident patients

8.9 Analysis of survival in primary total hip arthroplasty according to insert

Standard poly (UHMWPE) and cross -linked poly inserts, independently from the articular coupling, are considered in the following analysis. Monoblock polyethylene cups are excluded.

Polyethylene	N.	Removals	% survival at 19 yrs	Confidence Interval 95%	Mean Follow-up
Standard	19.468	1.503	85,7	84,7-86,6	10,2
Cross linked	22.588	694	91,5	89,9-92,8	5,1

Survival curve



Difference is statistically significant (p=0,001, Wilcoxon test).

The Cox multivariate analysis identifies any variables (independent of each other) that can influence the event, in our case the removal of at least one prosthesis component. Analysis was performed on four independent variables: sex, age at surgery, head diameter and types of poly.

Concerning type of polyethylene, standard poly have a higher risk of failure of 1,4 compared to cross linked poly.

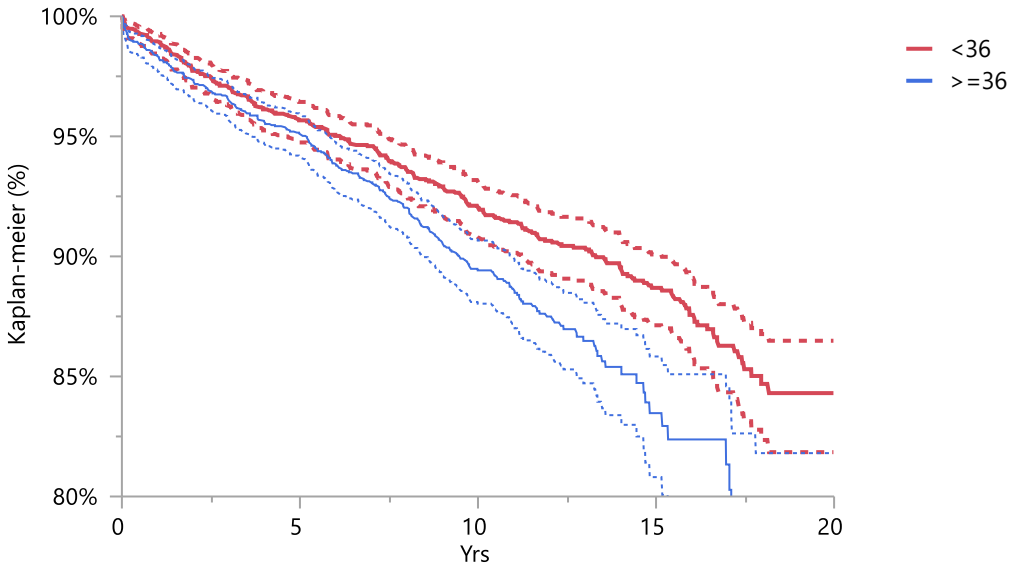
Survival analyses are performed only on patients living in the Emilia-Romagna region, in order to avoid the bias resulting from the 'loss' of non-resident patients

8.10 Analysis of survival in primary total hip arthroplasty, for met-met articular couplings, according to head diameters

Survival was calculated only for met-met articular couplings according to head diameters.

head diameters, met-met	N.	Removals	% survival at 19 yrs	Confidence Interval 95%	Mean Follow-up
<36 mm	2.310	241	84,7	82,4-86,8	12,4
>=36 mm	2.357	273	76,8	70,9-81,8	10,2

Survival curve



Difference is statistically significant (p=0,01, Wilcoxon test).

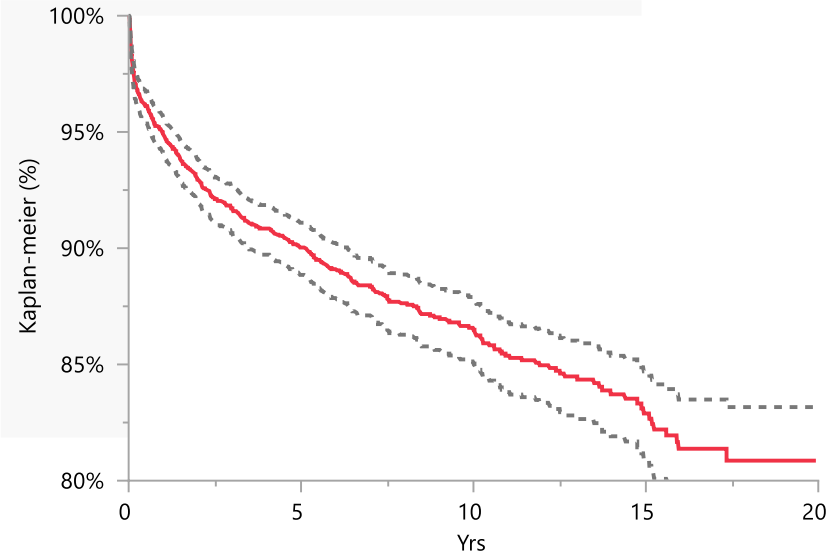
Survival analyses are performed only on patients living in the Emilia-Romagna region, in order to avoid the bias resulting from the 'loss' of non-resident patients

8.11 Survival analysis of total revision

In the present analysis the survival of the total revision operations was calculated. These operations were considered as "surviving" up to the moment when it was not necessary to perform a second revision of any component (even just a bearing or modular neck).

Number of total revision	Second revision	% survival at 19 yrs	Confidence Interval 95%	Mean Follow-up
3.084	376	80,9	78,3-83,2	7,7

Survival curve



	% Survival (95% CI)					
	1Yr	3Yrs	5Yrs	7Yrs	10Yrs	15Yrs
Total revision	94,9 (94,0-95,6)	91,7 (90,6-92,6)	90,0 (88,9-91,1)	88,3 (87,0-89,5)	86,4 (84,9-87,8)	82,9 (80,9-84,7)
implants exposed at risk	2.720	2.273	1.904	1.541	1.057	377

The following table shows the cause of **second revision** in total revisions according to **cause of revision**; percentage distribution of causes for revision is also reported.

Cause of second revision	Rate	%	% distribution of failure causes
Aseptic loosening of the cup	**74**/3.084	2,4	19,7
Recurrent prosthesis dislocation	**67**/3.084	2,2	17,8
Septic loosening	**59**/3.084	1,9	15,7
Aseptic loosening of the stem	**53**/3.084	1,7	14,1
Global aseptic loosening	**31**/3.084	1,0	8,2
Periprosthetic bone fracture	**22**/3.084	0,7	5,9
Breakage of prosthesis	**7**/3.084	0,2	1,9
Pain without loosening	**6**/3.084	0,2	1,6
Primary instability	**5**/3.084	0,2	1,3
Poly wear	**3**/3.084	0,1	0,8

Survival analyses are performed only on patients living in the Emilia-Romagna region, in order to avoid the bias resulting from the 'loss' of non-resident patients

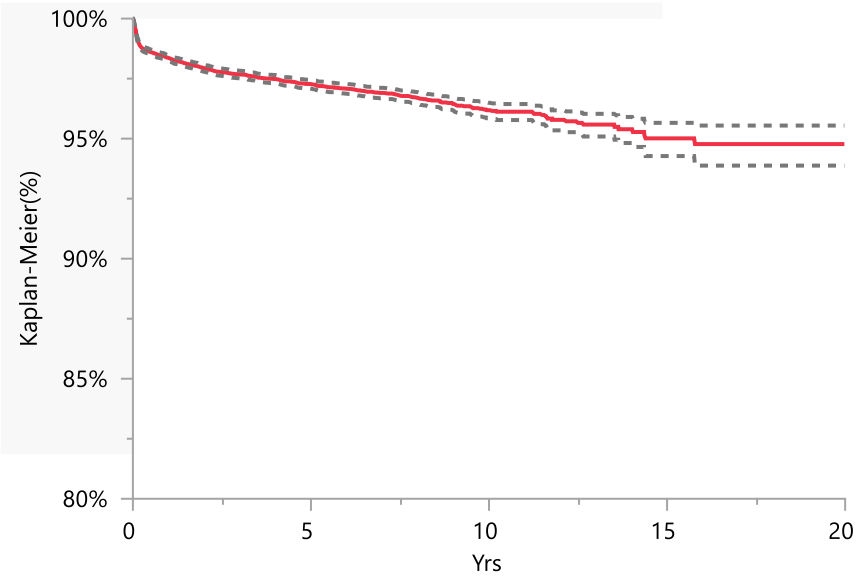
Other	**12**/3.084	0,4	3,2
Unknown *(13 performed outside region)*	**37**/3.084	1,2	9,8
Total	**376/3.084**	**12,2**	**100,0**

8.12 Survival analysis of hemiarthroplasty

Survival of hemiarthroplasty was calculated considering end point either head revision or implant of a cup to transform hemiarthroplasty to total hip prosthesis.

N. of hemiarthroplasty	N. revisions	% survival at 19 yrs	Confidence Interval 95%	Mean Follow-up
44.776	1.004	94,8	93,9-95,5	3,6

Survival curve



	% Survival (95% CI)					
	1	**3**	**5**	**7**	**10**	**15**
Hemiarthroplasty	98,4 (98,2-98,5)	97,7 (97,5-97,8)	97,3 (97,1-97,4)	96,9 (96,7-97,1)	96,2 (95,8-96,5)	95,0 (94,3-95,7)
implants exposed at risk	31.076	20.389	12.577	7.522	3.182	556

Survival analyses are performed only on patients living in the Emilia-Romagna region, in order to avoid the bias resulting from the 'loss' of non-resident patients

The following table shows the rate of revision in hemiarthroplasty according to **cause of revision**; percentage distribution of causes for revision is also reported.

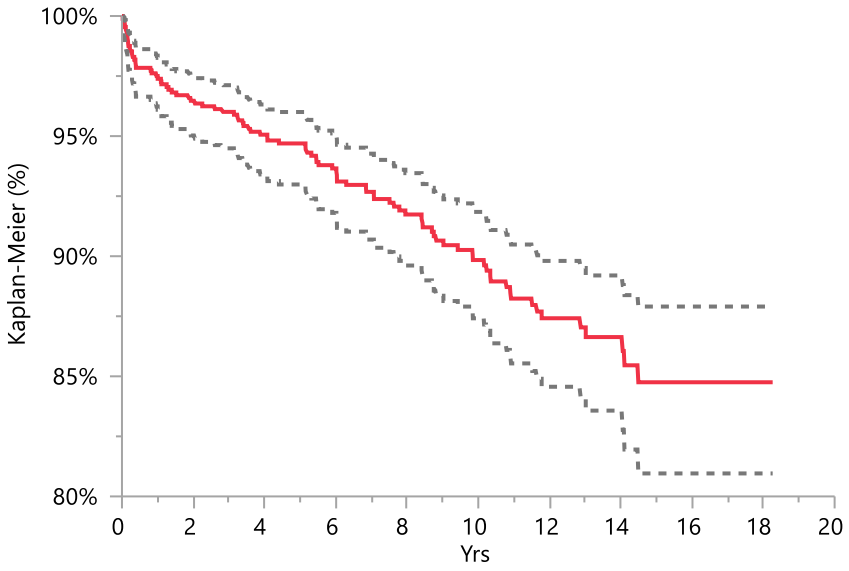
Cause of revision	Rate	%	% distribution of failure causes
Dislocation	**431**/44.776	1,0	42,9
Cotyloiditis	**133**/44.776	0,3	13,2
Aseptic loosening of the stem	**125**/44.776	0,3	12,5
Periprosthetic bone fracture	**123**/44.776	0,3	12,3
Septic loosening	**82**/44.776	0,2	8,2
Primary instability	**14**/44.776	0,02	1,4
Other	**26**/44.776	0,1	2,6
Unknown *(24 performed outside region)*	**70**/44.776	0,2	7,0
Total	**1.004/44.776**	**2,2**	**100,0**

8.13 Survival analysis of resurfacing

Analysis was performed only on patients resident in Emilia-Romagna region. This reduced the number of observed subjects.

N. of resurfacing	Removal	% survival at 16 yrs	Confidence Interval 95%	Mean Follow-up
882	92	84,8	81,0-87,9	9,5

Survival curve



Survival analyses are performed only on patients living in the Emilia-Romagna region, in order to avoid the bias resulting from the 'loss' of non-resident patients

Type of prosthesis	From years	N.	Revisions	% survival at 5 yrs (C.I. 95%)	N. at risk at 5 yrs	Mean Follow-up
BHR – Smith & Nephew	2001	510	36	97,4 (95,5-98,5)	416	9,5 (0,0-18,3)
ADEPT – Finsbury	2005	121	3	97,5 (92,6-99,2)	118	9,6 (0,1- 14,6)
BMHR – Smith & Nephew	2007	75	4	98,7 (91,1-99,8)	72	8,5 (0,3-12,6)
ASR – DePuy	2004	65	24	78,5 (66,8-86,8)	52	9,6 (0,1-15,3)
MRS – Lima	2005	43	12	79,1 (64,4-88,7)	35	10,9 (0,2-14,6)
Other (< 40 cases)	2003	68	13	-	-	10,2 (0,1-16,8)
Total	**2001**	**882**	**92**	**94,7 (93,0-96,0)**	**750**	**9,5 (0-18,3)**

The following table shows the rate of revision in resurfacing according to **cause of revision**

Cause of revision	Rate	%	% distribution of failure causes
Aseptic loosening	**27**/882	3,1	29,3
Periprosthetic bone fracture	**21**/882	2,4	22,8
Metal sensitization	**16**/882	1,8	17,4
Pain without loosening	**9**/882	1,0	9,8
Septic loosening	**4**/882	0,5	4,3
Breakage of prosthesis	**2**/882	0,2	2,2
Prosthesis dislocation	**1**/882	0,1	1,1
Unknown *(10 performed outside region)*	**12**/882	1,4	13,1
Total	**92/882**	**10,4**	**100,0**

Survival analyses are performed only on patients living in the Emilia-Romagna region, in order to avoid the bias resulting from the 'loss' of non-resident patients

PART TWO: KNEE PROSTHESIS

July 2000 – December 2019

9. RIPO capture

9.1 Percentage of R.I.P.O. data collection

Percentage of R.I.P.O. capture calculated versus Schede di Dimissione Ospedaliera (S.D.O.), according to Agency was **97,7**% for year 2019. Data are referred to primary knee prosthesis (Major Procedure Related – MPR - 8154), revision (8155;80;81;82;83;84) and prosthesis removal (8006).

9.2 Ratio public/private treatment

Percentage of primary total and unicondilar knee arthroplasties performed in public hospitals

% of operations performed in public hospitals (AUSL, AOSP, IRCCS)		
Year of operation	Primary	Revision
2000	57,0	75,0
2001	59,0	71,0
2002	53,0	70,0
2003	49,0	68,0
2004	47,1	58,3
2005	45,3	60,2
2006	42,9	54,3
2007	42,3	49,9
2008	40,6	55,0
2009	37,7	49,8
2010	37,3	50,9
2011	35,9	45,5
2012	33,8	43,9
2013	34,7	38,5
2014	34,1	37,5
2015	33,9	42,8
2016	34,6	43,8
2017	34,1	42,0
2018	31,3	39,7
2019	28,7	40,6

From database SDO

We can observe a steady shift in knee prosthetic surgery from public to private hospitals, especially for revision surgeries despite their usually high index of surgical complexity.

During 2019 percentage of primary THA and revisions performed in public hospitals is respectively 53,3% and 71,1%.

Percentage of primary total knee arthroprostheses and revision performed in public and private hospitals, in year 2019.

Type of operation	Public	Private
	%	%
Primary bicompartmental	49,0	52,2
Primary tricompartmental	31,3	27,3
Primary unicompartmental	7,1	12,8
Revision	9,0	6,0
Prosthesis removal	2,9	0,8
Implant of patella	0,7	0,9
Total	**100,0**	**100,0**

From database RIPO

10. Type of operation

Bicompartmental implant has only femoral and tibial component, whilst tricompartmental one has patella too.
Implant of patella occurs when a bicompartmental knee prosthesis is transformed into tricompartmental with a second surgery. This is not considered as a failure of primary bi-compartimental.

Number of knee operations carried out on patients with admission date between 1st July 2000 and 31st December 2019, according to **type**

Type of operation	Number	Percentage
Primary bicompartmental	76.672	62,0
Primary tricompartmental	21.779	17,6
Primary unicompartmental	13.137	10,6
Revision^	7.900	6,4
Prosthesis removal	1.748	1,4
Implant of patella	963	0,8
Other prostheses*	556	0,4
Other operations°	948	0,8
Total	**123.703**	**100,0**

*53 Hemicap–Arthrosurface, 31 Hemicap patello_femoral–Arthrosurface, 65 Avon-Patello-Femoral Joint Stryker, 99 Gender-Patello-Femoral Joint System Zimmer, 94 Journey-PFJ-Patellofemoral Smith&Nephew, 43 other patella-femoral, 53 Unicompartimental Plus+patella

°of which 486 spacer exchange, 73 stiff knee loosening, 78 debridement's, 6 dislocation reductions

^935 liner, 13 femoral component, 4 tibial component, 155 femoral component and liner, 428 tibial component and liner, 6.317 total, 48 patella.

Percentage of different type of operation in the years

Years of operation	% unicompartim	% bicompartim	% tricompartim
2001	10,4	81,2	8,4
2002	12,9	79,9	7,2
2003	12,7	78,7	8,6
2004	12,8	75,9	11,3
2005	12,4	75,6	12,1
2006	10,8	69,9	19,2
2007	11,6	69,2	19,2
2008	11,5	72,1	16,4
2009	13,0	72,3	14,8
2010	12,5	71,5	16,0
2011	9,8	73,4	16,8
2012	10,4	72,4	17,2
2013	12,1	69,1	18,9
2014	10,9	68,1	21,0
2015	10,1	67,8	22,1
2016	11,2	65,1	23,8
2017	13,1	60,9	26,0
2018	13,7	57,5	28,9
2019	12,3	56,4	31,3

Table below shows the year-to-year percentage variation of different types of knee operations.

Years of operation	Primary bi/tricompartmental		Primary unicompartmental		Revision (total+partial)	
	N.	Increase %	N.	Increase %	N.	Increase %
2000	716		68		41	
2001	2.015		235		145	
2002	2.377	18,0	353	50,2	158	9,0
2003	2.790	17,4	407	15,3	196	24,1
2004	3.365	20,6	497	22,1	215	9,7
2005	3.879	15,3	548	10,3	283	31,6
2006	4.374	12,8	532	-2,9	312	10,2
2007	5.138	17,5	671	26,1	380	21,8
2008	5.573	8,5	727	8,3	415	9,2
2009	5.520	-1,0	821	12,9	467	12,5
2010	5.625	1,9	803	-2,2	455	-2,6
2011	5.929	5,4	643	-19,9	477	4,8
2012	5.824	-1,8	678	5,4	502	5,2
2013	5.647	-3,0	774	14,2	500	-0,4
2014	5.976	5,8	732	-5,4	485	-3,0
2015	6.137	2,7	691	-5,6	527	8,7
2016	6.634	8,1	834	20,7	545	3,4
2017	6.473	-2,4	972	16,5	547	0,4
2018	6.911	6,8	1.093	12,4	600	9,7
2019	7.548	9,2	1.058	-3,2	650	8,3

11. Descriptive statistics of patients with knee prosthesis

11.1 Age

Number of knee operations carried out on patients with admission date between 1st July 2000 and 31st December 2019, according to **type of operation** and **age group** of patients at the time of surgery

Type of operation	<40		40-49		50-59		60-69		70-79		≥80		Total
	N.	%	N.	%	N.	%	N.	%	N.	%	N.	%	
Bi-tricomp	289	0,3	1.346	1,4	7.830	8,0	30.037	30,5	47.568	48,3	11.372	11,6	**98.442**
Unicomp	39	0,3	448	3,4	2.542	19,4	5.238	39,9	4.026	30,6	843	6,4	**13.136**
Revision	43	0,5	211	2,7	820	10,4	2.394	30,3	3.446	43,6	986	12,5	**7.900**
Prosthesis removal	21	1,2	52	3,0	198	11,3	551	31,5	724	41,4	202	11,6	**1.748**
Patella only	10	1,0	24	2,5	86	8,9	279	29,0	469	48,7	95	9,9	**963**
Total*	**402**	**0,3**	**2081**	**1,7**	**11476**	**9,4**	**38499**	**31,5**	**56233**	**46,0**	**13498**	**11,0**	**122.189**

*10 missing data (0,01%)

Mean age at surgery, according to type of operation - years 2000-2019

Type of operation	Mean age	Range
Primary bi/tricompartmental	70,5	13–96
Primary unicompartmental	66,1	23-93
Revision	69,6	18-95
Total	**69,9**	**13-96**

Mean age at surgery, according to type of operation - years 2001-2019

Tipo di intervento	Year 2001		Year 2019	
	Mean age	Range	Mean age	Range
Primary bi/tricompartmental°	71,2	23-92	70,4	23-92
Primary unicompartmental*	69,1	45-87	66,4	36-89
Revision^	71,8	26-87	69,6	26-89

° statistically different (t-test, p<0,001)
* statistically different (t-test, p<0,001)
^ statistically different (t-test, p<0,05)

Mean age at surgery, according to type of operation - years 2000-2019 - according to **private or public hospital**

Type of operation	Public		Private	
	Mean age	Range	Mean age	Range
Primary bi/tricompartmental*	71,0	13-94	70,3	19-96
Primary unicompartmental^	67,1	23-89	65,7	28-93

*mean age for bicompartmental in public and private hospital is significantly different (t-test, p<0.001)
^mean age for unicompartmental in public and private hospital is significantly different (t-test, p<0.001)

11.2 Gender

Number of knee operations carried out on patients with admission date between 1st July 2000 and 31st December 2019, according to **type of operation** and **gender** of patients

Type of operation	Males		Females		Total
	N.	%	N.	%	N.
Bi/tricompartmental	29.229	29,7	69.222	70,3	**98.451**
Unicompartmental	4.656	35,4	8.481	64,6	**13.137**
Revision	2.273	28,8	5.627	71,2	**7.900**
Prosthesis removal	695	39,8	1.053	60,2	**1.748**
Patella only	247	25,6	716	74,4	**963**
Total	**37.100**	**30,4**	**85.099**	**69,6**	**122.199**

11.3 Side of surgery

There is a prevalence of operations performed on the right side (54,7%) in comparison with the left side (45,3%). The percentage was calculated on patients affected by primary arthritis, on first side operated.

Percentage of operation carried out on each of two sides, according to gender

Side	Males	Females
Right	51,1	56,3
Left	48,9	43,7

Difference is statistically significant (Chi – squared p<0,001).

11.4 Bilateral arthroplasty

In the period of registry observation (20 years), 18.791 patients underwent bilateral operations.
15.425 (82,1%) chose to undergo the second operation at the same hospital where the first one was performed;
1.138 (6,1%) chose to undergo the second operation at a different hospital to follow the surgeon;
2.228 (11,9%) chose to undergo the second operation at a different hospital with a different surgeon.
In bilateral operations, it was observed that the first knee to be treated was the right one in 53,7% of cases.

11.5 Diseases treated with unicompartmental knee prosthesis

Number of primary unicompartmental knee prosthesis operations carried out on patients with admission date between 1st July 2000 and 31st December 2019, according to **diagnosis**

Diagnosis in unicompartimental knee prosthesis	Number	Percentage
Primary arthritis	10.862	83,0
Deformity	1.128	8,6
Necrosis of the condyle	671	5,1
Post-traumatic arthritis	122	0,9
Post-traumatic necrosis	93	0,7
Sequelae of fracture	87	0,7
Idiopathic necrosis	35	0,3
Post meniscectomy	20	0,2
Rheumatic arthritis	17	0,1
Sequelae of osteotomy	15	0,1
Other	41	0,3
Total*	**13.091**	**100,0**

*46 missing data (0,4%)

11.6 Diseases treated with bi-tricompartmental knee prosthesis

Number of primary bi-tricompartmental knee prosthesis operations carried out on patients with admission date between 1st uly 2000 and 31st December 2019, according to **diagnosis**.

Diagnosis in bi/tricompartmental knee prosthesis	Number	Percentage
Primary arthritis	82.690	84,3
Deformity	9.419	9,6
Post-traumatic arthritis	1.446	1,5
Sequelae of fracture	1.288	1,3
Rheumatic arthritis	1.179	1,2
Necrosis of the condyle	706	0,7
Sequelae of osteotomy	503	0,5
Post-traumatic necrosis	115	0,1
Sequelae of septic arthritis	98	0,1
Post meniscectomy	95	0,1
Sequelae of poliomyelitis	68	0,1
Idiopathic necrosis	41	0,04
Tumor	35	0,04
Chondrocalcinosis	29	0,03
TBC coxitis sequelae	17	0,02
Paget disease	15	0,02
Other	319	0,3
Total*	**98.063**	**100,0**

*388 missing data (0,4%)

11.7 Reasons for revisions and removal

Number of **revision operations** carried out on patients admitted between 1st July 2000 and 31st December 2019, according to **diagnosis**.
In the Table all revisions performed in the Region, without considering site and date of primary implant, are reported.

Diagnosis in revision	Number	Percentage
Total aseptic loosening	2.924	37,4
Two steps prosthesis removal	1.446	18,5
Pain without loosening	792	10,1
Aseptic loosening of tibial component	761	9,7
Insert wear	280	3,6
Septic loosening	197	2,5
Aseptic loosening of femoral component	197	2,5
Prosthesis dislocation	174	2,2
Instability	156	2,0
Periprosthetic bone fracture	134	1,7
Stiffness	77	1,0
Progression of disease	69	0,9
Breakage of prosthesis	38	0,5
Trauma	36	0,5
Other	528	6,8
Total*	**7.809**	**100,0**

* 91 missing data (1,2%)

Number of **prosthesis removal** carried out on patients admitted between 1st July 2000 and 31st December 2019, according to **diagnosis**.

In the Table all removals performed in the Region, without considering site and date of primary implant are reported.

Diagnosis in prosthesis removal	Number	Percentage
Septic loosening	1.511	88,0
Total aseptic loosening	97	5,6
Early infection	36	2,1
Pain without loosening	19	1,1
Aseptic loosening of tibial component	17	1,0
Periprosthetic bone fracture	9	0,5
Prosthesis dislocation	6	0,3
Other	23	1,3
Total*	**1.718**	**100,0**

* 30 missing data (1,7%)

12. Types of knee prosthesis

12.1 Unicompartmental prosthesis

Prostheses used in patients admitted between 1st July 2000 and 31st December 2019, primary unicompartmental surgery. All poly tibial components in **bold.**

Type of Prosthesis	2000-2013		2014-2016		2017-2019	
	N.	%	N.	%	N.	%
JOURNEY UNI - Smith & Nephew	183	2,4	463	20,5	811	26,0
PHYSICA ZUK - Lima	782	10,1	362	16,0	665	21,3
MITUS - ENDO-MODEL UNI - ALL POLY - Link	**403**	**5,2**	**94**	**4,2**	**221**	**7,1**
JOURNEY II - UNI XLPE - Smith & Nephew	-	-	-	-	211	6,8
OXFORD ANATOMIC PARTIAL KNEE - Biomet Merck	-	-	50	2,2	203	6,5
RESTORIS MCK UNI - Mako	-	-	88	3,9	192	6,1
UNI SIGMA HP - De Puy Johnson & Johnson	401	5,2	415	18,4	132	4,2
PERSONA UNI - Biomet	-	-	-	-	103	3,3
UNIVATION F - B.Braun	5	0,1	33	1,5	83	2,7
JOURNEY UNI - ALL POLY - Smith & Nephew	**240**	**3,1**	**75**	**3,3**	**74**	**2,4**
GENUS UNI - Adler-Ortho	31	0,4	33	1,5	64	2,0
UNI SIGMA HP - ALL POLY - De Puy Johnson & Johnson	**81**	**1,0**	**73**	**3,2**	**61**	**2,0**
GKS - ONE - Permedica	14	0,2	42	1,9	53	1,7
ALLEGRETTO UNI - Protek-Sulzer	**317**	**4,1**	**45**	**2,0**	**50**	**1,6**
BALANSYS - UNI - Mathys	140	1,8	22	1,0	47	1,5
HERMES UNI - Ceraver	-	-	37	1,6	35	1,1
GMK - UNI - FIXED - MEDACTA	1	0,0	5	0,2	26	0,8
GENESIS UNI - Smith & Nephew	1.026	13,2	148	6,6	20	0,6
GKS - ONE - ALL POLY - Permedica	**257**	**3,3**	**109**	**4,8**	**16**	**0,5**
IBALANCE UNI - Arthrex	5	0,1	24	1,1	7	0,2
TRIATHLON - PKR - Howmedica Osteonics	26	0,3	21	0,9	3	0,1
OPTETRAK - UNI - ALL POLY - Exactech	**172**	**2,2**	**4**	**0,2**	**2**	**0,1**
OXFORD UNICOMPARTMENTAL PHASE 3 - Biomet Merck	1.354	17,5	51	2,3	1	0,0
GENESIS UNI - ALL POLY - Smith & Nephew	**294**	**3,8**	**10**	**0,4**	**-**	**-**
HLS - UNI EVOLUTION - ALL POLY - Tornier	**154**	**2,0**	**2**	**0,1**	**-**	**-**
EFDIOS - Citieffe	477	6,1	-	-	-	-
PRESERVATION UNI - ALL POLY - Depuy	**379**	**4,9**	**-**	**-**	**-**	**-**
UC-PLUS SOLUTION - Endoplus	243	3,1	-	-	-	-
MILLER GALANTE UNI - Zimmer	179	2,3	-	-	-	-
MAIOR - Finceramica	154	2,0	-	-	-	-
UC-PLUS SOLUTION - ALL POLY - Endoplus	**144**	**1,9**	**-**	**-**	**-**	**-**
EIUS UNI - ALL POLY - Stryker Howmedica	**59**	**0,8**	**-**	**-**	**-**	**-**
PFC - UNI - De Puy Johnson & Johnson	56	0,7	-	-	-	-
UNICIA - VECTEUR ORTHOPEDIC - Stratec	27	0,3	-	-	-	-
PRESERVATION UNI - Depuy	27	0,3	-	-	-	-
Other (<25 cases)	105	1,4	49	2,2	42	1,3
Unknown	21	0,3	2	0,1	1	0,0
Total	**7.757**	**100,0**	**2.257**	**100,0**	**3.123**	**100,0**

12.2 Bi-tricompartmental knee prosthesis

Prostheses used in patients admitted between 1st July 2000 and 31st December 2019, primary bi/tricompartmental surgery.

Type of Prosthesis	2000-2013		2014-2016		2017-2019	
	N.	%	N.	%	N.	%
LEGION - Smith & Nephew	245	0,4	1.896	10,1	4.153	19,8
ATTUNE – DePuy	132	0,2	2.480	13,2	2.905	13,9
NEXGEN – Zimmer	12.907	22,0	2.148	11,5	1.459	7,0
PERSONA - Zimmer	169	0,3	900	4,8	1.433	6,8
VANGUARD – Biomet Merck France	4.521	7,7	1.691	9,0	1.418	6,8
PHYSICA - Lima	-	-	323	1,7	1.187	5,7
G.K.S. – Permedica	888	1,5	344	1,8	861	4,1
OPTETRACK – Exactech	1.221	2,1	560	3,0	829	4,0
TRIATHLON – Stryker Howmedica Osteonics	1.436	2,4	832	4,4	796	3,8
GEMINI - Link	2.207	3,8	737	3,9	616	2,9
GENUS – Adler-Ortho	1.277	2,2	556	3,0	563	2,7
GENESIS - Smith & Nephew	4.493	7,6	1.775	9,5	544	2,6
GMK - Medacta	93	0,2	110	0,6	542	2,6
JOURNEY – Smith & Nephew	267	0,5	205	1,1	418	2,0
BALANSYS - Mathys	715	1,2	296	1,6	400	1,9
P.F.C – DePuy	5.819	9,9	906	4,8	366	1,7
UNITY KNEE - Corin Medical	-	-	55	0,3	337	1,6
K-MOD - Gruppo Biompianti	5	0,0	19	0,1	337	1,6
APEX - Omnilife Science	180	0,3	186	1,0	320	1,5
GSP - TREKKING - Samo	828	1,4	477	2,5	288	1,4
INNEX - Protek Sulzer	338	0,6	273	1,5	165	0,8
COLUMBUS - B.Braun	340	0,6	180	1,0	164	0,8
TC-PLUS - SOLUTION - Smith & Nephew	2.528	4,3	513	2,7	162	0,8
ADVANCE - Wright	933	1,6	122	0,7	134	0,6
LCS – DePuy	940	1,6	32	0,2	100	0,5
RT-PLUS - Smith & Nephew	200	0,3	46	0,2	73	0,3
ACS - Implantcast	40	0,1	478	2,5	61	0,3
ENDO-MODEL - Link	360	0,6	65	0,3	61	0,3
U2 - United Orthopedic Corporation	34	0,1	29	0,2	59	0,3
SKS - DEEP DISH - Aston Medical	3	0,0	82	0,4	53	0,3
SIGMA RP - TC3 - DePuy	86	0,1	54	0,3	37	0,2
MULTIGEN - Lima	439	0,7	9	0,0	4	0,0
SCORPIO – Stryker Howmedica	2.639	4,5	152	0,8	3	0,0
FIRST - Symbios Orthopedie SA	962	1,6	31	0,2	2	0,0
GENIUS TRICCC - Dedienne Sante	646	1,1	39	0,2	-	-
PROFIX – Smith & Nephew	5.127	8,7	32	0,2	-	-
ROTAGLIDE – Corin Medical	846	1,4	29	0,2	-	-
SCORE – Amplitude	580	1,0	5	0,0	-	-
HLS – Tornier	386	0,7	2	0,0	-	-
INTERAX - Stryker Howmedica	737	1,3	-	-	-	-
T.A.C.K. – Link	636	1,1	-	-	-	-
AGC - Biomet Merck France	593	1,0	-	-	-	-
913 – Wright Cremascoli	358	0,6	-	-	-	-
PERFORMANCE – Kirschner Biomet	281	0,5	-	-	-	-

Merck						
DURACON – Stryker Howmedica	267	0,5	-	-	-	-
E.MOTION - B.Braun	181	0,3	-	-	-	-
CONTINUUM KNEE SYSTEM – Stratec Medical	166	0,3	-	-	-	-
RO.C.C. – Biomet Merck France	163	0,3	-	-	-	-
CINETIQUE - Medacta	100	0,2	-	-	-	-
Other (<100 cases)	395	0,7	71	0,4	75	0,4
Unknown	65	0,1	7	0,0	7	0,0
Total	**58.772**	**100,0**	**18.747**	**100,0**	**20.932**	**100,0**

Prosthesis system are reported in the Table, even if they are analytically registered (E.g.: NEXGEN - CR – Zimmer; NEXGEN - LCCK – Zimmer; NEXGEN – LPS – Zimmer; NEXGEN - RHK – Zimmer).

12.3 Revision prosthesis

Prostheses used in patients admitted between 1st July 2000 and 31st December 2019 in total revision surgery.

Type of Prosthesis	2000-2013		2014-2016		2017-2019	
	N.	%	N.	%	N.	%
LEGION - Smith & Nephew	252	6,8	326	26,5	494	35,8
NEXGEN – Zimmer	1.001	27,0	239	19,5	201	14,6
ENDO-MODEL - Link	343	9,3	96	7,8	140	10,1
ATTUNE – DePuy	-	-	28	2,3	71	5,1
SIGMA RP - TC3 - DePuy	207	5,6	97	7,9	55	4,0
RT-PLUS - Smith & Nephew	244	6,6	35	2,9	44	3,2
VANGUARD – Biomet Merck France	95	2,6	23	1,9	40	2,9
G.K.S. – Permedica	118	3,2	24	2,0	36	2,6
P.F.C – DePuy	277	7,5	76	6,2	33	2,4
OPTETRACK – Exactech	89	2,4	16	1,3	31	2,2
TRIATHLON – Stryker Howmedica Osteonics	35	0,9	46	3,7	25	1,8
COLUMBUS - B.Braun	5	0,1	9	0,7	21	1,5
BALANSYS - Mathys	22	0,6	5	0,4	19	1,4
LPS - HINGE - DePuy	21	0,6	9	0,7	17	1,2
DURATION MRH - Osteonics	112	3,0	20	1,6	12	0,9
ACS - Implantcast	16	0,4	36	2,9	10	0,7
GSP - TREKKING - Samo	19	0,5	22	1,8	9	0,7
GEMINI - Link	27	0,7	10	0,8	9	0,7
MUTARS - IMPLANTCAST	10	0,3	7	0,6	9	0,7
GENESIS - Smith & Nephew	136	3,7	53	4,3	8	0,6
TC-PLUS - SOLUTION - Smith & Nephew	35	0,9	2	0,2	1	0,1
SCORPIO – Stryker Howmedica	89	2,4	5	0,4	-	-
AGC - Biomet Merck France	127	3,4	-	-	-	-
PROFIX – Smith & Nephew	122	3,3	-	-	-	-
S-ROM NRH - Johnson & Johnson	47	1,3	-	-	-	-
INTERAX - Stryker Howmedica	35	0,9	-	-	-	-
Other (<25 cases)	211	5,7	41	3,3	93	6,7
Unknown	13	0,4	3	0,2	3	0,2
Total	**3.708**	**100,00**	**1.228**	**100,00**	**1.381**	**100,00**

12.4 Prosthesis fixation

Number of knee prosthesis arthroplasty performed on patients admitted to hospital between 1st July 2000 and 31st December 2019 according to **prosthesis fixation**

Fixation	Primary unicomp.		Primary bi/tricomp.		Total revision		Total	
	N.	%	N.	%	N.	%	N.	%
Cemented	12.338	94,0	92.654	94,1	6.231	98,8	111.223	94,4
Cementless	607	4,6	3.836	3,9	47	0,7	4.490	3,8
Femur cementless + Tibia cemented	161	1,2	1.308	1,3	17	0,3	1.486	1,3
Femur cemented + Tibia cementless	20	0,2	618	0,6	13	0,2	651	0,6
Total*	**13.126**	**100,0**	**98.416**	**100,0**	**6.308**	**100,0**	**117.850**	**100,0**

*55 missing data (0,05%)

Prosthesis fixation according to year of operation

Years of operation	% Cemented	% Cementless	% Cemented Tibia	% Cemented Femur
2001	86,7	6,7	6,0	0,6
2002	84,0	9,1	6,4	0,4
2003	87,8	7,6	4,2	0,4
2004	89,5	7,5	2,3	0,7
2005	90,5	6,2	2,6	0,6
2006	90,7	5,3	3,7	0,4
2007	91,0	4,5	3,1	1,4
2008	91,0	4,2	2,4	2,4
2009	91,5	4,5	1,5	2,5
2010	93,5	4,5	0,8	1,2
2011	94,8	4,1	0,4	0,6
2012	95,1	4,2	0,3	0,4
2013	96,6	3,0	0,2	0,2
2014	97,3	2,5	0,1	0,1
2015	97,8	2,0	0,2	0,0
2016	97,6	2,2	0,2	0,1
2017	97,5	2,3	0,0	0,2
2018	97,4	2,4	0,0	0,1
2019	98,1	1,8	0,0	0,0

12.5 Type of insert

Stabilization of insert in bi-tricompartmental knee prostheses according to year of intervention.

Years of operation	% Minimally stabilized	% Posterior stabilized	% Hinged
2001	47,7	50,1	2,2
2002	51,7	45,7	2,6
2003	46,4	51,3	2,3
2004	45,7	52,6	1,7
2005	42,6	55,8	1,5
2006	40,6	57,7	1,6
2007	40,8	57,1	2,0
2008	45,8	52,5	1,7
2009	51,3	46,8	1,8
2010	46,9	50,6	2,5
2011	49,0	48,9	2,1
2012	44,5	53,3	2,2
2013	41,0	56,1	3,0
2014	35,2	61,4	3,4
2015	36,2	60,9	2,9
2016	34,3	62,9	2,8
2017	31,7	65,2	3,1
2018	29,8	67,0	3,2
2019	28,5	67,9	3,6

Mobility of insert of bi-tricompartmental knee prosthesis according to year of implant

Years of operation	% fixed insert	% mobile insert
2001	74,1	25,9
2002	72,1	27,9
2003	69,7	30,3
2004	67,8	32,2
2005	66,0	34,0
2006	58,5	41,5
2007	62,2	37,8
2008	60,6	39,4
2009	59,3	40,7
2010	54,7	45,3
2011	55,3	44,7
2012	58,9	41,1
2013	64,4	35,6
2014	73,4	26,6
2015	75,6	24,4
2016	77,8	22,2
2017	78,7	21,3
2018	83,6	16,4
2019	87,0	13,0

Materials of insert of bi-tricompartmental knee prosthesis according to year of implant

Years of operation	% Standard poly	% Crosslinked poly	% Crosslinked antioxidant poly
2001	100,0	-	-
2002	100,0	-	-
2003	100,0	-	-
2004	100,0	-	-
2005	100,0	-	-
2006	100,0	-	-
2007	99,4	0,6	-
2008	96,1	3,9	-
2009	94,4	5,6	-
2010	94,3	5,7	-
2011	91,4	7,4	1,2
2012	89,3	8,0	2,7
2013	88,3	7,7	4,1
2014	77,1	12,6	10,3
2015	69,9	15,2	14,9
2016	62,6	18,8	18,6
2017	57,0	23,6	19,4
2018	56,9	26,0	17,0
2019	58,3	24,8	16,8

12.6 Type of femur

Materials of femur of bi-tricompartmental knee prosthesis according to year of implant

Years of operation	% cr-co	% ceramicised zirconium	% ceramicised cr-co	% ceramicised titanium
2001	99,6	0,4	-	-
2002	99,7	0,3	-	-
2003	99,5	0,5	-	-
2004	98,8	1,2	-	-
2005	98,6	1,3	0,03	0,03
2006	98,1	1,8	0,05	0,1
2007	96,7	3,0	0,1	0,2
2008	96,4	2,5	0,5	0,6
2009	96,4	2,1	1,1	0,5
2010	95,4	2,9	1,3	0,3
2011	92,8	4,3	2,5	0,4
2012	90,0	4,3	5,3	0,5
2013	87,0	6,1	6,0	0,9
2014	80,1	9,8	9,2	0,8
2015	79,7	10,3	9,4	0,6
2016	77,5	13,1	8,5	0,8
2017	75,4	14,3	9,6	0,8
2018	70,9	17,5	10,9	0,8
2019	71,9	17,5	9,9	0,7

Between 1st July 2000 and 31st December 2019, 22 cases of composite ceramic are observed.

12.7 Bone Cement

Types of cement used (since 1-1-2002)
In **bold** bone cement loaded with antibiotic

Cement	%
Surgical Simplex P - Howmedica	17,1
Antibiotic Simplex - Howmedica	12,4
Palacos R - Heraeus Medical	9,5
Palacos R+G - Heraeus Medical	9,1
Hi-Fatigue G - Zimmer	6,6
Hi-Fatigue - Zimmer	4,1
Versabond - Smith&Nephew	2,6
Refobacin Bone Cement R - Biomet	2,6
Osteobond - Zimmer	2,3
Palamed G - Heraeus Medical	2,1
Versabond AB - Smith&Nephew	2,0
Smartset MV - Depuy	1,9
Smartset GHV - Depuy	1,9
Aminofix 1 - Groupe Lepine	1,8
Smartset GMV - Depuy	1,7
Cemex System - Tecres	1,6
Palamed - Heraeus Medical	1,6
Cemex Genta System - Tecres	1,5
Cemfix 1 - Teknimed	1,4
Refobacin Revision - Biomet	1,2
Bone Cement R - Biomet	1,2
Other bone cement without antibiotic	7,2
Other bone cement loaded with antibiotic	6,6
Total	**100,0**

Bone cement loaded with antibiotic is used in 49,6% of cases.

13. Complications occurred during hospitalization

RIPO registers all kind of complications occurred during hospitalization. In the following tables only intra-operative and post-operative local complications are presented.

The rate of complications in **primary unicompartmental surgery** carried out on patients hospitalized between 1st July 2000 and 31st December 2019.

Complications occurred during hospitalization					
Intra-operative			**Local post-operative**		
	N.	**%**		**N.**	**%**
Tibial fracture	12	*0,1*	Early infection	4	*0,03*
Femoral fracture	10	*0,1*			
Anaesthesiologic	2	*0,02*			
Tibial tuberosity fracture	1	*0,01*			
Ligament lesion	1	*0,01*	Deep venous thrombosis	6	*0,05*
Other	6	*0,05*			
Total	**32**	***0,2***	**Total**	**10**	***0,1***

The rate of complications in **primary bi-tricompartmental surgery** carried out on patients hospitalized between 1st July 2000 and 31st December 2019

Complications occurred during hospitalization					
Intra-operative			**Local post-operative**		
	N.	**%**		**N.**	**%**
Femoral fracture	83	0,1	Deep venous thrombosis	167	*0,2*
Tibial fracture	40	0,04			
Ligament lesion	36	0,04			
Rupture patellar tendon	35	0,04			
Anaesthesiologic	31	0,03			
Hemorragia	25	0,03	Early infection	39	*0,04*
Vascular lesion	16	0,01			
Tibial tuberosity fracture	9	0,01			
Other	48	0,05			
Total	**323**	**0,3**	**Total**	**206**	***0,2***

The rate of complications in **revision surgery** carried out on patients hospitalized between 1st July 2000 and 31st December 2019

Complications occurred during hospitalization					
Intra-operative			**Local post-operative**		
	N.	**%**		**N.**	**%**
Femoral fracture	29	0,4	Early infection	17	*0,2*
Tibial fracture	28	0,4			
Rupture patellar tendon	20	0,3			
Anaesthesiologic	10	0,1			
Tibial tuberosity fracture	9	0,1	Deep venous thrombosis	10	*0,1*
Vascular lesion	5	0,1			
Hemorragia	4	0,1			
Ligament lesion	1	0,01			
Other	13	0,2			
Total	**119**	**1,5**	**Total**	**27**	***0,3***

13.1 Deaths occurred during hospitalization

Rate of deaths in knee prosthetic surgery carried out on patients hospitalized between 1st July 2000 and 31st December 2019

Only deaths occurred during hospitalization are recorded.

Year 2000-2019			
Type of operation	**Deaths**	**Number of surgery**	**Percentage**
Primary bi/tricompartmental	71	98.451	0,07
Primary unicompartmental	1	13.137	0,008
Revision	12	7.900	0,15
Prosthesis removal	5	1.748	0,29

14. Analysis of survival of primary surgery

14.1 Cox multivariate analysis

Bi-tri compartmental

The Cox multivariate analysis identifies any variables (independent of each other) that can influence the event, in our case the removal of at least one prosthestic component. Analysis was performed on following independent variables: gender, age at surgery, pathology and type of insert (fix vs mobile). Mobile insert includes all kind of mobility (sliding, rotating).

All primary bi-tri compartmental knee arthroplasties performed in the Region between July 2000 and December 2019 only on patients living in the Region, were analysed.

COX PROPORTIONAL RISK MODEL

Variables

Dependent: Follow-up
Independent: Age, gender, diagnosis, type of insert

Number of valid observations 62.689
Non revised: 60.327
Revised: 2.362

Chi-square: 236,4094 *p*= 0,0001

VARIABLE	SIGNIFICANCE (p)
Gender (Males vs females)	**S** (<0,0001)
Age (less than 60 yrs vs more than 60 yrs)	**S** (<0,0001)
Diagnosis (arthrosis vs other)	**NS** (0,2526)
Type of insert (Mobile vs fix)	**S** (<0,0001)

The chi-square test, used to test globally the model applied, was significant. This suggested that, on the whole, the variables inserted in the model influenced the outcome of prosthetic surgery. The effect of each variable was compared to the others when equal.

All variables inserted in the model influenced the outcome of prosthetic surgery (except diagnosis). At this point we tested how it acts, either by reducing or increasing the risk.

A relative risk rate below 1 indicated a reduced risk of prosthesis loosening. Conversely, a relative risk rate above 1 indicated an increased risk of prosthesis loosening.

The rate of relative risk was expressed with respect to the risk rate presented by the patients more than 60 yrs.

Survival analyses are performed only on patients living in the Emilia-Romagna region, in order to avoid the bias resulting from the 'loss' of non-resident patients

The following table shows that patients of the group 'less than 60 yrs' had a greater risk of failure than patients of the group 'more than 60 yrs'.

Age	Relative risk rate	Confidence interval 95%		Significance (p)
Less than 60 yrs	2,18	1,95	2,43	<0,001

The rate of relative risk was expressed with respect to the risk rate presented by the patients with poly fix insert.

The following table shows that patients of the group 'mobile insert' had a greater risk of failure than patients of the group 'fix insert.

Insert	Relative risk rate	Confidence interval 95%		Significance (p)
Mobile	1,3	1,2	1,4	<0,001

The rate of relative risk was expressed with respect to the risk rate presented by the females patients.

The following table shows that patients of the group 'males' had a greater risk of failure than patients of the group 'females'.

Gender	Relative risk rate	Confidence interval 95%		Significance (p)
Males	1,2	1,1	1,3	<0,0001

Unicompartmental

All primary unicompartmental knee arthroplasties performed in the Region between July 2000 and December 2019 only on patients living in the Region and affected by arthrosis, were analysed. Variables analysed in the model are: gender, age at surgery and type of tibial component (all poly vs metal back).

The rate of relative risk was expressed with respect to the risk rate presented by the patients more than 60 yrs.

The following table shows that patients of the group 'less than 60 yrs' had a greater risk of failure than patients of the group 'more than 60 yrs'.

Age	Relative risk rate	Confidence interval 95%		Significance (p)
Less than 60 yrs	1,8	1,5	2,1	<0,0001

Type of tibial component do not influence the risk (p=0,91).
Gender do not influence the risk (p=0,10).

Survival analyses are performed only on patients living in the Emilia-Romagna region, in order to avoid the bias resulting from the 'loss' of non-resident patients

14.2 Rate of failure

As already written in hip section, the recovery of data of operations not reported to RIPO is in progress. The uncertainty due to the failure to report of about 10% of operations performed in the Region, may lead to an underestimation of the revision rate that is not quantifiable at the moment.

By comparison with other data banks (S.D.O. hospital discharge data) it was determined the number of Revision, also they not communicated to RIPO.
Revisions include:

- revisions performed in the same hospital;
- revisions performed in a different hospital in Emilia-Romagna region;
- revisions performed outside Emilia-Romagna region.

Type of operation	Number of operations	N. of revisions performed in the same hospital	N. of revisions performed in a different hospital in Emilia Romagna region	N. of revisions performed outside Emilia-Romagna region	Mean Follow-up	Rate
Primary bicompartmental	48.685	962	791	131	7,3	1.884/48.685
Primary tricompartmental	14.004	319	122	37	5,8	478/14.004
Primary unicompartmental	7.650	374	322	56	7,2	752/7.650
Total revision	3.362	224	185	30	6,1	439/3.362

In Primary knee arthroplasties, **46,9%** of Revisions was performed in a different hospital.

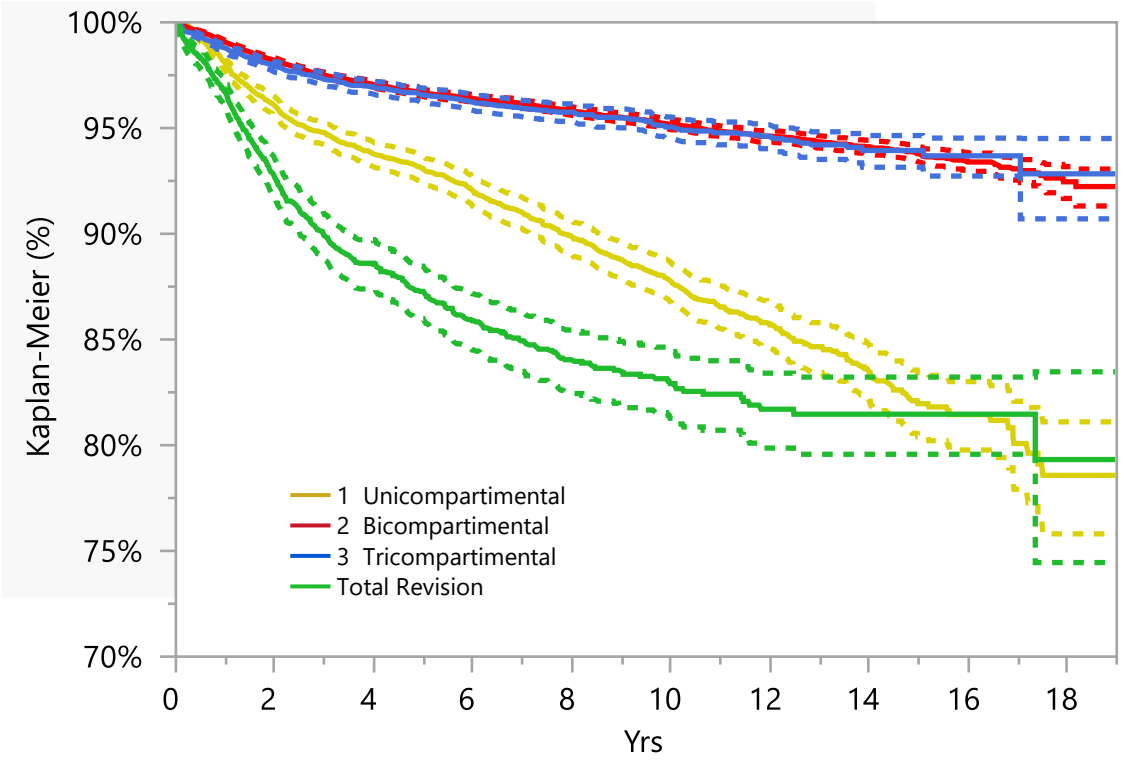
14.3 Survival analysis of uni and bicompartmental

Analysis has been separately performed for uni, bi, tricompartmental prosthesis and total revisions. The revision of a single component (even insert) is considered as a failure. Prosthetization of patella, in a second surgery, is not considered as a failure. Major revision is performed when femoral and/or tibial component are revised; minor revision when insert and/or patella are revised.

Type of operation	N. implants	N. major revisions	N. minor revisions	N. of revisions performed outside Emilia-Romagna region	Rate revisions	Survival at 18 Yrs (CI 95%)
Primary bicompartmental	48.685	1.516	237	131	1.884/48.685	92,5 (91,7-93,2)
Primary tricompartmental	14.004	339	102	37	478/14.004	92,8 (90,7-94,5)
Primary unicompartmental	7.650	676	20	56	752/7.650	78,6 (75,8-81,1)
Total revision	3.362	330	79	30	439/3.362	79,3 (74,4-83,5)

Survival analyses are performed only on patients living in the Emilia-Romagna region, in order to avoid the bias resulting from the 'loss' of non-resident patients

Survival curve



Survivorship of unicompartmental prostheses is significantly different from bi and tricompartimental ones (Wilcoxon, p=0,001).

	% Survival (95% CI)					
	1Yr	**3Yrs**	**5Yrs**	**7Yrs**	**10Yrs**	**15Yrs**
Primary bicompartmental	99,1 (99,0-99,1)	97,5 (97,3-97,6)	96,7 (96,5-96,8)	96,2 (96,0-96,3)	95,2 (94,9-95,4)	93,8 (93,4-94,1)
implants exposed at risk	44.996	37.929	30.785	24.115	14.099	3.091
Primary tricompartmental	98,8 (98,6-98,9)	97,3 (97,0-97,6)	96,6 (96,2-96,9)	95,9 (95,5-96,3)	95,0 (94,5-95,5)	93,9 (93,1-94,6)
implants exposed at risk	12.294	9.135	6.831	4.889	2.600	384
Primary unicompartmental	98,0 (97,7-98,3)	94,8 (94,2-95,3)	93,0 (92,4-93,6)	91,0 (90,2-91,7)	87,7 (86,7-88,6)	82,0 (80,4-83,4)
implants exposed at risk	6.909	5.486	4.495	3.621	2.345	580
Total revision	96,7 (96,0-97,2)	89,9 (88,7-90,9)	87,2 (85,9-88,4)	84,9 (83,5-86,3)	82,9 (81,3-84,4)	81,5 (79,6-83,2)
implants exposed at risk	2.973	2.278	1.776	1.320	703	127

Survival analyses are performed only on patients living in the Emilia-Romagna region, in order to avoid the bias resulting from the 'loss' of non-resident patients

The following table shows the rate of revision in knee arthroplasty according to **cause of revision**

Primary unicompartmental

Cause of revision	Rate	Percentage	% distribut. of failure causes
Total aseptic loosening	**294**/7.650	3,8	39,1
Pain without loosening	**118**/7.650	1,5	15,7
Tibial aseptic loosening	**96**/7.650	1,3	12,8
Septic loosening	**52**/7.650	0,7	6,9
Progression of disease	**27**/7.650	0,4	3,6
Femoral aseptic loosening	**24**/7.650	0,3	3,2
Insert wear	**23**/7.650	0,3	3,1
Breakage of prosthesis	**15**/7.650	0,2	2,0
Dislocation	**14**/7.650	0,2	1,9
Bone fracture	**7**/7.650	0,1	0,9
Instability	**3**/7.650	0,04	0,4
Other	**9**/7.650	0,1	1,2
Unknown *(52 performed outside region)*	**70**/7.650	0,9	9,3
Total	**752/7.650**	**9,8**	**100,0**

Primary bi-tricompartmental

Cause of revision	Rate	Percentage	% distribut. of failure causes
Total aseptic loosening	**641**/62.689	1,0	27,1
Septic loosening	**596**/62.689	1,0	25,2
Pain without loosening	**218**/62.689	0,3	9,2
Tibial aseptic loosening	**212**/62.689	0,3	9,0
Dislocation	**73**/62.689	0,1	3,1
Insert wear	**60**/62.689	0,1	2,5
Bone fracture	**56**/62.689	0,1	2,4
Instability	**57**/62.689	0,1	2,4
Femoral aseptic loosening	**49**/62.689	0,1	2,1
Stiffness	**34**/62.689	0,1	1,4
Breakage of prosthesis	**23**/62.689	0,04	1,0
Trauma	**8**/62.689	0,01	0,3
Other	**68**/62.689	0,1	2,9
Unknown *(154 performed outside region)*	**267**/62.689	0,4	11,3
Total	**2.362/62.689**	**3,8**	**100,0**

Survival analyses are performed only on patients living in the Emilia-Romagna region, in order to avoid the bias resulting from the 'loss' of non-resident patients

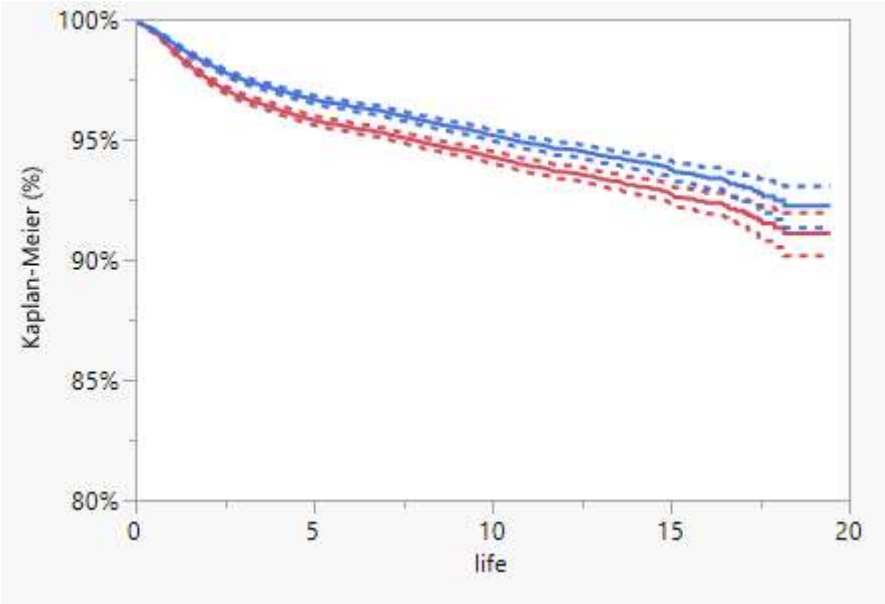
Total revision

Cause of revision	Rate	Percentage	% distribut. of failure causes
Septic loosening	**143**/3.362	4,3	32,6
Total aseptic loosening	**98**/3.362	2,9	22,3
Tibial aseptic loosening	**42**/3.362	1,2	9,6
Pain without loosening	**40**/3.362	1,2	9,1
Dislocation	**12**/3.362	0,4	2,7
Instability	**10**/3.362	0,3	2,3
Femoral aseptic loosening	**8**/3.362	0,2	1,8
Insert wear	**8**/3.362	0,2	1,8
Stiffness	**5**/3.362	0,1	1,1
Breakage of prosthesis	**5**/3.362	0,1	1,1
Periprosthetic bone fracture	**5**/3.362	0,1	1,1
Other	**16**/3.362	0,5	3,6
Unknown *(28 performed outside region)*	**47**/3.362	1,4	10,7
Total	**439/3.362**	**13,1**	**100,0**

14.4 Re-operation due to replacement of only the patella component

In rare cases bicompartmental prosthesis were transformed into tricompartmental prosthesis, with the addition of the patella component, during a second operation.

This procedure was done in 469 cases (out 48.685 bicompartmental prostheses recorded in the RIPO). The mean time lapse between primary bicompartmental arthroplasty and implanting the patella was 2,2 years (I.C. at 95 2,0-2,4).
These 469 re-operations were not considered as failures of the bicompartmental prosthesis as in dotted line.
For comparison, when resurfacing is considered a failure, the survival is traced as solid line
Survival at 19 yrs is 91,3 (90,5-92,1) and 92,5 (91,7-93,2) respectively.
16,8% of the 469 cases that underwent the addition of patella resurfacing, have been successively revised.



Survival analyses are performed only on patients living in the Emilia-Romagna region, in order to avoid the bias resulting from the 'loss' of non-resident patients

14.5 Analysis of the survival of unicompartmental prosthesis according to the most widely used commercial type in Emilia-Romagna

Survival analysis was not calculated if prostheses at risk are below 20 cases.

In **bold** Monoblock Prosthesis

Type	From years	N.	N. failures	% survival at 5 (I.C. at 95%)	N. at risk at 5 yrs	% survival at 10 (I.C. at 95%)	N. at risk at 10 yrs
PHYSICA ZUK - Lima	2005	1.186	48	95,7 (94,1-97,0)	471	92,2 (89,1-94,4)	122
OXFORD UNICOMPARTIMENTAL PHASE 3 - Biomet Merck	2000	862	146	90,6 (88,4-92,4)	738	85,7 (83,2-88,0)	543
GENESIS UNI - Smith & Nephew	2000	674	88	92,3 (90,0-94,1)	584	86,7 (83,7-89,3)	313
JOURNEY UNI - Smith & Nephew	2011	622	27	94,5 (91,8-96,3)	95	-	-
UNI SIGMA HP - DePuy	2009	498	23	95,4 (93,1-96,9)	279	-	-
MITUS - ENDO-MODEL UNI – ALL POLY - Link	**2003**	**451**	**43**	**92,4 (89,2-94,8)**	**240**	**87,9 (83,5-91,2)**	**162**
EFDIOS - Citieffe	2000	314	58	92,7 (89,2-95,2)	272	83,5 (78,7-87,4)	195
JOURNEY UNI - ALL POLY - Smith & Nephew	**2010**	**292**	**22**	**93,4 (89,3-96,0)**	**169**	**-**	**-**
ALLEGRETTO UNI - Protek-Sulzer	**2000**	**289**	**33**	**92,9 (89,1-95,4)**	**222**	**89,9 (85,3-93,1)**	**149**
GKS - ONE – ALL POLY Permedica	**2006**	**214**	**23**	**93,8 (89,5-96,3)**	**167**	**86,1 (79,2-91,0)**	**54**
RESTORIS MCK UNI - Mako	2014	198	2	-	-	-	-
OXFORD ANATOMIC PARTIAL KNEE - Biomet Merck	2014	188	7	-	-	-	-
PRESERVATION UNI – ALL POLY - DePuy	**2002**	**187**	**26**	**91,7 (86,8-95,0)**	**163**	**87,0 (81,1-91,2)**	**130**
UC-PLUS SOLUTION - Smith & Nephew	2000	176	15	97,7 (94,0-99,1)	164	95,2 (90,7-97,6)	145
HLS - UNI EVOLUTION - ALL POLY - Tornier	**2001**	**144**	**15**	**94,9 (89,7-97,6)**	**128**	**90,3 (84,1-94,3)**	**97**
UC-PLUS SOLUTION – ALL POLY - Smith & Nephew	**2003**	**140**	**24**	**88,3 (81,8-92,7)**	**117**	**81,2 (73,3-87,2)**	**54**
OPTETRAK UNI – ALL POLY -Exactech	**2005**	**131**	**6**	**98,4 (94,0-99,6)**	**120**	**95,9 (90,5-98,3)**	**74**
JOURNEY II - UNI XLPE - Smith & Nephew	2017	127	1	-	-	-	-
MILLER GALANTE UNI – Zimmer	2001	118	14	95,7 (90,1-98,2)	108	91,9 (85,1-95,7)	90
UNI SIGMA HP - ALL POLY - De Puy Johnson & Johnson	**2010**	**110**	**7**	**92,1 (84,3-96,2)**	**50**	**-**	**-**
BALANSYS - UNI - Mathys	2005	107	17	85,8 (77,8-91,3)	81	82,5 (73,3-89,0)	34
Other (<100 cases)	2000	589	93	87,9 (84,6-90,6)	292	79,4 (74,8-83,4)	157
Unknown	2001	33	14	-	-	-	-
Total	**2000**	**7.650**	**752**	**93,0 (92,4-93,6)**	**4.495**	**87,7 (86,7-88,6)**	**2.345**

Survival analyses are performed only on patients living in the Emilia-Romagna region, in order to avoid the bias resulting from the 'loss' of non-resident patients

14.6 Analysis of the survival of bi-tricompartmental prosthesis according to the most widely used commercial type in Emilia-Romagna

Survival analysis was not calculated if prostheses at risk are below 20 cases.

Type	From years	N.	N. failures	% survival at 5 (I.C. at 95%)	N. at risk at 5 yrs	% survival at 10 (I.C. at 95%)	N. at risk at 10 yrs
NEXGEN - LPS - FLEX FISSO - Zimmer	2002	6.055	150	97,9 (97,5-98,2)	4.372	97,1 (96,6-97,6)	1.970
VANGUARD - PS - Biomet Orthopedics	2005	3.293	72	97,8 (97,2-98,3)	1.905	96,6 (95,5-97,4)	497
LEGION - PS XLPE HIGH FLEXION - Smith & Nephew	2011	3.239	77	96,1 (95,0-97,0)	314	-	-
GENESIS II - PS HIGH FLEXION - Smith & Nephew	2004	2.968	71	97,8 (97,1-98,2)	1.956	96,9 (96,0-97,7)	330
GEMINI MK II – Link	2002	2.590	82	97,2 (96,5-97,8)	1.677	95,5 (94,3-96,5)	624
TC-PLUS - SB SOLUTION - Endoplus	2002	2.170	61	97,9 (97,2-98,5)	1.690	96,2 (94,9-97,2)	399
PROFIX - CONFORMING - Smith & Nephew	2000	2.040	89	96,9 (96,0-97,6)	1.847	95,6 (94,6-96,5)	1.309
NEXGEN - LPS - Zimmer	2000	2.012	92	97,3 (96,5-97,9)	1.802	95,8 (94,7-96,6)	1.430
PFC - RP - PS - De Puy Johnson & Johnson	2000	1.736	80	96,5 (95,5-97,3)	1.547	95,3 (94,2-96,3)	591
ATTUNE - PS FIXED – De Puy Johnson & Johnson	2012	1.595	43	96,1 (94,7-97,1)	277	-	-
NEXGEN - CR FLEX FISSO - Zimmer	2004	1.558	37	97,6 (96,6-98,3)	980	97,0 (95,7-97,9)	303
TRIATHLON - CR - Howmedica Osteonics	2005	1.407	25	98,3 (97,3-98,9)	831	97,3 (95,6-98,4)	127
GENESIS II - C R - Smith & Nephew	2001	1.284	48	96,5 (95,2-97,4)	856	95,5 (93,9-96,6)	373
PHYSICA - PS FIXED - Lima	2014	1.126	13	-	-	-	-
PERSONA - PS- Zimmer	2013	1.120	26	96,0 (94,0-97,4)	183	-	-
ATTUNE - PS MOBILE - De Puy Johnson & Johnson	2014	1.085	37	95,0 (93,1-96,5)	49	-	-
VANGUARD - CR-LIPPED - Biomet Orthopedics	2006	990	28	97,0 (95,6-98,0)	585	96,3 (94,6-97,5)	270
GENUS PE - Adler-Ortho	2008	946	37	97,1 (95,7-98,0)	780	95,1 (93,1-96,5)	152
OPTETRAK - LOGIC PS - Exactech	2011	851	23	96,4 (94,2-97,7)	101	-	-
NEXGEN - LPS - FLEX MOBILE - Zimmer	2002	846	39	96,8 (95,3-97,8)	707	95,4 (93,6-96,7)	379
ROTAGLIDE - Corin Medical	2000	655	78	92,0 (89,6-93,9)	539	89,1 (86,3-91,4)	316
FIRST - Symbios Orthopedie	2006	649	34	95,6 (93,7-96,9)	573	94,3 (92,2-95,9)	163
ADVANCE Medial Pivot - Wright	2000	634	23	96,5 (94,6-97,7)	501	96,2 (94,4-97,5)	312
PFC - RP - CVD - De Puy Johnson & Johnson	2001	620	32	95,7 (93,8-97,1)	478	94,5 (92,2-96,1)	169
PFC - PS - De Puy J.&J.	2000	616	37	95,0 (92,9-96,5)	457	92,8 (90,0-94,9)	158
GENIUS TRICCC - Dedienne Sante	2000	598	58	93,9 (91,6-95,6)	504	90,3 (87,4-92,5)	304

Survival analyses are performed only on patients living in the Emilia-Romagna region, in order to avoid the bias resulting from the 'loss' of non-resident patients

PROFIX - P S - Smith & Nep.	2002	589	21	97,4 (95,7-98,4)	527	96,2 (94,2-97,5)	422
LEGION - CR XLPE HIGH FLEXION - Smith & Nephew	2012	586	12	97,1 (94,9-98,4)	33	-	-
INNEX - MOBILE BEARING - UCOR - Protek Sulzer	2002	573	16	97,1 (95,3-98,3)	287	-	-
TRIATHLON - PS - Howmedica Osteonics	2007	566	9	98,4 (96,8-99,2)	182	98,4 (96,8-99,2)	24
SCORPIO - NRG - PS – Howmedica Osteonics	2004	550	38	95,5 (93,3-97,0)	477	92,8 (90,0-94,8)	231
SCORPIO - NRG - CR - Howmedica Osteonics	2007	534	22	95,9 (93,7-97,3)	390	95,6 (93,4-97,2)	108
T.A.C.K. - Link	2000	530	63	93,6 (91,1-95,4)	457	90,7 (87,8-93,0)	366
LEGION - CONSTRAINED - Smith & Nephew	2008	521	18	95,4 (92,6-97,1)	111	-	-
LCS - UNIVERSAL - RP - De Puy Johnson & Johnson	2000	488	20	96,5 (94,4-97,8)	433	96,2 (94,1-97,6)	353
JOURNEY II - BCS XLPE - Smith & Nephew	2012	464	14	95,1 (91,5-97,2)	43	-	-
PFC - SIGMA RPF - De Puy Johnson & Johnson	2005	449	25	96,2 (93,9-97,6)	407	93,2 (89,8-95,5)	150
SCORE - Amplitude	2004	437	12	98,1 (96,3-99,1)	394	97,0 (94,8-98,3)	310
OPTETRAK - RBK - HI-FLEX - Exactech	2006	399	15	96,4 (94,1-97,9)	364	96,0 (93,5-97,6)	210
GSP - TREKKING - MBH PS - Samo	2007	396	12	97,4 (95,0-98,6)	193	95,2 (91,1-97,4)	35
GENESIS II - MOBILE BEARING - Smith & Nephew	2001	359	15	97,1 (94,8-98,5)	314	95,7 (92,8-97,4)	131
BALANSYS - MOBILE BEARING - Mathys	2005	347	9	97,2 (94,8-98,6)	213	97,2 (94,8-98,6)	41
PFC - CVD - De Puy J.&J.	2000	334	9	98,1 (95,8-99,1)	279	98,1 (95,8-99,1)	171
APEX - PS - Omnilife Science	2011	333	10	96,1 (92,8-97,9)	58	-	-
LCS - COMPLETE - RP - De Puy Johnson & Johnson	2004	309	16	95,5 (92,5-97,4)	262	94,3 (90,9-96,5)	129
GENESIS II - DISHED - Smith & Nephew	2001	307	14	96,2 (93,2-97,9)	222	94,6 (91,0-96,8)	138
Other (<300 cases)	2000	10.709	558	95,5 (95,0-95,9)	6.287	93,3 (92,7-93,9)	3.571
Unknown	2000	226	42	91,0 (86,3-94,2)	166	83,0 (76,8-87,8)	117
Total	**2000**	**62.689**	**2.362**	**96,6 (96,5-96,8)**	**37.616**	**95,1 (94,9-95,3)**	**16.699**

Survival analyses are performed only on patients living in the Emilia-Romagna region, in order to avoid the bias resulting from the 'loss' of non-resident patients

PART THREE: SHOULDER PROSTHESIS

July 2008 – December 2019

15. RIPO capture

15.1 Percentage of R.I.P.O. data collection

Percentage of R.I.P.O. capture calculated versus Discharge Records (S.D.O.) was **96,9** in 2019. Data are referred to primary total prosthesis (Major Procedure Related – MPR - 8180), hemiarthroplasty (8181), revision (8197) and prosthesis removal (8001).

15.2 Ratio public/private treatment

Percentage of implants performed in public hospitals.

% of operations performed in public hospitals (AUSL, AOSP, IRCCS)		
Year of surgery	**Primary arthroprosthesis**	**Hemiarthroplasty**
2008	73,9	93,0
2009	65,7	83,6
2010	59,6	84,6
2011	49,1	87,1
2012	58,3	90,8
2013	59,8	93,2
2014	54,5	85,6
2015	57,6	94,9
2016	49,4	87,0
2017	48,7	82,9
2018	49,6	79,4
2019	48,7	51,5

From database SDO

16. Type of operation

Number of shoulder operations carried out on patients with admission date between 1st July 2008 and 31st December 2019 according to **type of operation**

Type of operation	Number of operation	Percentage
Reverse prosthesis	6.585	70,3
Hemiarthroplasty	1.013	10,8
Anatomical prosthesis	587	6,3
Revisions	587	6,3
Hemi stemless	143	1,5
Standard resurfacing	124	1,3
Prosthesis removal	146	1,6
Reverse stemless	76	0,8
Anatomical stemless	41	0,4
Anatomical resurfacing	12	0,1
Partial resurfacing	1	0,0
Other*	54	0,6
Total	**9.369**	**100,0**

*7 interposition prostheses, 7 balloon arthroplasties, 8 osteomyelitis spacers

Number of Reverse prosthesis and Anatomical prosthesis according to year of implant.

Year of surgery	Reverse prosthesis	Anatomical prosthesis
	N.	N.
2008	60	16
2009	188	40
2010	232	56
2011	361	42
2012	435	59
2013	449	44
2014	548	72
2015	670	51
2016	755	42
2017	862	48
2018	974	52
2019	1051	65
Total	**6.585**	**587**

17. Descriptive statistics of patients

17.1 Gender

Number of shoulder operations carried out on patients with admission date between 1st July 2008 and 31st December 2019 according to **type of operation** and **gender** of patients

Type of operation	Males		Females		Total
	N.	%	N.	%	N.
Reverse prosthesis	1.626	59,7	4.959	75,3	6.585
Hemiarthroplasty	337	12,4	676	10,3	1.013
Anatomical prosthesis	265	9,7	322	4,9	587
Revisions	233	8,6	354	5,4	587
Hemi stemless	68	2,5	75	1,1	143
Standard resurfacing	77	2,8	47	0,7	124
Prosthesis removal	68	2,5	78	1,2	146
Reverse stemless	25	0,9	51	0,8	76
Anatomical stemless	21	0,8	20	0,3	41
Anatomical resurfacing	4	0,1	8	0,1	12
Partial resurfacing	1	0,0	-	-	1
Total	**2.725**	**100,0**	**6.590**	**100,0**	**9.315**

17.2 Age

Mean age of patients, according to gender and type of operation

	Males		Females	
Type of operation	**Mean age**	**Range**	**Mean age**	**Range**
Reverse prosthesis	71,0	33-92	73,6	30-100
Hemiarthroplasty	58,1	15-91	71,5	18-97
Anatomical prosthesis	60,4	27-83	64,9	30-100
Revisions	64,4	23-88	68,8	32-90
Hemi stemless	55,2	26-78	63,2	32-86
Standard resurfacing	50,4	23-80	55,0	21-78
Prosthesis removal	63,6	25-88	71,9	47-86
Reverse stemless	70,4	55-81	71,6	52-84
Anatomical stemless	56,6	36-73	66,6	53-80
Anatomical resurfacing	71,3	64-76	65,8	51-79
Partial resurfacing	17,0	-	-	-

17.3 Pathologies

Number of shoulder operations carried out on patients with admission date between 1st July 2008 and 31st December 2019 according to **type of operation** and **diagnosis** of patients.

Diagnosis	**Reverse prosthesis**	
	N.	**%**
Eccentric osteoarthritis	3.170	48,1
Fracture	1.292	19,6
Concentric osteoarthritis	945	14,4
Cuff arthropathy	547	8,3
Necrosis	145	2,2
Sequelae of fracture	143	2,2
Non specified osteoarthritis	84	1,3
Inveterate dislocation	53	0,8
Rheumatic arthritis	50	0,8
Post-traumatic necrosis	28	0,4
Post-traumatic arthritis	25	0,4
Recurrent dislocation	17	0,3
Sequelae of septic arthritis	6	0,1
Pain	2	0,0
Other	26	0,4
Unknown	52	0,8
Total	**6.585**	**100,0**

Diagnosis	Anatomical prosthesis	
	N.	%
Concentric osteoarthritis	477	81,3
Eccentric osteoarthritis	34	5,8
Necrosis	29	4,9
Rheumatic arthritis	9	1,5
Sequelae of fracture	8	1,4
Non specified osteoarthritis	7	1,2
Fracture	7	1,2
Cuff arthropathy	6	1,0
Post-traumatic arthritis	2	0,3
Synovial chondromatosis	1	0,2
Post-traumatic necrosis	1	0,2
Other	1	0,2
Unknown	5	0,9
Total	**587**	**100,0**

Diagnosis	Hemiarthroplasty	
	N.	%
Fracture	615	60,7
Concentric osteoarthritis	94	9,3
Necrosis	85	8,4
Eccentric osteoarthritis	75	7,4
Sequelae of fracture	41	4,0
Inveterate dislocation	15	1,5
Rheumatic arthritis	12	1,2
Post-traumatic necrosis	11	1,1
Tumor	11	1,1
Cuff arthropathy	10	1,0
Sequelae of septic arthritis	5	0,5
Pathological fracture	5	0,5
Post-traumatic arthritis	4	0,4
Non specified osteoarthritis	4	0,4
Idiopathic homer head Necrosis	2	0,2
Glenoid erosion	1	0,1
Sequelae of osteomielitis	1	0,1
Sequelae of capsuloplasty	1	0,1
Recurrent dislocation	1	0,1
Other	15	1,5
Unknown	5	0,5
Total	**1.013**	**100,0**

Diagnosis	Standard Resurfacing		Anatomical Resurfacing		Partial Resurfacing	
	N	%	N	%	N	%
Concentric osteoarthritis	60	48,4	11	91,7	-	-
Necrosis	31	25,0	1	8,3	1	100,0
Eccentric osteoarthritis	9	7,3	-	-	-	-
Sequelae of capsuloplasty	3	2,4	-	-	-	-
Cuff arthropathy	3	2,4	-	-	-	-
Non specified osteoarthritis	3	2,4	-	-	-	-
Rheumatic arthritis	3	2,4	-	-	-	-
Sequelae of fracture	3	2,4	-	-	-	-
Fracture	3	2,4	-	-	-	-
Tumor	2	1,6	-	-	-	-
Inveterate dislocation	2	1,6	-	-	-	-
Pain	1	0,8	-	-	-	-
Idiopathic homer head Necrosis	1	0,8	-	-	-	-
Total	**124**	**100,0**	**12**	**100,0**	**1**	**100,0**

Diagnosis	Anatomical Stemless		Hemi Stemless		Reverse Stemless	
	N	%	N	%	N	%
Concentric osteoarthritis	31	75,6	74	51,7	15	19,7
Eccentric osteoarthritis	5	12,2	27	18,9	37	48,7
Cuff arthropathy	-	-	5	3,5	19	25,0
Necrosis	1	2,4	20	14,0	1	1,3
Non specified osteoarthritis	2	4,9	3	2,1	1	1,3
Sequelae of fracture	-	-	5	3,5	-	-
Fracture	-	-	2	1,4	-	-
Steroid-induced necrosis	-	-	2	1,4	-	-
Post-traumatic necrosis	-	-	2	1,4	-	-
Inveterate dislocation	-	-	-	-	2	2,6
Synovial chondromatosis	1	2,4	-	-	-	-
Post-traumatic arthritis	1	2,4	-	-	-	-
Sequelae of septic arthritis	-	-	1	0,7	-	-
Recurrent dislocation	-	-	1	0,7	-	-
Unknown	-	-	1	0,7	1	1,3
Total	**41**	**100,0**	**143**	**100,0**	**76**	**100,0**

Number of **shoulder revisions** carried out on patients with admission date between 1st July 2008 and 31st December 2019, according to **diagnosis** and **type of revision.**

Diagnosis	N.	%
Glenoid erosion	111	18,9
Two steps revision	77	13,1
Glenoid loosening	65	11,1
Humeral loosening	56	9,5
Anterior instability	55	9,4
Superior instability	35	6,0
Pain	35	6,0
Dislocation	29	4,9
Other instability	19	3,2
Periprosthetic bone fracture	15	2,6
Total aseptic loosening	12	2,0
Septic loosening	8	1,4
Cuff arthropathy	7	1,2
Poly wear	5	0,9
Tuberosity Reabsorption	4	0,7
Posterior instability	4	0,7
Fracture	3	0,5
Breackage of insert	3	0,5
Recurrent dislocation	2	0,3
Inferior instability	1	0,2
Other	22	3,7
Unknown	19	3,2
Total	**587**	**100,0**

Type of revision	N.	%
From hemi to reverse	161	27,4
From reverse to reverse	141	24,0
Implant after removal	78	13,3
From reverse to hemi	52	8,9
From anatomic to reverse	48	8,2
From hemi to hemi	27	4,6
Other	24	4,1
Unknown	23	3,9
From resurfacing to reverse	18	3,1
From anatomic to anatomic	7	1,2
From resurfacing to anatomic	4	0,7
From hemi to anatomic	4	0,7
Total	**587**	**100,0**

18. Surgical technique, anaesthesia and antithromboembolic prophylaxis

Number of shoulder operations carried out on patients with admission date between 1st July 2008 and 31st December 2019 according to **surgical approach.**

Type of operation	Deltoid-pectoral	Trans-deltoid	Superior lateral	Other
Reverse prosthesis	5.441	758	49	238
Hemiarthroplasty	970	26	1	7
Anatomical prosthesis	575	4	-	-
Revision	533	30	-	6
Hemi stemless	132	7	1	-
Prosthesis removal	131	4	-	2
Standard resurfacing	119	2	-	1
Reverse stemless	28	45	-	2
Anatomical stemless	40	-	-	-
Anatomical resurfacing	12	-	-	-
Partial resurfacing	1	-	-	-
Total*	**7.982**	**876**	**51**	**256**

*150 missing data (1.6%)

Number of shoulder operations carried out on patients with admission date between 1st July 2008 and 31st December 2019, according to **anaesthesia.**

Anaesthesia	N.	%
General	4.073	47,5
Mixed	3.955	46,1
Loco-regional	553	6,4
Total*	**8.581**	**100,0**

*734 missing data (7,9%)

Antithromboembolic prophylaxis

Heparin is used in 86% of primary surgery, and no prophylaxis in 14,0%.

19. Type of prosthesis

19.1 Prosthesis fixation

Number of shoulder operations carried out on patients with admission date between 1st July 2008 and 31st December 2019 according to **stem fixation** and **type of operation**

Stem fixation	Anatomical prosthesis	%	Reverse prosthesis	%	Hemiarthroplasty	%
Cemented	35	6,0	1.005	15,3	331	32,7
Cementless	552	94,0	5.580	84,7	682	67,3
Total	**587**	**100,0**	**6.585**	**100,0**	**1.013**	**100,0**

19.2 Material, form and fixation of glenoid in Anatomical prosthesis

Material of glenoid	Anatomical prosthesis	%
Metal backed	269	45,8
Polyethylene	308	52,5
Crosslinked polyethylene	6	1,0
Other	4	0,7
Total	**587**	**100,0**

Form of glenoid	Anatomical prosthesis	%
Pegs	403	68,7
Screws	167	28,4
Keel	17	2,9
Total	**587**	**100,0**

Fixation of glenoid	Anatomical prosthesis	%
Cemented	318	54,2
Cementless	269	45,8
Total	**587**	**100,0**

19.3 Type of prosthesis

Number of **primary** shoulder operations carried out on patients with admission date between 1st July 2008 and 31st December 2019 according to the **type of stem**.

Model of Stem	Anatomical prosthesis		Reverse prosthesis		Hemiarthroplasty	
	N	%	N	%	N	%
SMR ALETTATO	183	31,2	2.324	35,3	466	46,0
DELTA XTEND	1	0,2	1.313	19,9	37	3,7
AEQUALIS ASCEND FLEX S PTC	208	35,4	490	7,4	48	4,7
DELTA XTEND CEMENTED	-	-	446	6,8	21	2,1
TRABECULAR METAL REVERSE	-	-	338	5,1	12	1,2
AEQUALIS REVERSED	-	-	301	4,6	1	0,1
EQUINOXE PRIMARY	-	-	263	4,0	1	0,1
SMR CEMENTATO	4	0,7	125	1,9	94	9,3
COMPREHENSIVE MINI	-	-	135	2,1	6	0,6
BIGLIANI/FLATOW	111	18,9	-	-	24	2,4
DUOCENTRIC	-	-	120	1,8	-	-
AEQUALIS REVERSED CEMENTED	-	-	92	1,4	-	-
EQUINOXE PLATFORM FRACTURE	-	-	90	1,4	2	0,2
ARROW	1	0,2	57	0,9	5	0,5
AFFINIS FRACTURE	-	-	44	0,7	16	1,6
SMR REVISIONE	-	-	40	0,6	17	1,7
UNIVERS REVERS	-	-	55	0,8	1	0,1
ANATOMICAL SHOULDER	12	2,0	20	0,3	18	1,8
AFFINIS INVERSE	-	-	47	0,7	-	-
ANATOMICAL SHOULDER CEMENTED	8	1,4	25	0,4	8	0,8
ANATOMICAL SHOULDER FRACTURE	1	0,2	6	0,1	31	3,1
TITAN	-	-	35	0,5	-	-
LTO CEMENTATO	2	0,3	-	-	31	3,1
GLOBAL FX	-	-	-	-	33	3,3
HUMELOCK REVERSED	-	-	29	0,4	-	-
BIGLIANI/FLATOW TRABECULAR METAL	2	0,3	-	-	25	2,5
AEQUALIS ASCEND	21	3,6	-	-	3	0,3
PROMOS	-	-	17	0,3	6	0,6
GLOBAL ADVANTAGE	2	0,3	-	-	21	2,1
GLOBAL UNITE	3	0,5	2	0,0	15	1,5
Other (models < 20 cases)	23	3,9	156	2,4	68	6,7
Unknown	5	0,9	15	0,2	3	0,3
Total	**587**	**100,0**	**6.585**	**100,0**	**1.013**	**100,0**

Number of shoulder **Anatomical prosthesis** carried out on patients with admission date between 1st July 2008 and 31st December 2019 according to the **type of glenoid.**

Model of Glenoid	Anatomical prosthesis	
	N	%
AEQUALIS PERFORM	232	39,5
SMR RIVESTITA	158	26,9
BIGLIANI/FLATOW TRABECULAR METAL	73	12,4
BIGLIANI/FLATOW	44	7,5
SMR;SMR PEG TT	29	4,9
ANATOMICAL SHOULDER	16	2,7
Other (models < 10 cases)	32	5,5
Unknown	3	0,5
Total	**587**	**100,0**

Number of shoulder **Reverse prosthesis** carried out on patients with admission date between 1st July 2008 and 31st December 2019 according to the **type of metaglena**

Model of metaglena	Reverse prosthesis	
	N	%
SMR RIVESTITA	2.286	34,7
DELTA Xtend	1.761	26,7
AEQUALIS REVERSED	731	11,1
EQUINOXE REVERSE	353	5,4
TRABECULAR METAL REVERSE	325	4,9
SMR;SMR PEG TT	205	3,1
DUOCENTRIC	139	2,1
AEQUALIS REVERSED II	138	2,1
COMPREHENSIVE REVERSE MINI	103	1,6
AFFINIS INVERSE	90	1,4
COMPREHENSIVE REVERSE	65	1,0
ARROW	57	0,9
UNIVERS REVERS	56	0,9
TITAN REVERSE	35	0,5
ANATOMICAL SHOULDER INVERSE/REVERSE	34	0,5
HUMELOCK REVERSED	31	0,5
AEQUALIS PERFORM+ REVERSED	29	0,4
SHOULDER SYSTEM	26	0,4
DELTA CTA	21	0,3
PROMOS REVERSE	17	0,3
AGILON	14	0,2
T.E.S.S.	10	0,2
Other (models < 10 cases)	49	0,7
Unknown	10	0,2
Total	**6.585**	**100,0**

Number of shoulder **Hemiarthroplasty** carried out on patients with admission date between 1st July 2008 and 31st December 2019 according to the **type of humer head**

Model of Humer Head	Hemiarthroplasty	
	N	%
SMR	513	50,6
SMR CTA	65	6,4
BIGLIANI/FLATOW	61	6,0
DELTA XTEND CTA	58	5,7
GLOBAL ADVANTAGE	49	4,8
RANDELLI - LTO	33	3,3
AEQUALIS ASCEND FLEX PYC	39	3,8
ANATOMICAL SHOULDER FRACTURE	31	3,1
ANATOMICAL SHOULDER	26	2,6
AEQUALIS	18	1,8
AFFINIS FRACTURE	16	1,6
GLOBAL UNITE	15	1,5
M.R.S.	14	1,4
AEQUALIS ASCEND FLEX	10	1,0
Other (models < 10 cases)	65	6,4
Total	**1.013**	**100,0**

Number of shoulder **resurfacing** carried out on patients with admission date between 1st July 2008 and 31st December 2019 according to the **type of prosthesis**.

Model of prosthesis	Standard Resurfacing		Anatomical Resurfacing		Partial Resurfacing	
	N	%	N	%	N	%
SMR - Lima	54	43,5	1	8,3	-	-
EPOCA RH - Synthes	10	8,1	11	91,7	-	-
COPELAND - Biomet	18	14,5	-	-	-	-
GLOBAL CAP – DePuy	15	12,1	-	-	-	-
PYROTITAN - Ascension Orthopedics	8	6,5	-	-	-	-
AEQUALIS RESURFACING - Tornier	6	4,8	-	-	-	-
EQUINOXE - Exactech	4	3,2				
DUROM SHOULDER - Zimmer	4	3,2	-	-	-	-
COPELAND TS - Biomet	2	1,6	-	-	-	-
CAPICA - Implantcast	1	0,8	-	-	-	-
COPELAND THIN - Biomet	1	0,8	-	-	-	-
HEMICAP - Arthrosurface	-	-	-	-	1	100,0
OVO - Arthrosurface	1	0,8	-	-	-	-
Total	**124**	**100,0**	**12**	**100,0**	**1**	**100,0**

Number of shoulder **stemless** carried out on patients with admission date between 1st July 2008 and 31st December 2019 according to the **type of prosthesis**.

Model of prosthesis	Anatomical Stemless		Hemi Stemless		Reverse Stemless	
	N.	%	N.	%	N.	%
T.E.S.S. - Biomet	8	19,5	68	47,6	-	-
VERSO - Biomet	-	-	-	-	61	80,3
ECLIPSE - Arthrex	7	17,1	26	18,2	-	-
SIDUS - Zimmer	3	7,3	21	14,7	-	-
COMPREHENSIVE VERSA -DIAL- Biomet	-	-	15	10,5	-	-
AFFINIS SHORT - Mathys	5	12,2	9	6,3	-	-
MIRAI - Permedica	3	7,3	-	-	7	9,2
SMR - Lima	6	14,6	1	0,7	-	-
T.E.S.S. INVERSA - Biomet	-	-	-	-	5	6,6
BIGLIANI/FLATOW - Zimmer	4	9,8	-	-	-	-
HUMELOCK - Fx Solution	2	4,9	1	0,7	-	-
AFFINIS FRACTURE - Mathys	3	7,3	-	-	-	-
SMR INVERSA HP - Lima	-	-	-	-	3	3,9
GLOBAL ICON - DePuy	-	-	1	0,7	-	-
SIMPLICITI - Tornier	-	-	1	0,7	-	-
Total	**41**	**100,0**	**143**	**100,0**	**76**	**100,0**

20. Complications occurred during hospitalization

RIPO registers all kind of complications occurred during hospitalization. In the following tables only intra-operative and post-operative local complications are presented.

Complications rate in **primary shoulder operations (total reverse prosthesis and total anatomical prosthesis)** carried out on patients hospitalized between July 1st 2008 and December 31st 2019.

Complications occurred during hospitalization					
Intra-operative			**Post-operative local**		
	N.	**%**		**N.**	**%**
Muscular lesion	30	*0,4*	Dislocation	12	*0,2*
Tendon lesion	4	*0,1*			
Vascular lesion	1	*0,01*			
Fracture	42	*0,6*	Early Infection	1	*0,01*
Other	15	*0,2*			
Total	**92**	***1,3***	**Total**	**13**	***0,2***

Complications rate in **hemiarthroplasties** carried out on patients hospitalized between July 1st 2008 and December 31st 2019.

Complications occurred during hospitalization					
Intra-operative			**Post-operative local**		
	N.	**%**		**N.**	**%**
Muscular lesion	8	*0,8*	Early Infection	3	*0,3*
Tendon lesion	2	*0,2*			
Vascular lesion	1	*0,1*			
Fracture	12	*1,2*	Dislocation	-	-
Other	3	*0,3*			
Total	**26**	**2,6**	**Total**	**3**	***0,3***

They were observed also 3 deaths in hemiarthroplasty, 4 deaths in reverse prosthesis and 1 death in revision.

21. Duration of pre-operative and post-operative hospitalization

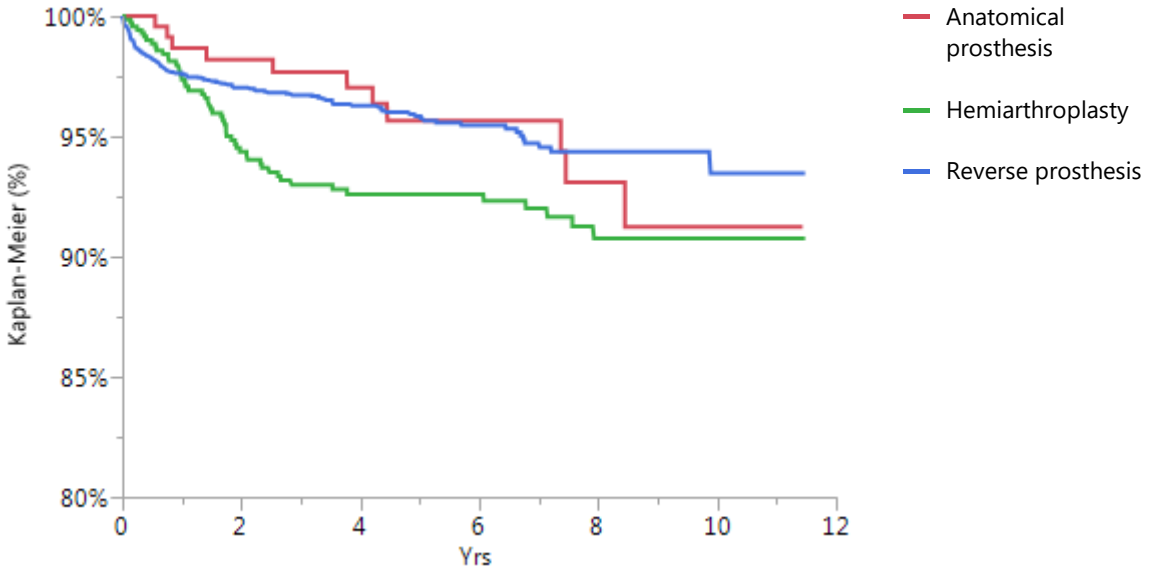
Year 2019			
Type of operation	**N.**	**Mean pre-op. (range)**	**Mean post-op. (range)**
Reverse prosthesis	1.054	1,4 (0-17)	4,0 (0-23)
Hemiarthroplasty	53	2,2 (0-12)	5,5 (2-32)
Revisions	80	0,9 (0-9)	4,8 (1-28)
Anatomical prosthesis	65	0,3 (0-1)	3,4 (2-17)
Prosthesis removal	26	1,2 (0-22)	5,8 (1-18)

22. Analysis of survival of primary surgery

Survival curve is used to estimate the probability of each patient to remain at the initial condition (unrevised prosthesis). Following figure shows curves according to Type of operation.

All primary shoulder arthroplasties performed in the Region between July 2008 and December 2019 only on patients living in the Region were analysed.

Type of operation	Number of implants	Number of revisions	Mean Follow-up	Survival at 10 yrs (C.I. 95%)	N. at risk at 10yrs
Anatomical prosthesis	245	11	5,3	91,2 (83,5-95,5)	18
Reverse prosthesis	3.691	133	3,7	93,5 (91,1-95,3)	97
Hemiarthroplasty	717	52	5,5	90,8 (87,8-93,0)	60
Standard resurfacing	41	3	7,9	92,1 (78,2-97,4)	12
Anatomical resurfacing	2	1	6,9	-	-
Partial resurfacing	1	-	-	-	-
Anatomical stemless	17	5	5,0	-	-
Hemi stemless	60	7	6,6	84,1 (69,0-92,6)	4
Reverse stemless	35	1	2,0	-	-



Difference is statistically significant (p=0,0106 Wilcoxon Test).

Survival analyses are performed only on patients living in the Emilia-Romagna region, in order to avoid the bias resulting from the 'loss' of non-resident patients

Anatomical prosthesis			
Cause of revision	**Rate**	**%**	**% distribut. of failure causes**
Instability	**4**/245	1,6	36,4
Pain	**2**/245	0,8	18,2
Total aseptic loosening	**1**/245	0,4	9,1
Glenoid erosion	**1**/245	0,4	9,1
Poly wear	**1**/245	0,4	9,1
Breakage of insert	**1**/245	0,4	9,1
Septic loosening	**1**/245	0,4	9,1
Total	**11/245**	**4,5**	**100,0**
Reverse prosthesis			
Cause of revision	**Rate**	**%**	**% distribut. of failure causes**
Septic loosening	**31**/3.691	0,8	23,3
Instability	**25**/3.691	0,7	18,8
Glenoid loosening	**21**/3.691	0,6	15,8
Dislocation	**10**/3.691	0,3	7,5
Humeral component loosening	**8**/3.691	0,2	6,0
Periprosthetic bone fracture	**6**/3.691	0,2	4,5
Glenoid erosion	**4**/3.691	0,1	3,0
Pain	**3**/3.691	0,1	2,3
Other	**8**/3.691	0,2	6,0
Unknown *(5 performed outside region)*	**17**/3.691	0,5	12,8
Total	**133/3.691**	**3,6**	**100,0**
Hemiarthroplasty			
Cause of revision	**Rate**	**%**	**% distribut. of failure causes**
Glenoid erosion	**13**/717	1,8	24,5
Instability	**8**/717	1,1	15,1
Septic loosening	**6**/717	0,8	11,3
Humeral component loosening	**4**/717	0,6	7,5
Periprosthetic bone fracture	**4**/717	0,6	7,5
Cuff arthropathy	**2**/717	0,3	3,8
Pain	**3**/717	0,4	5,7
Total aseptic loosening	**1**/717	0,1	1,9
Dislocation	**2**/717	0,3	3,8
Other	**2**/717	0,3	3,8
Unknown *(5 performed outside region)*	**7**/717	1,0	13,2
Total	**52/717**	**7,4**	**100,0**
Resurfacing			
Cause of revision	**Rate**	**%**	**% distribut. of failure causes**
Glenoid erosion	**3**/41	7,3	100,0
Total	**3/41**	**7,3**	**100,0**
Anatomical Stemless			
Cause of revision	**Rate**	**%**	**% distribut. of failure causes**
Pain	**1**/17	5,9	20,0
Septic loosening	**1**/17	5,9	20,0
Instability	**1**/17	5,9	20,0
Dislocation	**1**/17	5,9	20,0

Survival analyses are performed only on patients living in the Emilia-Romagna region, in order to avoid the bias resulting from the 'loss' of non-resident patients

Poly wear	**1**/17	5,9	20,0
Total	**5/17**	**29,4**	**100,0**
Hemi Stemless			
Cause of revision	**Rate**	**%**	**% distribut. of failure causes**
Pain	**2**/60	10,0	28,6
Glenoid erosion	**2**/60	10,0	28,6
Septic loosening	**1**/60	5,0	14,3
Humeral component loosening	**1**/60	5,0	14,3
Unknown *(1 performed outside region)*	**1**/60	5,0	14,3
Total	**7/60**	**11,7**	**100,0**
Reverse Stemless			
Cause of revision	**Rate**	**%**	**% distribut. of failure causes**
Septic loosening	**1**/35	2,9	100,0
Tota	**1/35**	**2,9**	**100,0**

22.1 Analysis of the survival of Reverse prosthesis according to the most widely used commercial models in Emilia-Romagna

Type	From years	N.	N. failures	% survival at 5 yrs (C.I. 95%)	N. at risk at 5 yrs	Mean Follow-up
SMR - Lima	2008	849	38	94,8 (92,7-96,3)	259	3,8
SMR INVERSA HP - Lima	2008	776	24	95,4 (92,9-97,0)	158	3,0
DELTA XTEND - Depuy	2008	773	22	97,9 (96,6-98,7)	378	4,9
AEQUALIS REVERSED II - Tornier	2011	327	14	91,9 (85,7-95,6)	33	2,6
EQUINOXE REVERSE - Exactech	2013	253	4	-	-	2,3
TRABECULAR METAL REVERSE - Zimmer	2008	203	7	94,3 (87,1-97,6)	59	3,6

Survival analyses are performed only on patients living in the Emilia-Romagna region, in order to avoid the bias resulting from the 'loss' of non-resident patients