Register endoprotetike Slovenije

THE NATIONAL ARTHROPLASTY REGISTRY OF SLOVENIA: 5th REPORT 2024 (data from 2019 to 2023)

ORTOPEDSKA BOLNIŠNICA
OSPEDALE ORTOPEDICO
VALDOLTRA

https://www.res-nars.si/

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Valdoltra Orthopaedic Hospital

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5TH REPORT OF THE NATIONAL ARTHROPLASTY REGISTRY OF SLOVENIA (RES) FOR THE PERIOD 2019-2023

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1 Message from the Head of the National Arthroplasty Registry of Slovenia (RES)

Dr. Vesna Levašič, PhD, MD

Dear Sir/Madam,

We present to you the 5th report of the National Arthroplasty Registry of Slovenia (RES). It includes data from the years 2019, 2020, 2021, 2022, and 2023. The RES register—and with it, the annual report—is slowly growing from an infant into a toddler.

Many changes have taken place in the past year. Most notably, we have succeeded in further digitalising data entry and have begun preparing automated data exports. Together with my colleagues, we strive to ensure that the data are up-to-date and accurate, and we contact the institutions promptly if we notice any discrepancies. Thanks to this effort, the compliance rate compared to the Health Insurance Institute of Slovenia (ZZZS) is nearly 100% at the time of publication.

We are also seeing an increase in the number of recorded surgeries, from an initial 7,821 in 2019 to 10,225 in 2023. The lowest number of procedures was recorded in 2020—6,534—due to the impact of the COVID-19 pandemic (Figure 1).

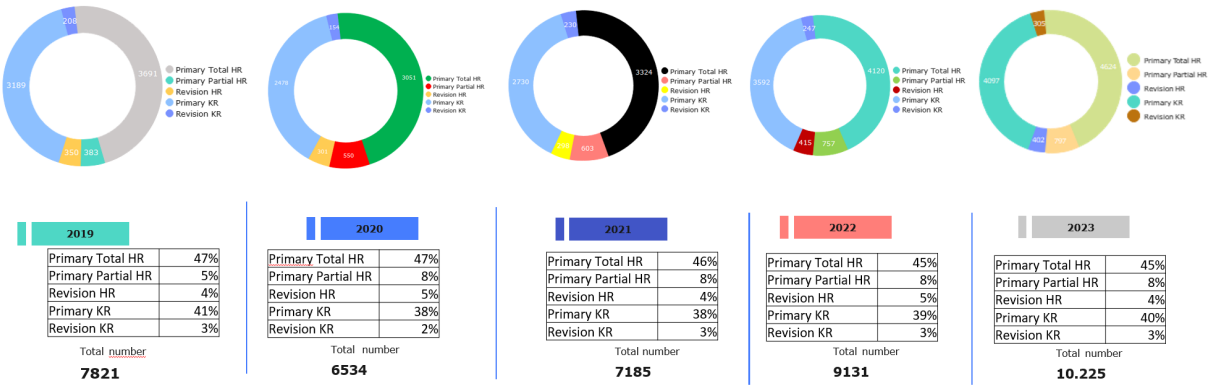


Figure 1: Number of surgeries in RES by year

At the end of 2021, the Ministry of Health added the collection of quality of life questionnaires (PROMs) to the Collections Act, namely the Oxford Hip and Oxford Knee Score and the EQ-5D-5L questionnaire. In 2022, we newly developed the PROMs application as an additional RES module. We employed the first one, and then last year, a second administrator for data entry and calling patients 6 and 12 months after surgery. This report shows the results of the responses of patients operated on in 2023. PROMs are a very current topic in the registries,

which was also recognised by our Ministry of Health in its VBHC program. Many of you have positively received our website https://www.res-nars.si/en , especially the Statistics tab, where data is displayed in real time as it is entered into the application. This tab is interactive, you can select the type of joint, individual year, provider, and you have an overview of the preoperative diagnosis, age structure of patients, approach and manufacturers of endoprostheses used. The website also publishes all annual reports, publications related to RES, and a description of activities.

Dear colleagues, patients, and decision-makers, I invite you to review the latest report in the hope that it will satisfy your curiosity, and we are also open to your comments and suggestions.

2 Statistical report

Prof. Dr. Eva Podovšovnik, PhD

The Valdoltra Orthopedic Hospital (OB Valdoltra), as the manager of the National Arthroplasty Registry of Slovenia (RES), has been collecting data on hip and knee endoprostheses implanted in hospitals in the Republic of Slovenia (RS) to patients who are citizens of the RS, since 1 January 2019. With the amendment to the Health Care Databases Act (ZZPPZ-B) in 2018, the RES has obtained a legal basis for its operations. The manager of the database under the serial number NIJZ 53.1 of the the National Arthroplasty Registry is OB Valdoltra, which gives us the authority to collect data on hip and knee endoprostheses from all Slovenian public and private institutions that perform hip and knee arthroplasty, for insured persons of the Health Insurance Institute of the Republic of Slovenia (ZZZS) and self-payers. The law came into effect on 1 January 2019, so providers performing hip and knee arthroplasty must, on the 1st of each month, send completed forms found on the RES website, with original implant labels and complete patient information to the RES, which is based in the OB Valdoltra. This data is gathered on prescribed forms and is then digitised (form[1]).

The RES gathers basic data of the patient[2] who has had an endoprosthesis or part of it inserted, replaced or removed in the hip or knee joint. In addition, the RES also keeps data on the provider[3], data on the implanted parts of the endoprosthesis[4], data on the surgical procedure[5] and also data on the previous surgical procedure[6] in the case of removal of a previously inserted endoprosthesis or part of it. The data is stored permanently in the RES.

On 14 July 2021, the Ministry of Health added to Annex 1 of the ZZPPZ-B the collection of quality of life questionnaires (PROMs), namely the Oxford Hip Score (OHS) and Oxford Knee

[1] All necessary forms for data reporting are available on the website https://www.res-nars.si/.
[2] The basic patient data that is entered into the RES are the ZZZS health insurance number, EMŠO, personal name, birth surname, gender, date of birth, place of birth, citizenship, CRP changes (general status, date, type and group of event), residence (permanent and temporary, residence for mail delivery), date and place of death, education, marital status and occupation.
[3] The following information about the provider is entered in the RES: personal name, healthcare professional number, ZZZS number of thesurgeon, title, provider number and ZZZS number of the healthcare provider where the procedure was performed.
[4] Data on the installed parts of the endoprosthesis that are kept in the RES are: manufacturer, type, original name, catalog number, part of the endoprosthesis, type of material and method of fixation of the endoprosthesis.
[5] The following data about the surgical procedure is kept in the RES: date, side of the procedure, reason for the operation - diagnosis or reason for revision, previous surgical procedures on the joint in question, surgical approach and, in the case of revision, its scope.
[6] Regarding the previous surgical procedure to remove a previously inserted endoprosthesis or part thereof, data on the date of the previous surgical procedure, the healthcare provider of the previous surgical procedure, and the removed part of the endoprosthesis are entered in the RES.

Score (OKS) and the EQ-5D-5L questionnaire. Preoperative forms are collected in paper form by individual hospitals. Digitisation took place in parallel with the digitisation of the RES register itself. Patients are invited 6 and 12 months after surgery to complete quality of life questionnaires by phone or in writing. The data is stored permanently in the RES application.

The manager obtains relevant data for the collection from the Central Population Register (CRP), the Register of Spatial Units of the Republic of Slovenia, the Register of Movement of Health Workers and the Network of Health Institutions, from the ZZZS from the Register of Insured Persons of Compulsory Health Insurance and the Central Patient Data Register (CRPP) based on the connecting character of the Unified Citizen Identification Number (EMŠO) or the ZZZS number of the insured person.

Providers who perform arthroplasty for their patients and the National Institute of Public Health (NIJZ) are entitled to access the obtained data.

The RES collection is maintained for the following reasons:

- monitoring the survival[7] of inserted hip and knee endoprostheses,
- ensuring control over the quality of endoprosthetic surgeries,
- enabling rapid detection of lower quality endoprostheses,
- indirectly also reducing the costs of primary and revision hip and knee endoprostheses surgeries,
- as a basis for clinical and epidemiological studies and expert analyses, and
- providing data for CRPP.

According to the ZZPPZ-B, the manager (OB Valdoltra) is obliged to analyse the obtained data and prepare and publish periodic reports on its website, at least once a year. All reports are published on the RES website https://www.res-nars.si/en .

In this document, we present an analysis of the data for the period from 2019 to 2023. It should be noted that the number of units in individual analyses may differ due to missing data. This is presented in more detail for each analysis separately. In the chapter on the research plan, we describe the method of obtaining data. Then we provide general information about hospitals and surgical procedures. Each chapter ends with an analysis of the survival of hip endoprostheses and, subsequently, knees. This is followed by a concluding chapter with key findings and proposed measures.

[7] Survival is defined as the time from endoprosthesis insertion to its removal.

3 Summary of key findings

Asst. Prof. Dr. Simon Kovač, PhD, MD, orthopaedic surgery specialist

This year's report confirms a continued increase in the number of hip and knee surgeries in Slovenia. In 2023, the number of these procedures registered in the national registry rose by 12.1% compared to 2022. Most surgeries were performed in public institutions, although procedures at concessionaire facilities are also increasing.

Many factors are known to influence the outcomes of total hip and knee replacements. Consequently, this year's report includes tables outlining reasons for endoprosthesis revisions, along with corresponding probabilities. These data provide insight into which factors most affect the likelihood of early revision. This allows us to assess whether a higher-than-average revision rate may be related to prosthesis design.

The 2023 report presents three-year outcome data, as four-year data remain unreliable due to the smaller number of observed prostheses. The cumulative three-year revision rate for total hip arthroplasty in Slovenia is 2.26%.

The use of cemented hip prostheses has continued to decline, while the proportion of hybrid endoprostheses has increased slightly. The anterior surgical approach is becoming more common. The most frequently used head size remains 32 mm, although the use of 36 mm heads has increased slightly. Notably, the revision rate for prostheses with 36 mm heads is the highest at 2.72% after three years. Dual-mobility heads accounted for 8.6% of implants in 2023, up by 1.3%. The share of ceramic heads continues to rise. The best currently observed survival is associated with ceramic heads paired with classic polyethylene, although results are still preliminary due to limited follow-up. Globally, cross-linked polyethylene demonstrates significantly lower revision rates than classic polyethylene.

In 2023, a total of 402 revision hip arthroplasties were recorded, approximately three-quarters of which were first revisions. Aseptic loosening remains the leading cause, followed by infection. The lateral surgical approach is most commonly used in revisions.

The report also includes 12-month PROMs results. Improvement in the Oxford Hip Score (OHS) was slightly greater in women, with the most significant gains observed in patients aged 55 to 65.

Partial hip arthroplasties continue to increase year by year—797 were recorded in 2023, with two-thirds performed on women and one-third on men. The posterior approach is not used for these procedures; the other three surgical approaches are used in roughly equal proportions. Cemented prostheses dominate this group, comprising 79.8% of implants in 2023. The 90-day postoperative mortality rate has remained steady between 2019 and 2023, at around 14%.

In 2023, 3,546 primary total and 551 primary partial knee replacements were performed, totaling 4,097—a 15.5% increase from 2022. This year's report presents combined data for total and partial prostheses in the introduction, while revision probabilities are shown separately. The three-year cumulative revision rate is 2.87% for total knee replacements and 3.35% for partial ones. It is worth noting that one type of uncemented partial prosthesis shows particularly poor results. The patellofemoral prosthesis was used in only 15 cases in 2023.

Fully cemented endoprostheses remain predominant in knee arthroplasty, representing 83.2% of cases in 2023. The medial parapatellar approach was the most commonly used, at 89.3%.

Twelve-month PROMs results for knee replacements are also included. Of all patients, 1,449 (39.3%) completed the OKS questionnaire. Improvements were similar between men and women, with the greatest, although not statistically significant, improvement in the 55–65 age group. The greatest gain in EQ-5D-5L scores was seen in patients younger than 55.

In 2023, 305 knee endoprosthesis revisions were performed—fewer than hip revisions. Unlike hip prostheses, infections were the most common cause of knee revisions, followed by aseptic loosening. This trend also holds for prostheses implanted between 2019 and 2023, where infection remains the leading cause, followed by instability or malalignment. This indicates that most revisions stem from surgical complications rather than implant design.

In contrast to global trends, Slovenia reports a higher three-year revision rate for cemented total knee prostheses compared to uncemented ones. However, this may be due to the predominance of a single uncemented model in the country. The revision rate for partial knee replacements strongly depends on the implant type. Three types show lower revision rates than total knee prostheses, while one has significantly worse outcomes. The primary cause for revision in that case is early aseptic loosening, and the implant is no longer in use.

Looking ahead, continued high compliance in data collection and longer follow-up periods will allow for even more reliable analysis and an accurate picture of hip and knee arthroplasty outcomes in Slovenia.

4 List of abbreviations

C

CI – confidence interval

CoC – ceramic-on-ceramic bearing surface

CoP – ceramic-on-polyethylene bearing surface

CoXP – ceramic-on-crosslinked polyethylene bearing surface

CRP – Central Population Register

CRPP – Central Patient Data Register

E

EMŠO – Unified Citizen Identification Number

EQ-5D-5L – Standardised Questionnaire for Self-Assessment of Quality of Life

I

IQ – interquartile range

IS – information system

IT – information technology

K, L

KS – Clinical Sanatorium

M

Me – median

MoP – metal-on-polyethylene bearing surface

MoXP – metal-on-crosslinked polyethylene bearing surface

MZ – Ministry of Health

N

NIJZ – National Institute of Public Health

O

OB – Orthopaedic Hospital

OECD – Organization for Economic Co-operation and Development

OHS – Oxford Hip Score

OKS – Oxford Knee Score

P, Q

PE - polyethylene

PEP - partial endoprosthesis

PROM - patient-reported outcome measure

R

RES – The National Arthroplasty Registry of Slovenia

RS – Republic of Slovenia

S

SB – General Hospital

SD – Standard Deviation

SURS – Statistical Office of the Republic of Slovenia

T

TEP – total endoprosthesis

U, V, W

UKC – University Clinical Center

X, Y

XLPE – Highly cross-linked polyethylene

Z

ZZPPZ-B – Act on Databases in the Field of Healthcare

ZZZS – Health Insurance Institute of Slovenia

5 Terminology used

A

The acetabular component is the part of a total hip replacement that is inserted into the acetabulum. The acetabular component may consist of a single part (monobloc) or multiple parts (modular acetabular component). Typically, a modular acetabular component consists of a metal cup and an insert.

Arthrodesis is a procedure in which the bones of a natural joint are fused together.

Arthroplasty is a procedure in which a native joint is surgically replaced with an artificial prosthesis.

Aseptic loosening of a prosthesis means loosening of a part of or the whole prosthesis without evidence of inflammation.

B

A **bilateral prosthesis** is an endoprosthesis that has been inserted into the knee/hip on both sides at the same time

A **bipolar head endoprosthesis** is a composite head of the femoral part of the prosthesis used for hemiarthroplasty, where the smaller head is fixed to the stem of the prosthesis, and the larger head snaps onto the smaller head. The result is that movement can occur in two planes, one between the smaller and larger heads and one between the larger head and the acetabulum of the pelvis.

The **bearing surface** represents the two surfaces in the combination of the head and the acetabulum in a total hip endoprosthesis that articulate together. The report includes metal-on-polyethylene, metal-on-metal, ceramic-on-polyethylene, ceramic-on-ceramic, and dual-mobility heads, where the outer polyethylene part of the head articulates with the metallic acetabular component.

C

Cement is the material used to attach joint replacements to the bone – polymethyl methacrylate (PMMA).

A **cemented endoprosthesis** is a prosthesis that is designed to be attached to the bone with bone cement.

An **uncemented endoprosthesis** is fixed in such a way that the bone gradually grows into the surface of the endoprosthesis. This process is called osseointegration.

The **confidence interval** is the interval that contains the true value of the parameter with a certain level of confidence (usually 95%).

Compliance is the ratio between the completed forms in the RES database for a certain period and the record of the number of registered cases of hip or knee arthroplasty by the ZZZS (in the same period).

Cross-linked polyethylene has a modified network structure. This structure is created during the cross-linking process, where additional links are formed in the material, increasing its density and resistance to deformation at high temperatures.

Cumulative revision rate: The cumulative revision rate is defined as 1 - S(t), where S(t) represents the survival probability estimated using the Kaplan-Meier method. This measure reflects the proportion of primary replacements that have been revised by time t, accounting

for right-censored data such as patient death or the end of the observation period due to database closure.

Data coverage is a measure of how well the data covers a specific area, population, region, or category. Coverage is crucial in data analysis, as it affects the reliability of the results and the conclusions that can be drawn from them.

A **dislocation of a part of an endoprosthesis** in a hip prosthesis means that the articular head has slipped out of the centre of the cup. In a knee prosthesis, this typically means that the patella has shifted to one side, but it can also occur when the PE insert has slipped or the prosthesis completely dislocates.

A **dual mobility** hip replacement is the type of replacement featuring two articular surfaces: an inner articulation, where the head of the prosthesis moves within the greater polyethylene head, and an outer articulation, where the polyethylene head moves within the metal acetabulum shell. This dual articulation allows for an increased range of motion and better stability, which is particularly beneficial for patients at higher risk of dislocation.

E

An **endoprosthesis** is an artificial orthopaedic implant that replaces a defective joint or part of a bone.

The **endoprosthesis insert** is part of a knee endoprosthesis and is attached to the surface of the tibial plateau to provide an articular surface with the femoral component. Acetabular inserts are part of a hip prosthesis and are inserted within the modular acetabular component.

An **endoprosthesis manufacturer** is the company that manufactures part or all of an endoprosthesis.

The **endoprosthesis neck** is the part of the proximal stem of a hip prosthesis.

Endoprosthesis type is a generic description of the prosthesis, e.g. cemented stem (hip), patellofemoral endoprosthesis (knee).

F, G

Femoral stem is the stem of a hip replacement that is inserted into the patient's femur (thigh bone). A modular head is attached to the neck of the stem. The stem can also have a modular structure with a modular neck of a proximal stem.

Femoral knee component is the part of a knee prosthesis used to replace the surface of the femur (thigh bone).

A **fracture** of a part of an endoprosthesis is when one part of the endoprosthesis cracks or breaks.

H

The **head of an endoprosthesis** is the spherical part of the femoral component of an artificial hip replacement, usually modular. Older models had the head firmly attached to the stem (monobloc).

A **hybrid prosthesis** is an arthroplasty in which one component is cemented and the other is uncemented.

In hip arthroplasty, "hybrid" refers to the combination of a cemented stem and an uncemented acetabular component, while "reverse hybrid" refers to the combination of an uncemented stem and a cemented acetabular component.

In the case of knee arthroplasty, "hybrid" refers to the combination of an uncemented femoral component and a cemented tibial component, and "reverse hybrid" is the reverse combination.

I, J

Incidence refers to the number of events in a given population over a limited period of time.

The **incidence rate** is the number of new cases per specified number of people (for example, per 1,000 or 100,000 people) per year. It is an important indicator in epidemiology, as it allows comparisons between different groups or regions.

The **interquartile range** is the range of values from the 25th (first quartile) to the 75th (third quartile) percentile of the distribution of variables.

K

The **Kaplan-Meier Survival Curve** shows the proportion of patients who are revision-free over time. It accounts for censored data —that is, patients whose outcomes are unknown due to death or database closure.

L

Lethality is the number of deaths from a specific disease (in our case, surgery), usually calculated per 100 patients. The meaning is often mistakenly equated with **mortality**.

M, N

A **minimally invasive surgical approach** is an operation performed through small incisions (usually less than 10 cm). This may require the use of special instruments.

Modified polyethylene is any polyethylene component that has been modified in some way to improve its performance characteristics. Some of these processes involve chemical changes, such as increasing the cross-linking of the polymer chains or the addition of vitamin E and/or other antioxidants.

A **modular component** consists of more than one piece, e.g. modular acetabular cup with a modular insert or a femoral stem with a modular femoral head.

A **modular stem** is a femoral stem that consists of an additional modular neck and also has a modular head.

A **monobloc component** is assembled or supplied as one piece, e.g. a monobloc knee tibial component.

Mortality is the number of deaths per specified population (usually per 1,000) in one year

O

Osteoarthrosis is a degenerative joint disease in which the articular cartilage wears away and the bone underneath changes.

Osteolysis is the pathological destruction or disappearance of bone tissue.

Osteosynthesis is a fracture that has been repaired with, for example, plates, screws, nails, or wires.

An **osteotomy** is a surgical procedure in which a bone is intentionally cut to change its shape, length, or alignment. This procedure is usually used to treat bone deformities, improve joint function, or reduce pain.

The **Oxford Hip Score** is a standardized questionnaire to measure function and pain after hip arthroplasty.

The **Oxford Knee Score** is a standardized questionnaire to measure function and pain after knee arthroplasty.

P, Q

In **partial knee arthroplasty**, only one compartment of the knee, which consists of three compartments: medial (inner), lateral (outer), and patellofemoral (anterior), is resurfaced with prosthetic components.

The **patient** is the person using the health care service.

The **patellar part** of the knee endoprosthesis. It's a polyethylene button cemented into the inner surface of the patella. There are also designs in which the polyethylene button is attached to a metal plate. See also patella resurfacing.

A **patellofemoral endoprosthesis** is a knee implant that replaces the patellofemoral joint surface. It is a two-piece knee prosthesis that provides an articular surface between the patella and the trochlea.

Patellar resurfacing is the fixation of a polyethylene button to the bony part of the patella.

Periprosthetic joint inflammation is (usually) a bacterial infection of the implanted endoprosthesis.

Prevalence is the proportion of individuals who suffer from a particular disease or condition.

Primary knee arthroplasty refers to the initial (first) total or partial knee replacement surgery.

Primary partial hip arthroplasty refers to the initial partial hip replacement surgery.

Primary total hip arthroplasty refers to the initial total hip replacement surgery.

The **procedure** is a single operation. See also primary hip/knee replacement and revision hip/knee.

The **provider of healthcare services** is a public health institution or other legal person in the Republic of Slovenia that has a contract with the ZZZS for the provision of certain health services or offers these services on a self-pay basis.

R

A **reverse hybrid endoprosthesis** is a total hip prosthesis with a cemented acetabulum and an uncemented stem.

Revision burden is the number of revisions in a given period x 100 / the sum of the number of primary and revision surgeries in the same period. It is the proportion of revision surgeries performed as a % of the total number of surgeries for a given joint.

Revision hip arthroplasty refers to the re-operation of a previously implanted hip/knee replacement, where one or more prosthetic components are replaced, removed, or added.

Revision knee arthroplasty refers to the re-operation of a previously implanted knee replacement, where one or more prosthetic components are replaced, removed, or added.

Rheumatoid arthritis is an autoimmune inflammatory disease of the joints.

S

The **surgical approach -** the specific pathway or technique used by the surgeon to access a joint during an operation.

T

The **tibial component** is a part of a knee prosthesis used to replace the articular surface of the tibia of the knee joint. It can be modular or monobloc (one-piece).

A **two-stage revision** is a revision procedure that consists of two consecutive events, where the second stage of a two-stage revision follows the first stage of revision. It is used in some cases of infection of joint prostheses.

U

Unicondylar arthroplasty is the replacement of one tibial condyle and one femoral condyle in the knee, with or without patellar resurfacing.

V, W, X, Y, Z

6 Research design

RES obtains data directly from hip and knee arthroplasty providers in the Republic of Slovenia, who are obliged, according to the Health Care Database Act, to send data on knee and hip arthroplasty performed at least once a month on prescribed forms. The RES manager, OB Valdoltra, then checks the data for consistency with those held by the Slovenian Health Insurance Institute, which is the payer for this activity and has control over the actual procedures performed.

Until 2022, we manually entered the data into the Microsoft Excel application. In 2022, we digitalised RES. Since the second half of 2022 (when the application was tested), we have been entering data directly into the application. We then import it into the IBM SPSS PASW Statistics and R computer programs, where we perform all statistical analyses. For graphic displays, we use the IBM SPSS PASW Statistics, Tableau, Microsoft Excel and R programs.

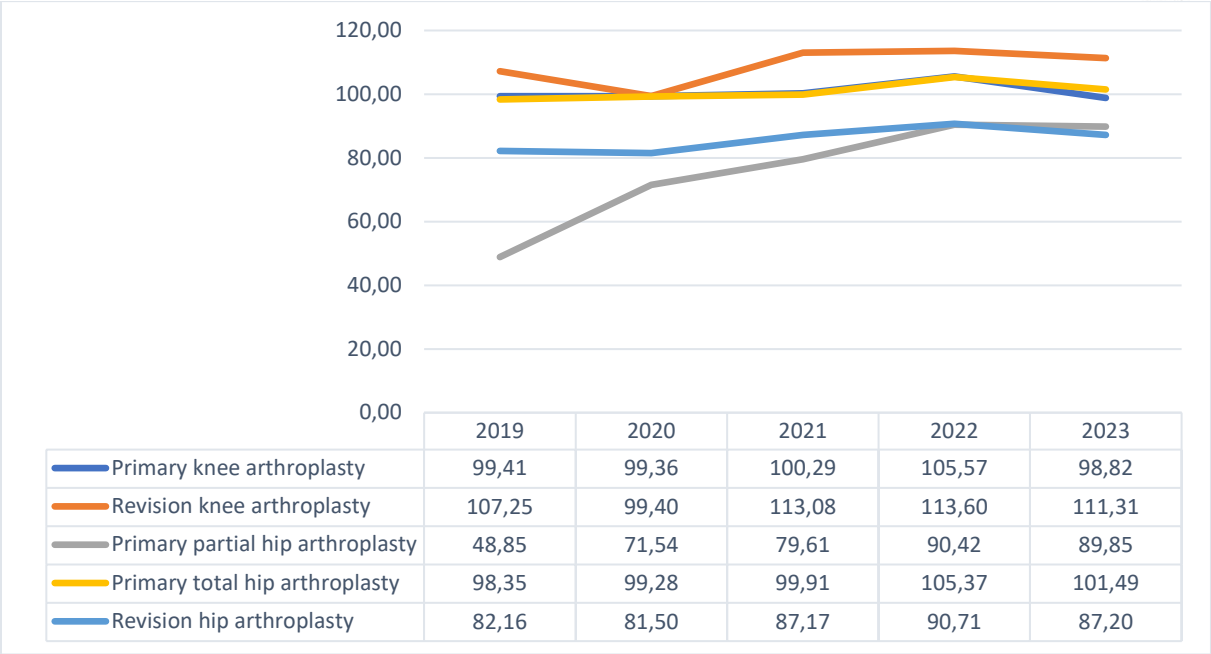
6.1 Compliance with received forms

Figure 2 shows the ratio (share) between the forms received in the RES database and the data on the number of knee and hip arthroplasties (ZZZS data). In report, we present the data for the period from 1.1.2019 to 31.12.2023, with forms received by 17.8.2024. In total, data for 18,817 primary total hip arthroplasties, 3,093 primary partial hip arthroplasties, 16,070 primary knee arthroplasties, 1,768 revision hip arthroplasties and 1,194 revision knee arthroplasties were received.

The ratio between forms received in the RES database and data from the ZZZS has been steadily increasing since 2019. In 2019, compliance was 93.5%, in 2020, 95.2%, in 2021, 97.8%, in 2022, 103.5% and in 2023 99%.[8].

Based on the above, we can conclude that the RES database has a high level of comparability with the actual number of hip and knee arthroplasties, which allows us to generalise the results obtained at the national level. The larger number of entries in the RES is a result of reporting self-paid procedures and procedures paid for through ZZZS conventions with foreign insurance companies.

[8] In the RES database, we have a larger number of data, as the unit of observation is each side of the hip or knee, while in the ZZZS database, the unit of observation is a single surgical procedure (in the case of surgical procedures on both hips or both knees, this is recorded as one piece of data).

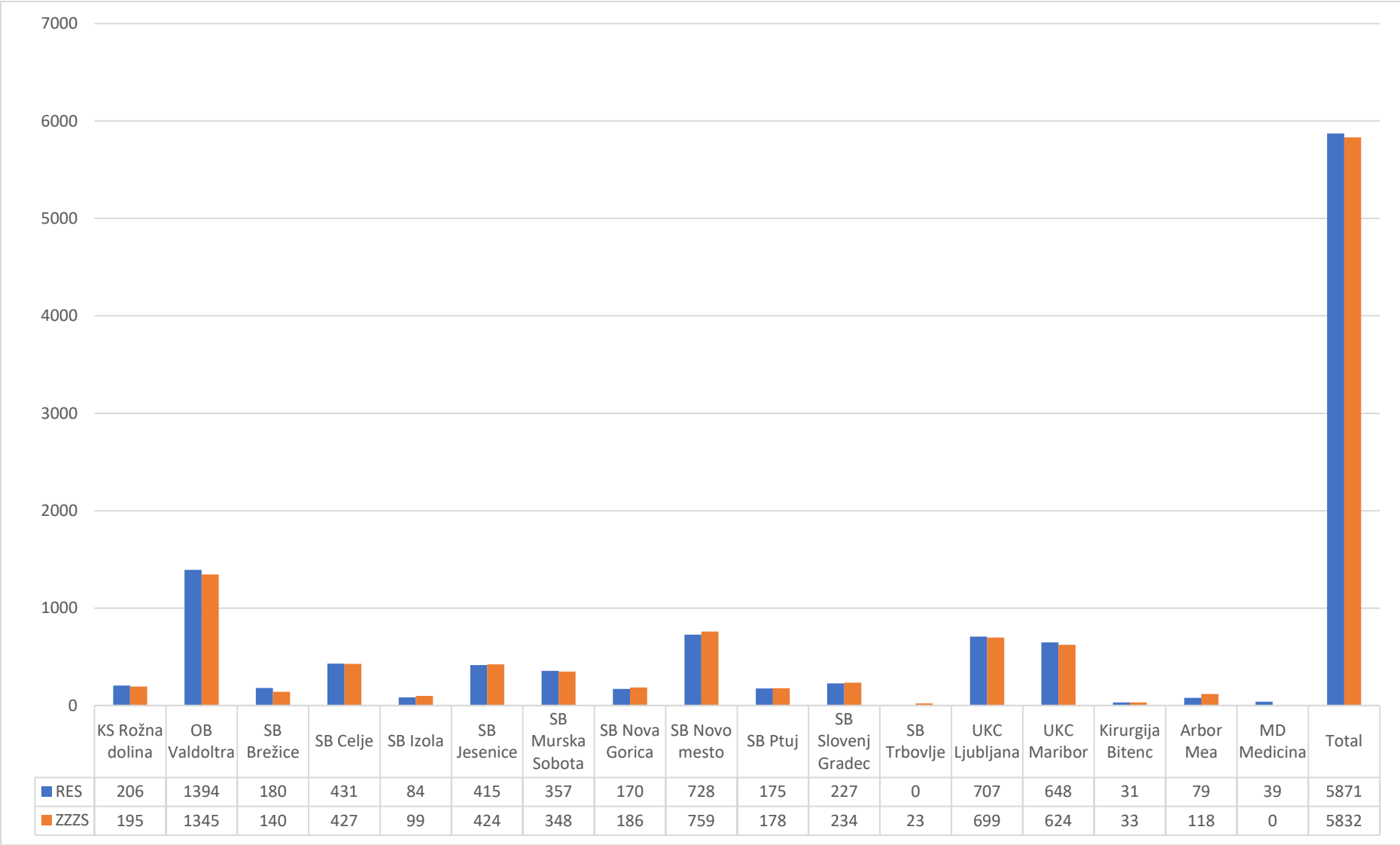


	2019	2020	2021	2022	2023
Primary knee arthroplasty	99,41	99,36	100,29	105,57	98,82
Revision knee arthroplasty	107,25	99,40	113,08	113,60	111,31
Primary partial hip arthroplasty	48,85	71,54	79,61	90,42	89,85
Primary total hip arthroplasty	98,35	99,28	99,91	105,37	101,49
Revision hip arthroplasty	82,16	81,50	87,17	90,71	87,20

Figure 2: Ratio between forms received (RES) and hip and knee arthroplasties performed (ZZZS) in % (Source: RES and ZZZS).

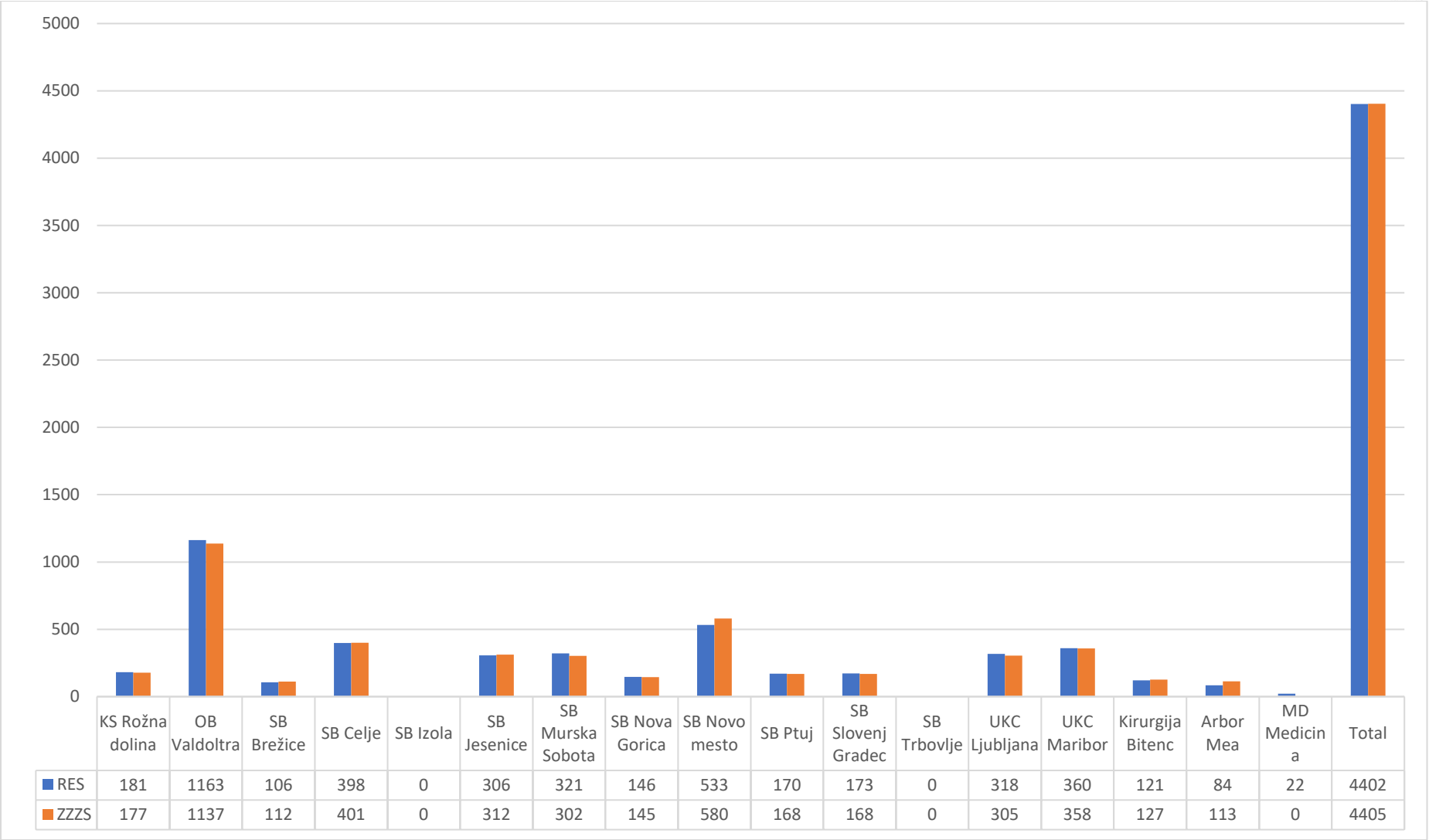
The largest number of hip arthroplasties, 1,394, was received from the Valdoltra General Hospital (Figure 3). This was followed by the Novo Mesto General Hospital (728 forms received), the Ljubljana University Hospital (707 forms), the Maribor University Hospital (648 forms), the Celje General Hospital (431 forms), the Jesenice General Hospital (415 forms) and the Murska Sobota General Hospital (357 forms). The other providers sent fewer than 300 forms each. The Trbovlje General Hospital did not send any forms on hip arthroplasties performed between 2019 and 2023, even though they have 23 such surgical procedures recorded in the ZZZS database in 2023. The MD Medicina Private Hospital performs only private surgical procedures that are not recorded by the ZZZS.

The largest number of knee arthroplasties in 2023 was sent by the Valdoltra General Hospital (1,163). This is followed by SB Novo mesto (533 forms), SB Celje (398 forms) and UKC Ljubljana (318 forms) and SB Jesenice (306 forms). Other providers sent fewer than 300 received forms each. MD Medicina performed only self-pay surgical procedures in 2023, which are not recorded by the ZZZS. (Figure 4)



	KS Rožna dolina	OB Valdoltra	SB Brežice	SB Celje	SB Izola	SB Jesenice	SB Murska Sobota	SB Nova Gorica	SB Novo mesto	SB Ptuj	SB Slovenj Gradec	SB Trbovlje	UKC Ljubljana	UKC Maribor	Kirurgija Bitenc	Arbor Mea	MD Medicina	Total
RES	206	1394	180	431	84	415	357	170	728	175	227	0	707	648	31	79	39	5871
ZZZS	195	1345	140	427	99	424	348	186	759	178	234	23	699	624	33	118	0	5832

Figure 3: Number of forms received in RES and number of recorded total hip arthroplasties according to ZZZS data for 2023 (Source: RES and ZZZS).



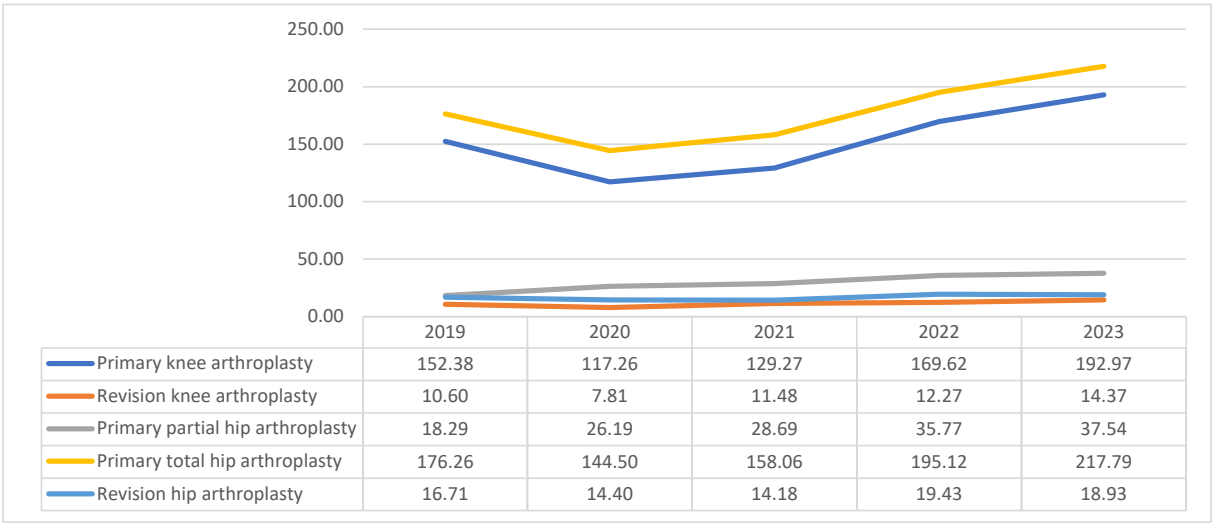
	KS Rožna dolina	OB Valdoltra	SB Brežice	SB Celje	SB Izola	SB Jesenice	SB Murska Sobota	SB Nova Gorica	SB Novo mesto	SB Ptuj	SB Slovenj Gradec	SB Trbovlje	UKC Ljubljana	UKC Maribor	Kirurgija Bitenc	Arbor Mea	MD Medicina	Total
RES	181	1163	106	398	0	306	321	146	533	170	173	0	318	360	121	84	22	4402
ZZZS	177	1137	112	401	0	312	302	145	580	168	168	0	305	358	127	113	0	4405

Figure 4: Number of forms received in RES and number of all knee arthroplasties recorded according to ZZZS data for 2023 (Source: RES and ZZZS).

Figure 5 shows the incidence rate of individual arthroplasties in the Republic of Slovenia for the period from 2019 to 2022. First, we obtained data on the number of inhabitants – we used the website www.stat.si, which is the official website of the Statistical Office of the Republic of Slovenia (SURS). We took into account the number of inhabitants of the Republic of Slovenia for the fourth quarter (Q4) of each year. We calculated the incidence rate using the following formula:

$$incidence\ rate(year) = \frac{number\ of\ RES\ operations\ (year)}{100{,}000\ inhabitants\ of\ the\ Republic\ of\ Slovenia\ (year, Q4)}$$

The highest incidence rate (Figure 5) is observed in total hip arthroplasty (ranging from 144.5 operations per 100,000 population of the Republic of Slovenia in 2020 to 217.8 operations per 100,000 population of the Republic of Slovenia in 2023) and primary knee arthroplasty (total and partial combined) (ranging from 117.3 operations per 100,000 population of the Republic of Slovenia in 2020 to 193 operations per 100,000 population of the Republic of Slovenia in 2023). The incidence rate in the case of partial hip arthroplasty ranges from 18.3 (in 2019) to 37.5 (in 2023) operations per 100,000 population of the Republic of Slovenia. In the case of revision hip arthroplasty, the incidence rate is from 14.2 (in 2021) to 19.4 (in 2022) operations per 100,000 inhabitants of the Republic of Slovenia. The lowest incidence rate is observed in revision knee arthroplasty: from 7.8 (in 2020) to 14.4 (in 2023) operations per 100,000 inhabitants of the Republic of Slovenia.



	2019	2020	2021	2022	2023
Primary knee arthroplasty	152.38	117.26	129.27	169.62	192.97
Revision knee arthroplasty	10.60	7.81	11.48	12.27	14.37
Primary partial hip arthroplasty	18.29	26.19	28.69	35.77	37.54
Primary total hip arthroplasty	176.26	144.50	158.06	195.12	217.79
Revision hip arthroplasty	16.71	14.40	14.18	19.43	18.93

Figure 5: Incidence rate of number of operations per 100,000 population by year (Source: RES, SORS).

6.2 Healthcare service providers

Table 1 shows that 17 providers[9] in the Republic of Slovenia perform hip and knee arthroplasty. It should be noted that data on the number of operations is obtained both through RES and from ZZZS records, which means that sometimes data on self-paid surgical procedures is missing, which should also be obtained from providers under the ZZPPZ-B. It is clear that despite the legal obligation to provide data, there are providers who do not report the necessary data to RES at all (SB Trbovlje). Bitenc Surgery began sending data on arthroplasty to the RES database in 2020, and Arbor Mea and MD Medicina in 2022. SB Izola does not perform knee arthroplasty.

[9] We obtained information for SB Trbovlje through the records of the Slovenian Health Insurance Institute.

Table 1: List of providers who perform hip and knee arthroplasty in the Republic of Slovenia (Source: OB VALDOLTRA)

Service provider	Data for 2019 to 2023	
	Hip	Knee
KS Rožna dolina	Yes	Yes
OB Valdoltra	Yes	Yes
SB Brežice	Yes	Yes
SB Celje	Yes	Yes
SB Izola	Yes	No
SB Jesenice	Yes	Yes
SB Murska Sobota	Yes	Yes
SB Nova Gorica	Yes	Yes
SB Novo mesto	Yes	Yes
SB Ptuj	Yes	Yes
SB Slovenj Gradec	Yes	Yes
SB Trbovlje	No	No
UKC Ljubljana	Yes	Yes
UKC Maribor	Yes	Yes
Kirurgija Bitenc	Yes	Yes
Arbor Mea	Yes	Yes
MD Medicina	Yes	Yes

6.3 Data description

As part of RES, we collect data about the patient, the surgical procedure and the implant, as well as data that the patient completes in a health self-assessment (PROMs).

6.3.1 Data about patients

The collected information about the patient is: their name and surname, date of birth, date of death, permanent address, their Unified Citizen Identification Number (EMŠO), and health insurance number. For data processing, the individual's data is excluded from the analysis. In the analysis, we only consider the Number and the individual's date of birth, from which we calculate their age at the time of surgery.

Data entry users in the application obtain the remaining patient data from the CRRP (Central Patient Data Register) using the health insurance number or EMŠO number. Data on (possible) patient deaths is also updated daily in the RES application.

6.3.2 Data about surgery

We collect basic information about the surgery: the date of the surgery, the hospital code and the surgeon code. These are provided to us by the providers on prescribed forms.

The following information varies depending on the type of arthroplasty and whether the primary surgery or revision surgery was performed.

In the part of the questionnaire intended for primary surgery, the side of the hip or knee surgery is first recorded. This is followed by information on the diagnosis, previous surgeries, the current surgery, prosthesis fixation and the approach used. This part is adapted to the type of endoprosthesis – hip or knee. The final part of the questionnaire for primary endoprostheses collects information about the implant. For hip endoprosthesis, data are collected on the acetabular part, insert, ring, femoral part, neck and head. In addition, it is also recorded whether screws, wires and plates were used. In the case of knee endoprosthesis, data are recorded on the femoral part, tibial part, insert, patellar button and stem extension. As in the

case of hip endoprosthesis, in the case of knee endoprosthesis, whether screws, wires and plates were used is entered under other.

The form intended for revision of hip and knee endoprostheses first records which side was operated on. This is followed by information on previous surgical procedures on the same hip or knee (anamnesis): primary surgery, replacement, removal and date of previous surgery. The questions are adapted to the type of surgical procedure (hip or knee). Then, data are collected on the new implant, separately for hip and knee endoprosthesis. In the case of hip endoprosthesis, there are questions related to the acetabular part, insert, ring, femoral part, neck and head. In addition, it is recorded whether screws, wires and plates were used. In the case of knee endoprosthesis, data are recorded on the femoral component, the tibial component, the insert, the patellar component and the tibial or femoral stem. In addition, it is recorded whether screws, wires and plates were used. The reasons for revision are then listed, for both knee and hip endoprostheses, with one of the listed reasons being selected. In the case of hip endoprosthesis, information is recorded on the current surgical procedure on this hip: the extent of the revision, the 2-stage revision designation, the conversion to a total prosthesis, the approach and other specifics. In the case of knee endoprosthesis, the extent of the revision and the approach are recorded as well. The last part of the questionnaire provides information on the removed part of the prosthesis, separately for hip and knee endoprosthesis.

All data on the surgical procedure are recorded by their providers on prescribed forms, which are published on the RES website: https://www.res-nars.si/en.

6.3.3 Self-assessment of health and quality of life of patients – PROMs questionnaires

We began collecting data on self-reported health and quality of life of patients who had undergone hip or knee arthroplasty in September 2022. Validated questionnaires are translated into Slovenian(patient-reported outcome measures – PROMs).

The data collection methodology in this case is as follows. We send printed consent forms for data collection to all hip and knee arthroplasty providers in the Republic of Slovenia (RS) and questionnaires for collecting data on well-being and quality of life for patients who have been referred for hip or knee arthroplasty. The providers then provide all patients who have been referred for hip or knee arthroplasty with consent forms and questionnaires on well-being (OHS or OKS) and quality of life (EQ5D5L) for completion before surgery. It is recommended that patients complete these forms when they visit the anesthesiology clinic or on the day of hospitalisation. The providers then send these forms back to RES. Data entry workers enter this data into the RES application and link it to the appropriate surgery. The application then creates a worksheet, and the RES manager calls the patient after 6 and 12 months (if they have signed a consent to use the phone number) or sends questionnaires by return mail and asks the patient again about their well-being and quality of life. The data is entered into the RES application on an ongoing basis.

When checking the well-being of patients before surgery, 6 months and 12 months after surgery, we use the Oxford Hip Score (OHS) in the case of hip arthroplasty (Kalairajah et al., 2005) or the Oxford Knee Score (OKS) in the case of knee arthroplasty. We use the methodology and guidelines from the Organisation for Economic Cooperation and Development (OECD) to calculate the values (OECD, 2019).

To identify quality of life, we use the EQ-5D-5L questionnaire, which patients complete before surgery, 6 months and 12 months after surgery. To calculate the values, we use the methodology and guidelines of the EuroQol Foundation (Van Reenen et al., 2021) and the score values for Slovenia prepared by Prevolnik Rupel et al. (Prevolnik Rupel et al., 2020; Prevolnik Rupel & Ogorevc, 2020a, 2020b).

Data for the period before surgery is obtained from providers into the RES database on paper-prescribed forms. Data for the period 6 months and 12 months after surgery are obtained mostly through telephone interviews with patients. These take place in the RES call centre. All

data (both from prescribed forms and interviews conducted over the phone) is entered into the RES application by administrators and is connected with the data of the surgery.

6.4 Statistical analysis of data in RES

Descriptive variables are presented as counts or proportions (%), while numerical variables are presented as medians (Me) and interquartile ranges (IQR).

In the survival analysis, the unit of observation is the endoprosthesis, and we are interested in the time from the date of primary surgery to the first revision (event). Follow-up time in patients who died during the observation period or did not have an event (first revision) at the end of follow-up (31.12.2023) is considered censored. The Kaplan-Meier method is used, and the cumulative % of revisions (with 95% confidence intervals, CI) after one, two and three years from primary insertion is reported.

7 Hip arthroplasty

Hip arthroplasty is divided into three categories, namely primary total hip arthroplasty, primary partial hip arthroplasty and revision hip surgery.

In this chapter, we present the results on the compliance of the data obtained on hip arthroplasty, data on primary total hip arthroplasty, data on primary partial total hip arthroplasty and data on revision hip arthroplasty for the period from 01. 01. 2019 to 31. 12. 2023. The second part presents the results on the demographic characteristics of the patients, the results on the surgical procedure, the data on the inserted and removed materials and the results from the questionnaires on functionality and pain and the general health before and after hip arthroplasty. Finally, we present the results on the survival of hip implants for the period from 1.1.2019 to 31.12. 2023.

7.1 Primary total hip arthroplasty – data until 31. 12. 2023

There are 18,817 primary total hip arthroplasties registered in the RES database for the period from 1.1.2019 to 31.12.2023. Between 1.1.2022 and 31.12.2023, 4,624 primary total hip arthroplasties were entered.

At the beginning of the chapter, we present the compliance of the obtained data by the healthcare provider. Then, we present the results of the analyses according to the characteristics of the patients, the surgical procedure, and then according to the characteristics of the inserted prosthesis. We also examined differences according to the gender of the patients, their age at the time of the surgical procedure, and the healthcare provider. The final part includes data on functionality and pain, as well as general health before and after primary total hip arthroplasty.

7.1.1 Compliance with the data obtained

Compliance is defined as the ratio between the completed forms in the RES database for the period from 1 January 2019 to 31 December 2023 and the number of primary total hip arthroplasties registered by the ZZZS (in the same period), according to hip arthroplasty providers in the Republic of Slovenia. This allows us to monitor outcomes up to five years postoperatively.. It should be noted that in the RES database we have data on individual surgeries according to the side of the surgery (in the case of simultaneous surgery on the left and right hip, two separate cases are recorded), while the ZZZS records data on patients or performed surgeries regardless of the side of the surgery (in the case of simultaneous surgery on the left and right hip, only one case is recorded). The discrepancy therefore occurs due to different case handling methodologies, due to non-reporting of data to the RES database, or due to reporting of cases that the ZZZS does not record (self-payers and paid through conventions).

As shown in Table 3, the ZZZS recorded 18,626 primary total hip arthroplasties during the period from 2019 to 2023, while the RES database contains 18,817 primary total hip arthroplasties, which means 101% compliance. In most institutions, the number of hip arthroplasties in the RES database is always slightly higher than in the ZZZS database, which occurs due to different methodologies for handling the unit in question. In 2023, the exceptions are SB Brežice, SB Nova Gorica, SB Novo mesto, SB Ptuj, Kirurgija Bitenc and Arbor Mea, where slightly fewer units are recorded in the RES database than in the ZZZS database. SB Trbovlje does not submit data to the RES at all. Based on the above, we can conclude that it is possible to generalise the results obtained to all primary total hip arthroplasties performed in the period between 2019 and 2023 in the Republic of Slovenia.

Table 2: Data on compliance of primary total hip arthroplasties in the period from 2019 to 2023, by provider - comparison of RES and ZZZS (Source: RES and ZZZS)[10].

Compliance	2019	2020	2021	2022	2023
KS Rožna dolina	104.65	108.06	110.43	132.80	104.15
OB Valdoltra	102.03	102.61	103.40	105.05	105.84
SB Brežice	103.33	100.00	79.37	98.02	95.24
SB Celje	97.79	86.87	86.24	96.47	100.96
SB Izola	100.00	100.00	100.00	60.00	175.00
SB Jesenice	97.51	97.11	95.30	104.12	101.61
SB Murska Sobota	101.28	102.72	102.60	107.23	100.76
SB Šempeter pri Novi Gorici	97.39	98.18	93.79	96.39	98.17
SB Novo mesto	99.60	101.67	102.16	110.96	99.12
SB Ptuj	97.45	94.90	95.24	101.90	98.62
SB Slovenj Gradec	97.35	89.57	100.85	100.00	102.05
UKC Ljubljana	87.33	97.30	98.89	102.59	102.54
UKC Maribor	100.22	99.08	97.08	99.07	103.19
Kirurgija Bitenc	NP	NP	NP	NP	96.77
Arbor Mea	NP	NP	NP	NP	66.95
MD Medicina	NP	NP	NP	NP	NP
Total	98.35	99.28	99.91	105.37	102.30

7.1.2 Gender and age of patients in primary total hip arthroplasties

Based on Figure 6 and Table 3, we can see that slightly more (53.8%) primary total hip arthroplasties were performed among women than among men (46.2%).

Figure 7 shows the age distribution of patients undergoing primary total hip arthroplasty. The median age was 69 years. The youngest patient was 14.6 years old, and the oldest was 96.3 years old. Table 4 shows that women were older (Me = 70.8 years) than men (Me = 67.7 years) at the time of surgery in 2023.

[10] For MD Medicine, Arbor Meo and Bitenc Surgery, the ZZZS does not keep records of operations performed throughout the years, as they were performed on a self-pay basis. For this reason, compliance could not be calculated. In this case, the table shows the code NP (no data).

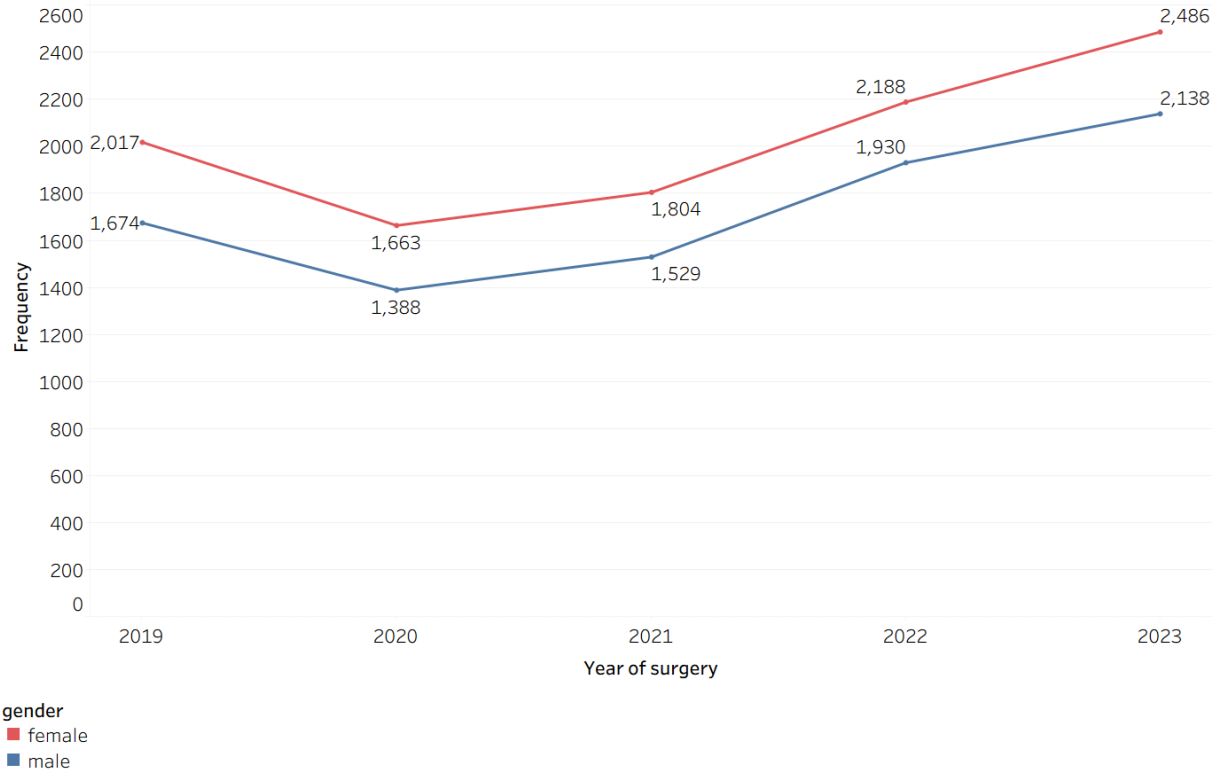


Figure 6: Primary total hip arthroplasty between 2019 and 2023, by patient gender (Source: RES).

Table 3: Primary total hip arthroplasties between 2019 and 2023, by patient gender (Source: RES).

			Year of surgery					Total
			2019	2020	2021	2022	2023	
Gender	Male	Number	1,674	1,388	1,529	1,930	2,138	8,659
		%	45.4%	45.5%	45.9%	46.9%	46.2%	46.0%
	Female	Number	2,017	1,663	1,804	2,188	2,486	10,158
		%	5.6%	54.5%	54.1%	53.1%	53.8%	54.0%
Total		Number	3,691	3,051	3,333	4,118	4,624	18,817
		%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

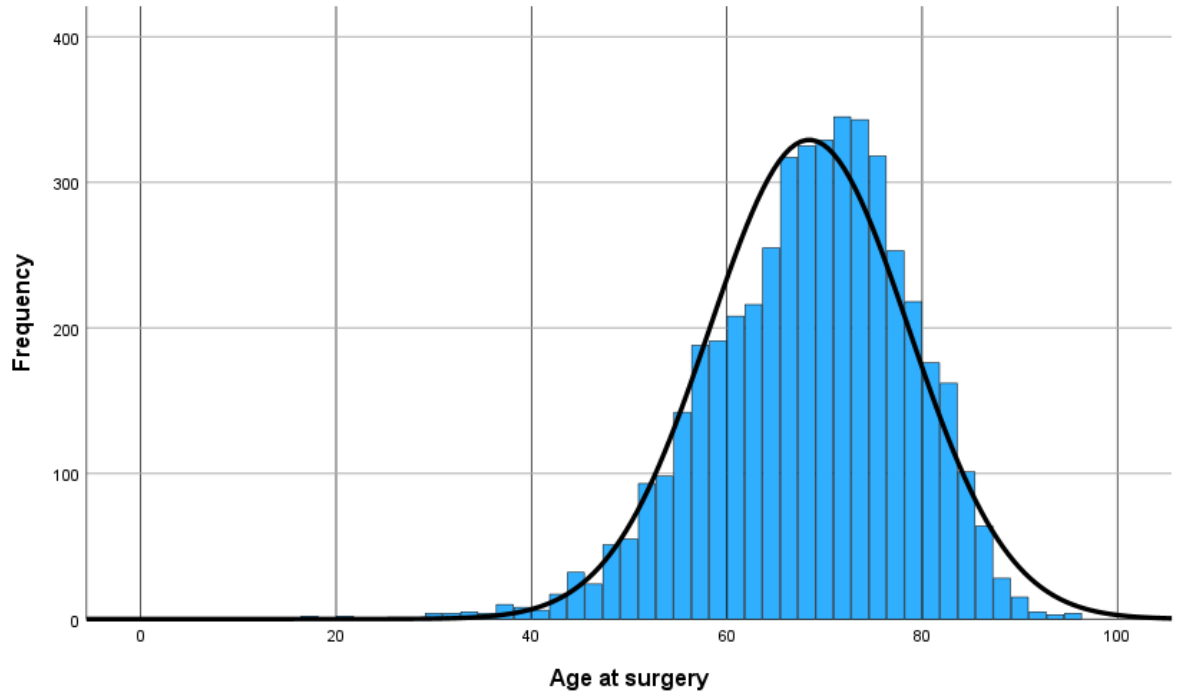


Figure 7: Primary total hip arthroplasty in 2023, by patient age (Source: RES).

Table 4: Age of patients undergoing primary total hip arthroplasty between 2019 and 2023, by gender (Source: RES).

Age at surgery			Year of surgery					Total
			2019	2020	2021	2022	2023	
Gender	Men	Median	67.3	66.9	67.1	67.0	67.7	67.2
	Women	Median	70.0	70.5	70.5	70.7	70.8	70.5
Total		Median	68.8	69.0	69.1	69.2	69.4	69.1

7.1.3 Characteristics of the surgical procedure in primary total hip arthroplasty

This chapter describes the healthcare provider, the site of the procedure, the diagnosis before the procedure, previous surgeries on the operated hip, the surgical approach used, and the fixation method of the prosthesis.

In 2023, the largest number of primary total hip arthroplasties (Table 5) was performed in the General Hospital Valdoltra (1269 - 27.4%). This was followed by SB Novo mesto (700 - 14.6%), UKC Maribor - orthopedics (465 - 10%), SB Jesenice (388 - 6.8%), SB Celje (387 - 6.8%), SB Murska Sobota (324 - 5.8%), UKC Ljubljana - orthopedics (286 - 6.2%), KS Rožna dolina (201 - 4.3%), while the other providers performed less than 200 such operations each.

Slightly more primary total hip arthroplasties were performed on the right hip (2449 - 53.1%) than on the left hip (2160 - 46.9%) in 2023 (Figure 8).

Table 5: Primary total hip arthroplasty between 2019 and 2023, by provider (Source: RES).

Hospital	2019	2020	2021	2022	2023
Arbor Mea				3	79
Kirurgija Bitenc			11	14	30
KS Rožna Dolina	90	67	127	166	201
MD medicina				15	39
OB Valdoltra	1,005	1,023	1,064	1,166	1,269
SB Brežice	31	39	50	99	100
SB Celje	266	172	163	246	314
SB Izola	6	4	2	3	7
SB Jesenice	196	168	223	278	315
SB Murska Sobota	238	189	197	252	266
SB Nova Gorica	149	108	136	80	107
SB Novo mesto	500	366	473	587	675
SB Ptuj	153	93	80	161	143
SB Slovenj Gradec	147	103	119	148	199
UKC Ljubljana - Ortopedija	434	319	280	364	286
UKC Ljubljana - Travmatologija	21	77	75	112	77
UKC Maribor - Ortopedija	408	254	281	369	461
UKC Maribor - Travmatologija	47	69	52	55	56

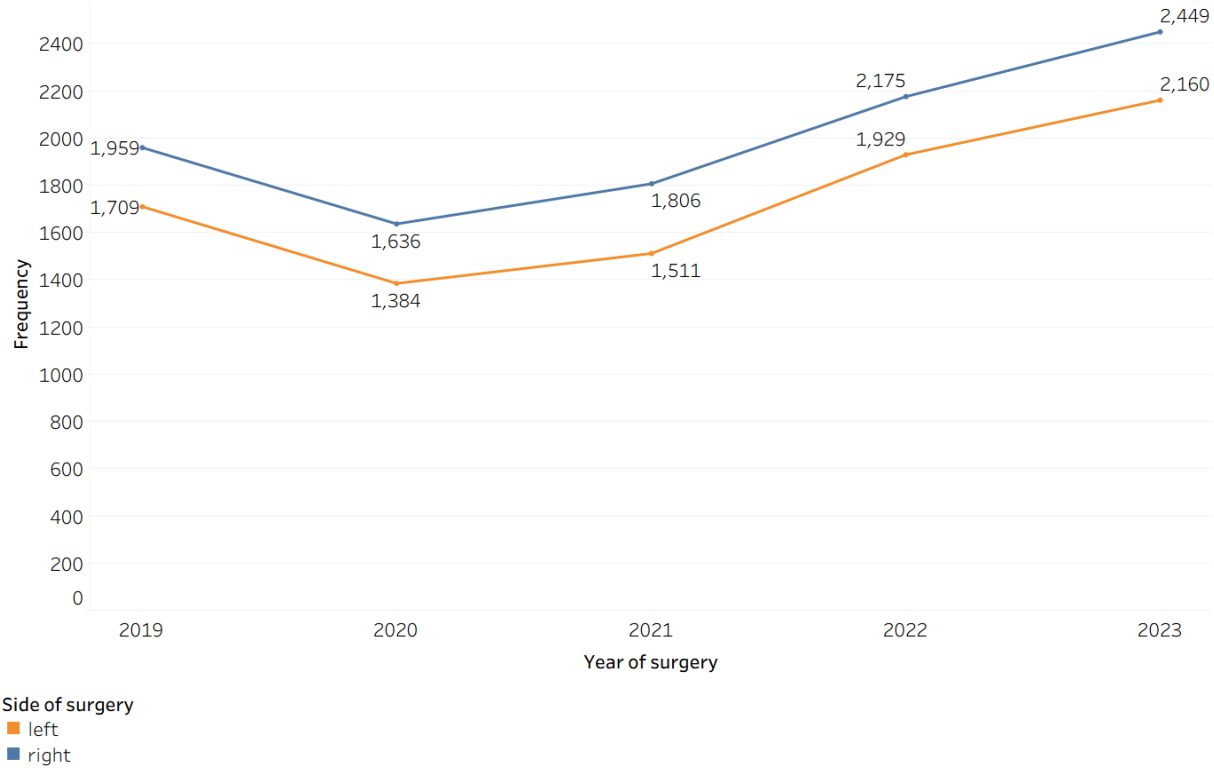


Figure 8: Primary total hip arthroplasty between 2019 and 2023, by surgical side[11] (Source: RES).

[11] In the RES database, we do not have data on the side of surgery for 23 primary total hip arthroplasties performed in 2019, 31 performed in 2020, 16 performed in 2021, 14 performed in 2022, and 15 performed in 2023.

Table 6: Primary total hip arthroplasty between 2019 and 2023, by surgical side (Source: RES).

			Year of surgery					Total
			2019	2020	2021	2022	2023	
Side	Right	Number	1,959	1,636	1,806	2,175	2,449	10,025
		%	53.1%	53.6%	54.2%	52.8%	53.0%	53.3%
	Left	Number	1,709	1,384	1,511	1,929	2,160	8,693
		%	46.3%	45.4%	45.3%	46.8%	46.7%	46.2%
	No data	Number	23	31	16	14	15	99
		%	0.6%	1.0%	0.5%	0.3%	0.3%	0.5%
Total		Number	3,691	3,051	3,333	4,118	4,624	18,817
		%	100,0%	100.0%	100.0%	100.0%	100.0%	100.0%

Diagnosis	2019	2020	2021	2022	2023
ankylosing spondylitis	4	2	1	3	3
avascular necrosis	271	239	340	382	346
dysplasia	183	141	156	168	207
epiphysiolysis/Perthes disease	15	17	15	6	15
hip fracture	191	241	270	327	310
idiopathic arthrosis	2,987	2,374	2,499	3,182	3,704
Other	19	27	36	31	26
rheumatoid/uric/psoriatic arthritis	18	10	16	19	13

Figure 9: Primary total hip arthroplasty between 2019 and 2023, by diagnosis[12] (Source: RES).

Table 7: Primary total hip arthroplasty in 2023, by preoperative diagnosis (by gender and age) (Source: RES).

	Years 2019 - 2022					***Year 2023***				
Diagnosis	***Number***	***f%***	***Age (Me)***	***(f_M%)***	***($f_Ž$%)***	***Number***	***f%***	***Age (Me)***	***(f_M%)***	***($f_Ž$%)***
idiopathic osteoarthrosis	*11,042*	*77.8*	*69.4*	*46.8*	*53.2*	*3,704*	*80.1*	*69.8*	*47.3*	*52.7*
avascular necrosis	*1,232*	*8.7*	*68.6*	*49.7*	*50.3*	*346*	*7.5*	*69.1*	*48.6*	*51.4*
hip fracture	*1,029*	*7.3*	*69.5*	*43.5*	*56.5*	*310*	*6.7*	*69.9*	*39.4*	*60.6*
dysplasia	*648*	*4.6*	*58.1*	*27.5*	*72.5*	*207*	*4.5*	*59.0*	*33.3*	*66.7*
other	*233*	*1.7*	*NP*	*45.9*	*54.1*	*57*	*1.3*	*NP*	*47.4*	*52.6*

[12] TheRES database is missing information on diagnosis for 3 primary total hip arthroplasty procedures performed in 2019.

The most common diagnosis in 2023 was (3704 - 80.1%) was idiopathic osteoarthrosis (Figure 9). Less common diagnoses were avascular necrosis (346 - 7.5%), hip fracture (310 - 6.7%), dysplasia (207 - 4.5%), epiphysiolysis/Perthes disease (15 - 0.3%), rheumatoid/gout/psoriatic arthritis (13 - 0.3%) and ankylosing spondylitis (3 - 0.1%). In 21 cases, other diagnoses were reported[13].

For patients with dysplasia (Table 7), the median age at primary total hip arthroplasty was lower (59 years) compared to patients with other diagnoses, whose median ages ranged between 67 and 70 years.. Similarly, a higher proportion of women (66.7%) than men (33.3%) underwent surgery due to dysplasia; the same trend was observed for fractures (60.6% women and 39.4% men). Additionally, fractures were a more common diagnosis among women (7.6%) than men (5.7%).

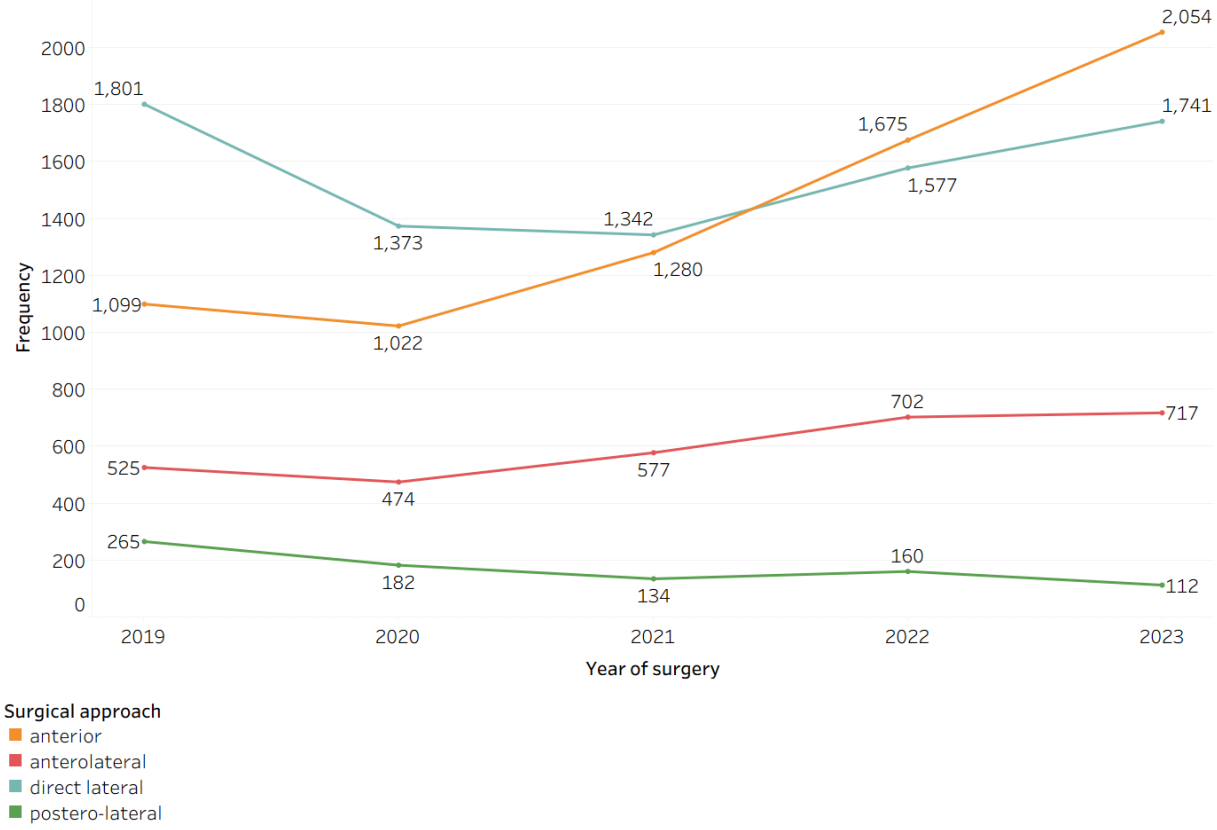


Figure 10: Primary total hip arthroplasty between 2019 and 2023, by surgical approach[14] used (Source: RES).

[13] Among other diagnoses, pathological fracture accounted for two cases, while the following were each mentioned once:: aseptic necrosis, CAM deformity, CAM impingement, Coxa Vara, DISH, myopathy of the critically ill, polyarthritis, destroyed OS, consequences of septic arthrosis, consequences of septic arthritis, post-traumatic coxarthrosis, psoriatic arthropathy, septic arthritis, spasm, cerebral palsy, post-leukemia condition, post-radiotherapy CA condition, post-osteomyelitis condition in childhood, tumor - metastasis, fracture - infection.

[14] Data on the surgical approach are not avaliable in RES database in 1 primary total hip arthroplasty performed in 2021 and for 4 cases in 2022.

Table 8: Primary total hip arthroplasty in 2023, by surgical approach used (by gender and age) (Source: RES).

	Years 2019 - 2022					Year 2023				
Surgical approach	Number	f%	Age (Me)	(f♂%)	(f♀%)	Number	f%	Age (Me)	(f♂%)	(f♀%)
Anterior	5,076	35.8	67.7	47.8	52.2	2,054	44.4	68.5	46.6	53.4
Direct lateral	6,093	42.9	69.3	45.5	54.5	1,741	37.7	69.8	44.9	55.1
Anterolateral	2,278	16.1	70.1	43.8	56.2	717	15.5	70.4	48.0	52.0
Postero-lateral	741	5.2	70.2	44.1	55.9	112	2.4	70.6	49.1	50.9

The anterior surgical approach was most commonly used in primary total hip arthroplasties in 2023 (44.4% of all cases). This is followed by the direct lateral surgical approach (37.7% of all cases). Less common surgical approaches are anterolateral (15.5%), posterolateral (2.4%). The median age of patients ranges between 68 and 71 years (Figure 10, Table 8).

In 97.1% of the cases in 2023, there were no previous operations.. In 100 cases, patients had previously undergone osteosynthesis after a fracture, in 28 cases a femoral osteotomy, in 11 cases an acetabular osteotomy and in one case an arthrodesis. In 17 cases, other previous surgical procedures were reported[15].

7.1.4 Characteristics of inserted primary total hip arthroplasty

The following chapter presents the characteristics of the femoral stem, acetabulum, and head.

94.4% of primary total hip arthroplasty endoprostheses were uncemented in 2023 (Table 9). 77 (1.7%) were cemented, 140 (3%) were hybrid, and 42 (0.9%) were reverse hybrid. The median age of patients with uncemented prostheses was 69.9 years, with reverse hybrid 76.2 years, with hybrid 77.9 years, and with cemented prostheses 81.6 years. All types of prostheses were implanted more frequently in women than in men (Table 9).

[15] Other previous surgical procedures on the operated hip were hip arthroscopy seven times, and one case of fem. head forage, hip radiotherapy, prostate irradiation, open hip reduction, open reduction in childhood and then debridement due to inflammation Girldestone procedure, osteotomy of the acetabulum and femur, hip resection due to TB infection, insertion of a DHS screw and insertion of a spacer.

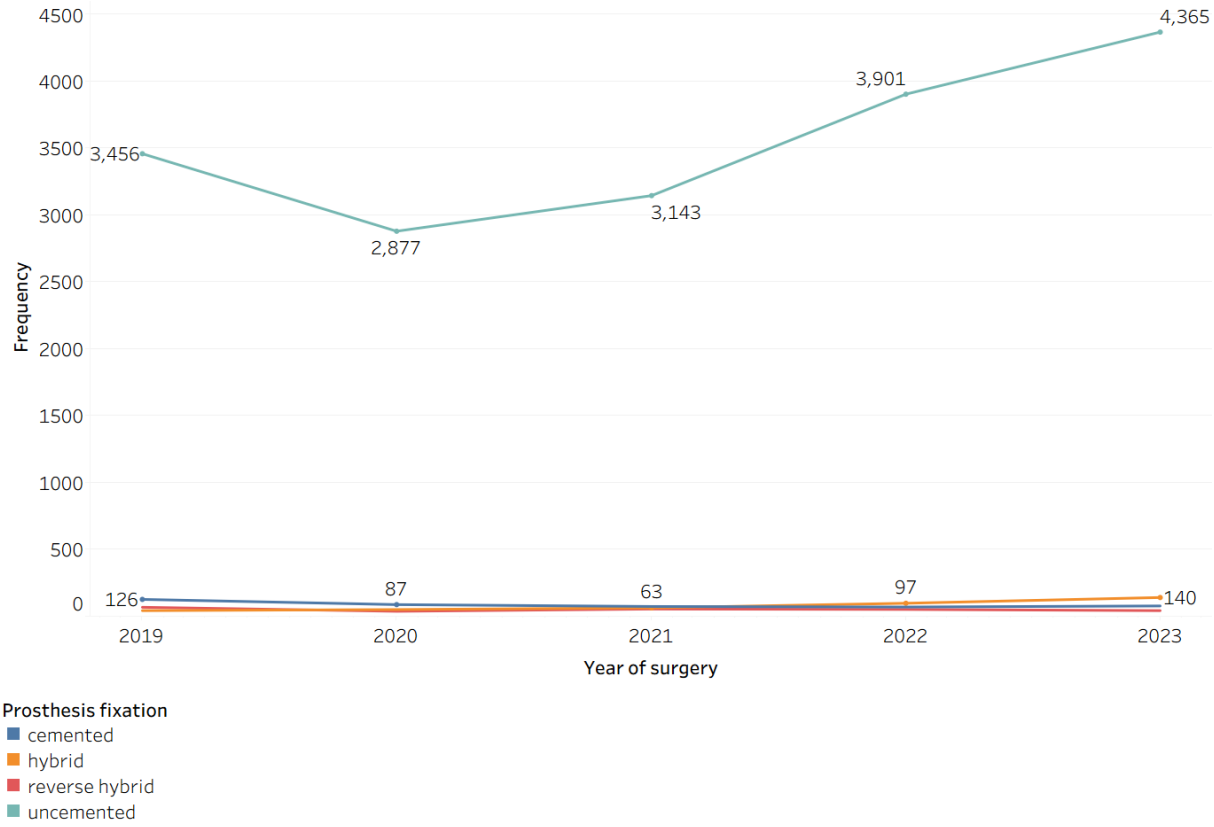


Figure 11: Primary total hip arthroplasty between 2019 and 2023, by prosthesis fixation (Source: RES).

Table 9: Primary total hip arthroplasty in 2023, by prosthesis fixation (by gender and age) (Source: RES).

	Years 2019 - 2022					Year 2023				
Prosthesis fixation	**Number**	**f%**	**Age (Me)**	**(fM%)**	**(fŽ%)**	**Number**	**f%**	**Age (Me)**	**(fM%)**	**(fŽ%)**
Uncemented	13,377	94.3	68.5	47.2	52.8	4,365	94.4	69.9	47.4	52.6
Hybrid	252	1.8	79.6	20.6	79.4	140	3.0	77.9	19.3	80.7
Cemented	355	2.5	79.5	25.6	74.4	77	1.7	81.6	31.2	68.8
Reverse hybrid	209	1.5	71.6	28.2	71.8	42	0.9	76.2	38.1	61.9

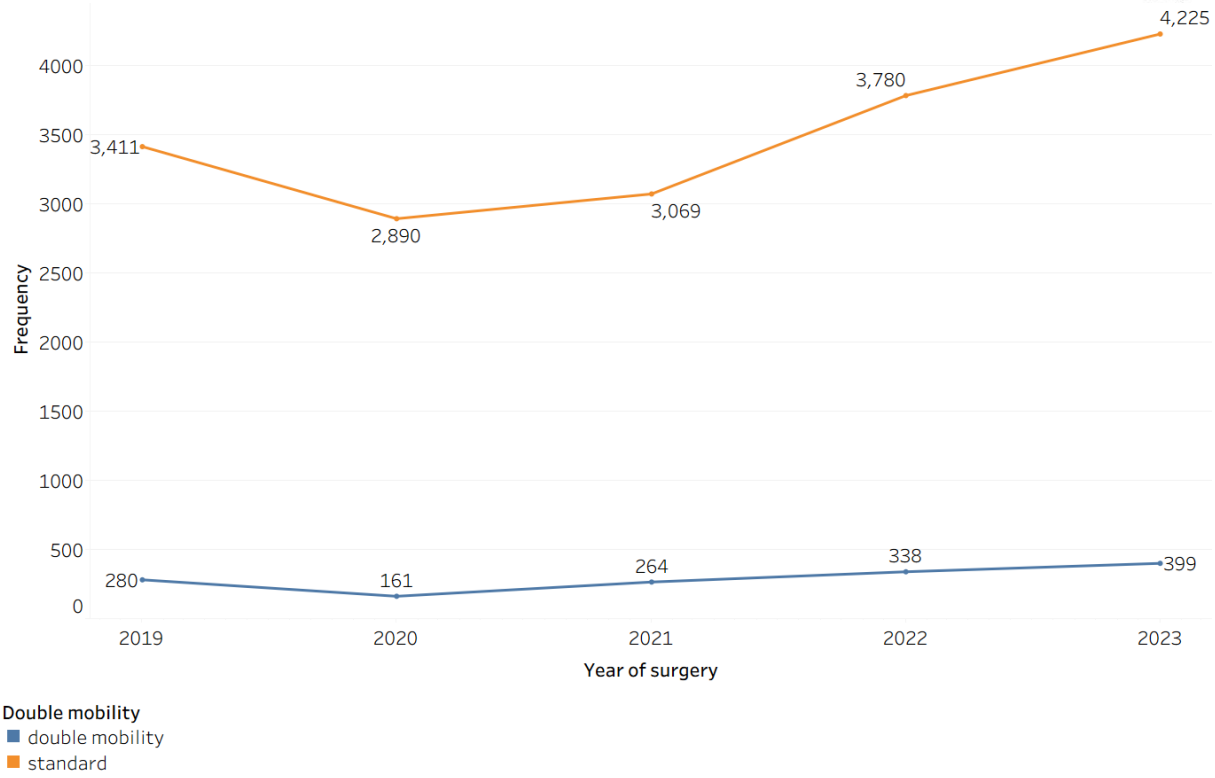


Figure 12: Standard and Dual mobility primary total hip arthroplasty between 2019 and 2023 (Source: RES).

The RES database (see Figure 12) has data on 4,225 (91.4%) standard heads and 399 (8.6%) dual-mobility heads implanted in 2023. The median age of patients who received standard heads was 69 years, while for those who received dual-mobility heads, the median age was 72.9 years. (Table 10).

Figure 13 shows the distribution of femoral components by the provider of primary total hip arthroplasty.

Table 10: Primary total hip arthroplasty in 2023 according to dual mobility of the endoprosthesis head (by gender and age) (Source: RES).

	Years 2019 - 2022					Year 2023				
Type of femoral head	**Number**	**f%**	**Age (Me)**	**(f_M%)**	**e ($f_Ž$%)**	**Number**	**f%**	**Age (Me)**	**(f_M%)**	**($f_Ž$%)**
Standard head	13,152	92.7	68.5	46.9	53.1	4,225	91.4	69.0	47.4	52.6
Dual-mobility head	1,041	7.3	74.3	34.4	65.6	399	8.6	72.9	33.7	66.3

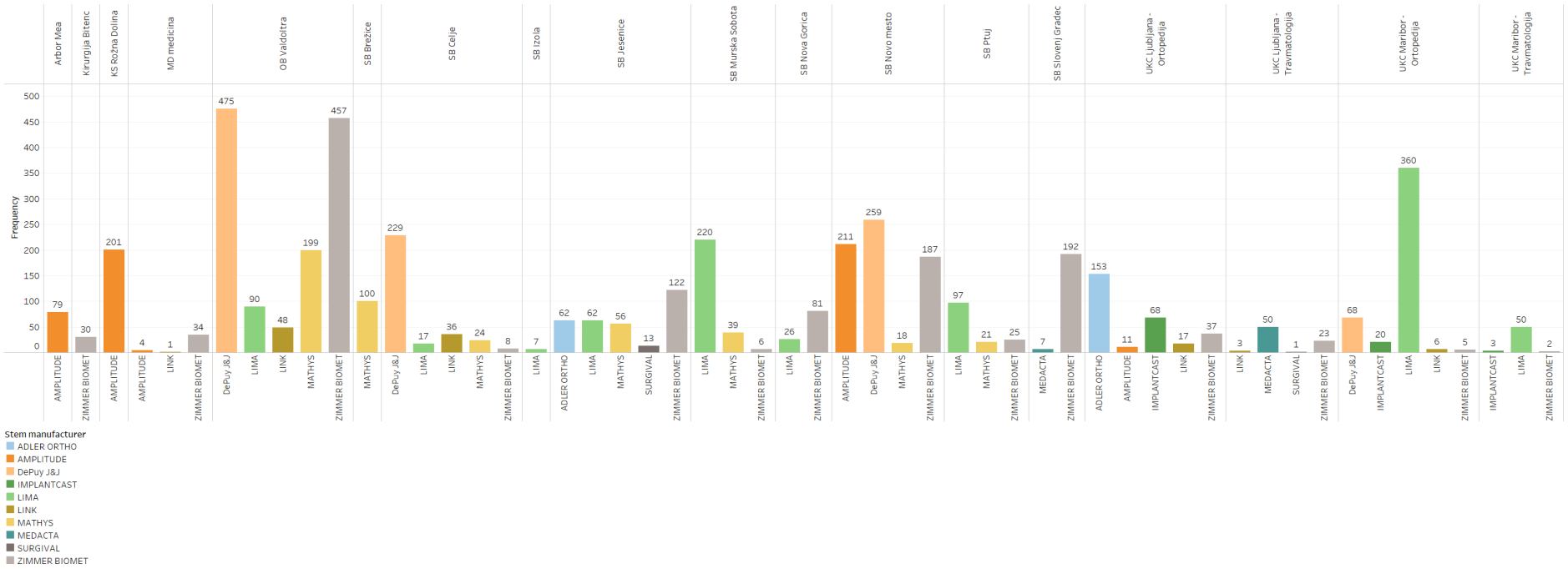


Figure 13: Primary total hip arthroplasty according to the manufacturer of the femoral part of the endoprosthesis and the provider performing the surgery (Source: RES).

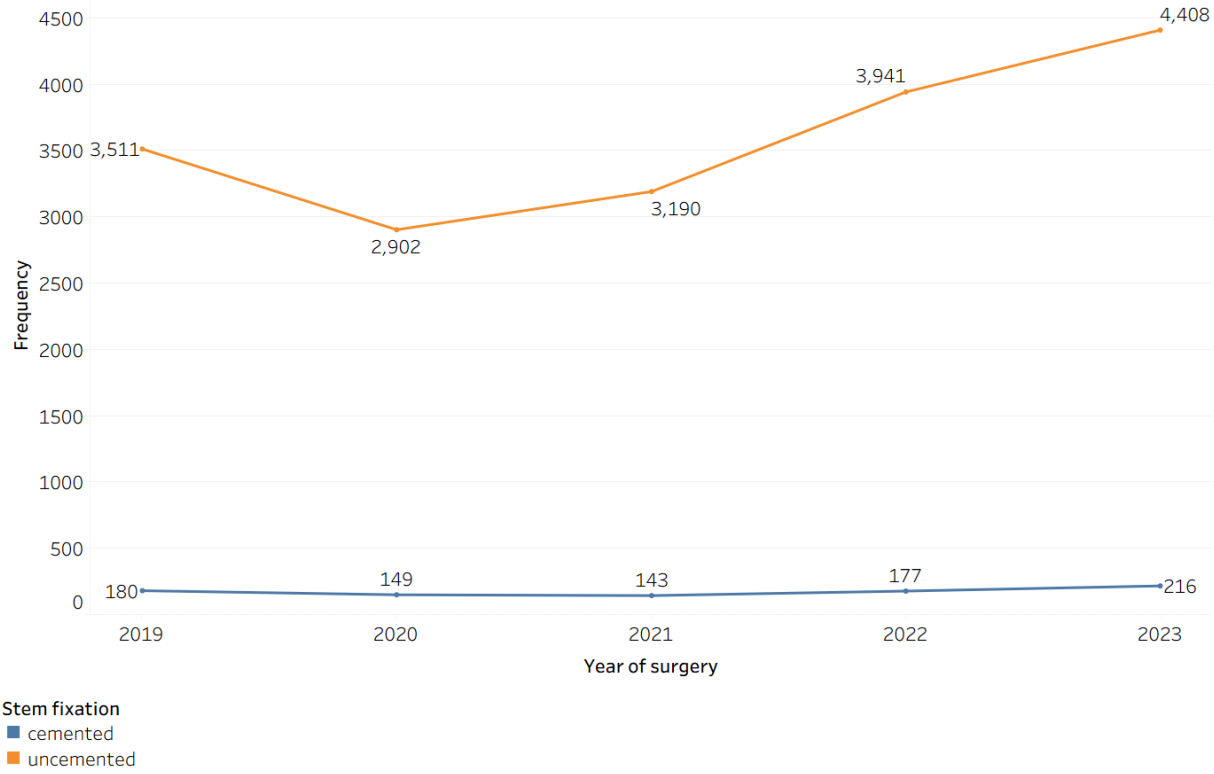


Figure 14: Primary total hip arthroplasty between 2019 and 2023, by fixation of the endoprosthesis stem (Source: RES).

Table 11: Primary total hip arthroplasty in 2023, by fixation of the endoprosthesis stem (by gender and age) (Source: RES).

	Years 2019 - 2022					Year 2023				
Stem fixation	**Number**	**f%**	**Age (Me)**	**(f_M%)**	**($f_Ž$%)**	**Number**	**f%**	**Age (Me)**	**(f_M%)**	**($f_Ž$%)**
Uncemented	13,544	95.4	68.5	47.0	53.0	4,408	95.3	69.0	47.4	52.6
Cemented	649	4.6	79.6	23.6	76.4	216	4.7	80.0	22.2	77.8

Figure 14 shows that the majority of femoral stems were uncemented in the period from 2019 to 2023.

In 2023, there were 4,408 (95.3%) total hip arthroplasties with uncemented femoral components and 216 (4.7%) with cemented ones. The median age of patients with uncemented femoral components was 69 years, and that of those with cemented parts was 80 years (Table 11).

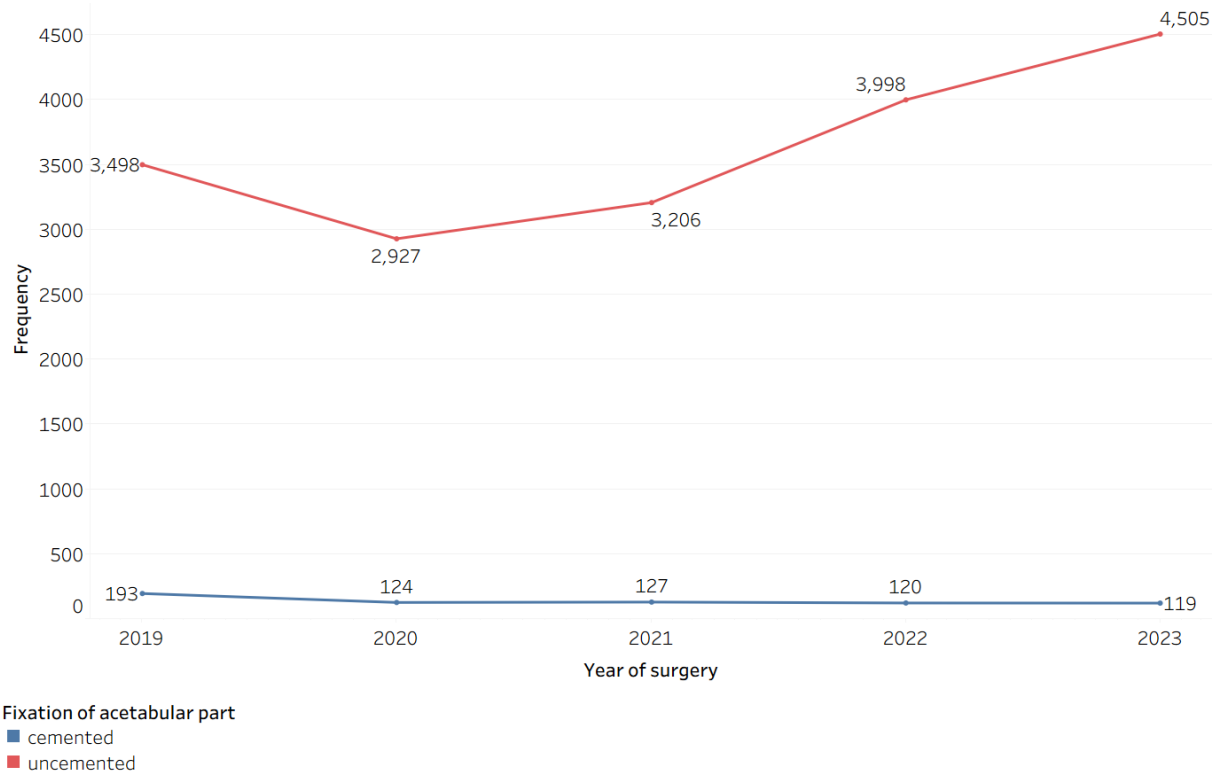


Figure 15: Primary total hip arthroplasty between 2019 and 2023, by acetabular fixation of the endoprosthesis (Source: RES).

Table 12: Primary total hip arthroplasty in 2023, by fixation of the acetabular part of the endoprosthesis (by gender and age) (Source: RES).

	Years 2019 - 2022					Year 2023				
Fixation of the acetabular part	**Number**	**f%**	**Age (Me)**	**(f_M%)**	**($f_Ž$%)**	**Number**	**f%**	**Age (Me)**	**(f_M%)**	**($f_Ž$%)**
Uncemented	13,629	96.0	68.6	46.7	53.3	4,505	97.4	69.0	46.6	53.4
Cemented	564	4.0	77.2	26.6	73.4	119	2.6	80.0	33.6	66.4

Figure 15 shows that the vast majority of acetabular components were uncemented in the period from 2019 to 2023.

In 2023, there were 4505 (97.4%) primary total hip arthroplasties with uncemented and 119 (2.6%) with cemented acetabular components. The median age of patients with uncemented acetabular components was 69 years, and those with cemented acetabular component were 80 years (Table 12).

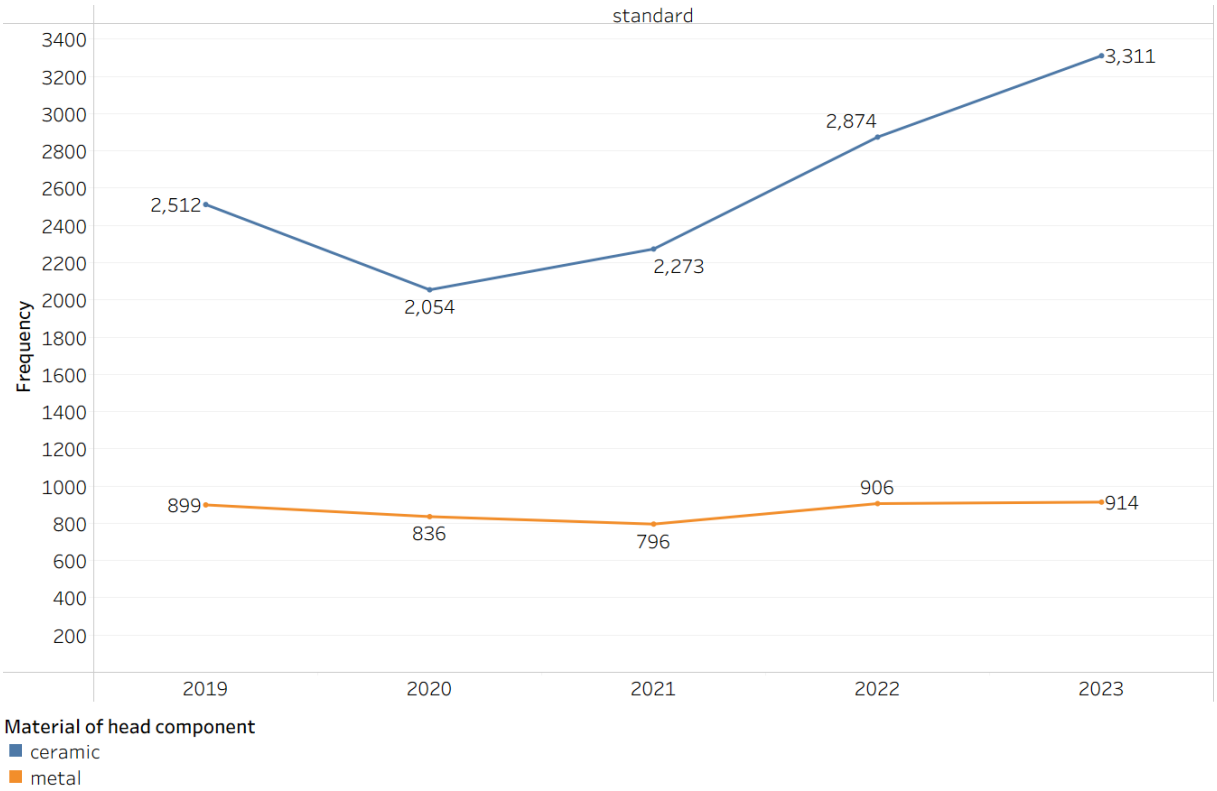


Figure 16: Primary total hip arthroplasty between 2019 and 2023, by standard endoprosthesis head material (Source: RES).

Table 13: Primary total hip arthroplasty in 2023, according to head material and dual mobility of the endoprosthesis (by gender and age) (Source: RES).

	Years 2019 - 2022					Year 2023				
	Number	f%	Age (Me)	(f_M%)	($f_Ž$%)	Number	f%	Age (Me)	(f_M%)	($f_Ž$%)
Dual mobility	1,041	7.3	74.3	34.4	65.6	398	8.6	72.9	33.7	66.3
Standard - ceramic	9,713	68.4	65.7	49.8	50.2	3,311	71.6	66.8	49.6	50.4
Standard - metal	3,439	24.2	75.4	38.6	61.4	915	19.8	75.8	39.5	60.5

Figure 16 shows primary total hip arthroplasty according to the material of the inserted head.

*In 2023, **3,311 (71.6%)** standard ceramic heads, **915 (19.8%)** standard metal heads, and **398 (8.6%)** dual-mobility heads were used.. The remaining data are presented in Table 13.*

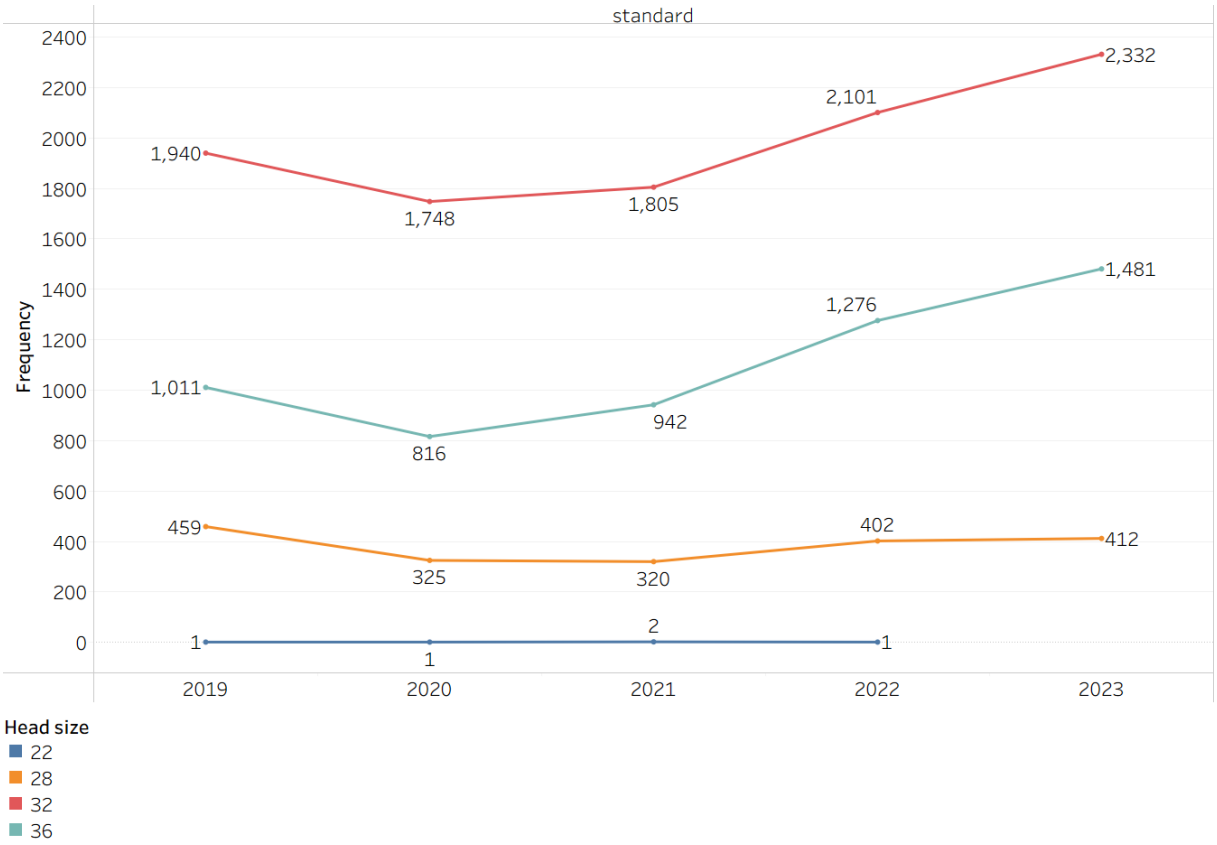


Figure 17: Primary total hip arthroplasty with a standard head between 2019 and 2023, by endoprosthesis head size[16] (Source: RES).

Table 14: Primary total hip arthroplasty in 2023, according to head size and dual mobility of the endoprosthesis head (by gender and age) (Source: RES).

	Years 2019 - 2022					Year 2023				
Head size	**Number**	**f%**	**Age (Me)**	**(f_M%)**	**(f_F%)**	**Number**	**f%**	**Age (Me)**	**(f_M%)**	**(f_F%)**
Dual mobility	1,041	7.3	74.3	34.4	65.6	398	8.6	72.9	33.7	66.3
Standard 22 mm	7	0.0	NA	0.0	100	1	0.01	72.1	0.0	100
Standard 28 mm	1,506	11.5	69.3	10.1	89.9	412	9.7	70.6	8.3	91.7
Standard 32 mm	7,594	57.7	69.2	43.0	57.0	2,332	55.2	69.5	38.6	61.4
Standard 36 mm	4,045	30.8	66.7	67.8	32.2	1,481	35.0	67.7	72.3	27.7

In 2023, the most commonly used standard head diameter was 32 mm (55.2%), followed by 36 mm (35%), 28 mm (9.7%), and 22 mm (0.01%). Dual-mobility heads were used in 8.6% of cases. The remaining data, by gender and age, are presented in Table 14.

[16] In the RES database, we do not have data for 21 endoprosthesis head sizes that were inserted in 2022 for total hip arthroplasty.

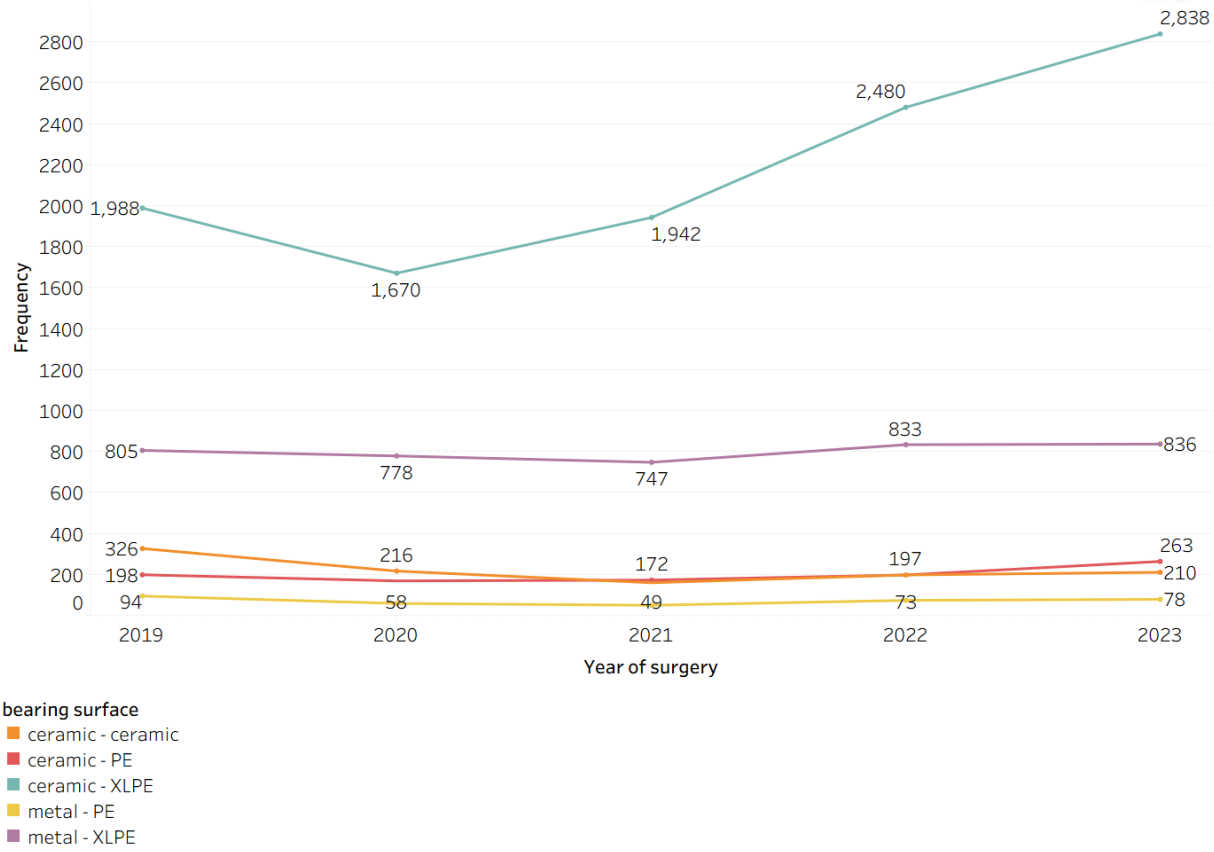


Figure 18: The bearing surface os standard primary total hip arthroplasty between 2019 and 2023.(Source: RES).

Table 15: Bearing surface of the primary total hip arthroplasty (by gender and age) (Source: RES).

Bearing surface	Years 2019 - 2022					Year 2023				
	Number	f%	Age (Me)	(f_M%)	($f_Ž$%)	Number	f%	Age (Me)	(f_M%)	($f_Ž$%)
Metal + PE	276	1.9	77.9	29.3	70.7	78	1.7	77.8	25.6	74.4
Metal + XLPE	3,163	22.3	75.2	39.4	60.6	836	18.1	75.6	40.7	59.3
Ceramic + PE	735	5.2	69.4	46.8	53.2	263	5.7	67.6	46.4	53.6
Ceramic + XLPE	8,080	56.9	66.0	49.3	50.7	2,838	61.4	67.3	49.3	50.7
Ceramic + ceramic	898	6.3	59.8	56.3	43.7	210	4.5	61.4	59.5	40.5
Dual mobility	1,041	7.3	74.3	34.4	65.6	398	8.6	72.9	33.8	66.2

In 2023, the most frequently used bearing surface was ceramic+XLPE (61.4%), followed by: metal+XLPE (18.1%), dual mobility (8.6%), ceramic+PE (5.7%), ceramic+ceramic (4.5%) and metal+PE (1.7%). The remaining data, by gender and age, are presented in Table 15.

7.1.5 Mortality 90 days after primary total hip arthroplasty

For each patient, the date of surgery and date of death were recorded in the database.

From Figure 19, we can see that there were 16 patient deaths within 90 days of surgery in 2019. 14 in 2020, 16 in 2021, 15 in 2022, and 18 in 2023.

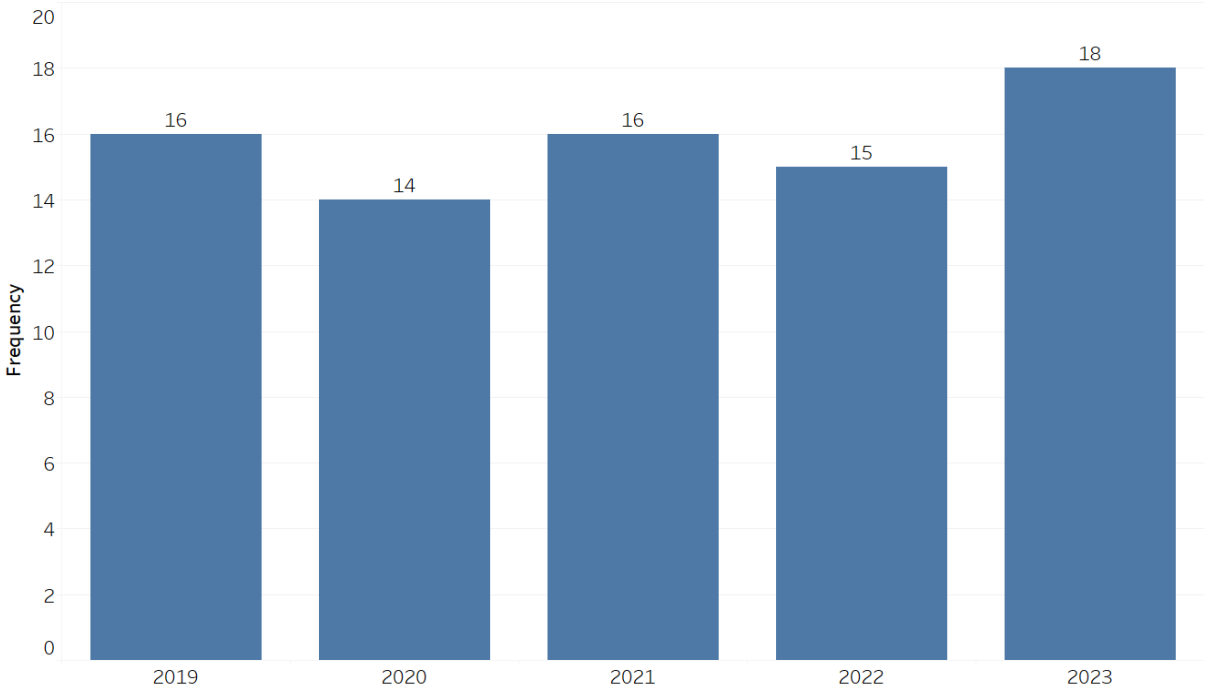


Figure 19: Number of deaths within 90 days after primary total hip arthroplasty between 2019 and 2023 (source: RES).

Mortality was calculated using the following formula:

$$Mortality\ 90\ days\ after\ primary\ total\ hip\ arthroplasty = \frac{number\ of\ all\ deaths\ 90\ days\ after\ primary\ total\ hip\ arthroplasty}{number\ of\ all\ primary\ total\ hip\ arthroplasties} * 100$$

From Figure 20, we can see that patient mortality 90 days after primary total hip arthroplasty increased between 2019 (0.43%) and 2021 (0.48%), while in 2022 it decreased to 0.36% and 0.39% in 2023.

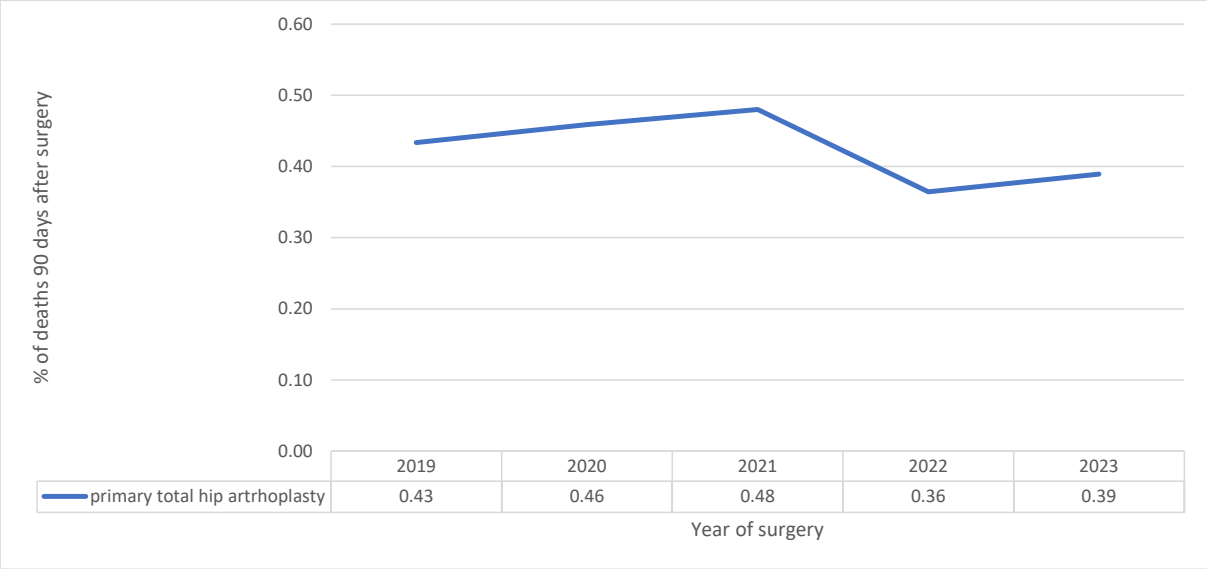


Figure 20: Mortality 90 days after primary total hip arthroplasty (Source: RES).

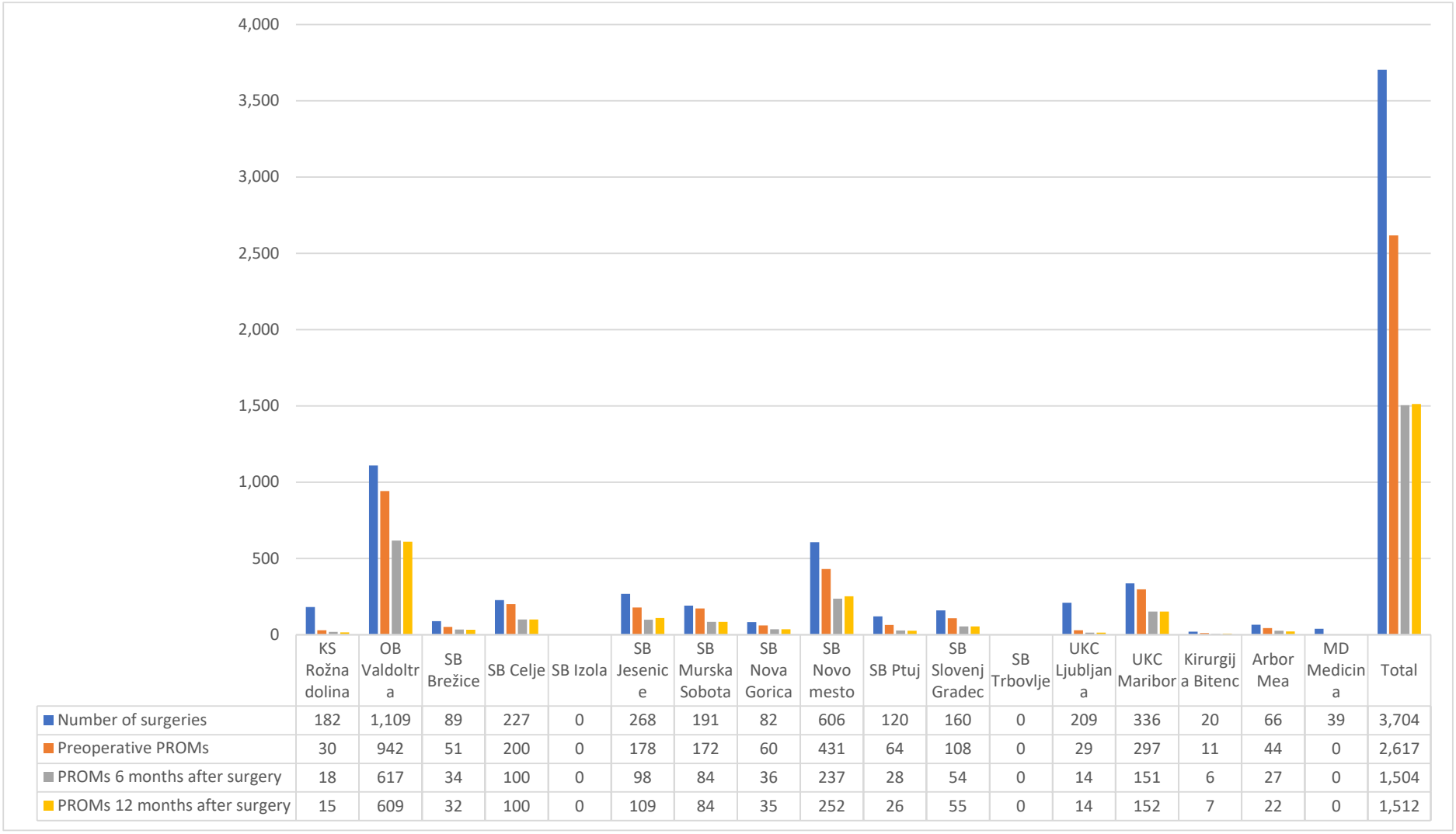
7.1.6 Self-assessment of health and quality of life of patients – PROMs questionnaires before and after primary total hip arthroplasties with a diagnosis of idiopathic osteoarthrosis

The patients completed the questionnaires before the primary total hip arthroplasty, and the first group 3 months later[17], and then 6 months and 12 months later. In the analysis, we only considered the questionnaires that were fully completed.

The analysis considered only patients with a primary diagnosis of idiopathic arthrosis. The database, retrieved from the application on 17.3.2025, contained data on 4624 primary total hip arthroplasties performed between 1.1.2023 and 31.12.2023. Of these, 3704 (69.8%) were diagnosed with idiopathic arthrosis (see Figure 21). The **Oxford Hip Score** (**OHS) questionnaire** is used to assess the functional impairment of a patient with a hip pathology. It consists of 12 questions, each scored on a 5-point scale, with 0 indicating that the patient has no problems at all and 4 indicating that the patient has severe problems with hip functionality. The OHS score is the sum of the answers of an individual patient to all 12 questions. The score can range from 0 (complete non-functionality of the operated hip with severe pain) to 48 (complete functionality of the operated hip with no pain).

In the preoperative period (see Figure 21), 2,617 (70.7%) OHS questionnaires were completed for primary total hip arthroplasties performed from 1 January 2023 to 31 December 2023. with a median score of 18 points. 6 months after surgery, 1,504 (40.6%) completed questionnaires were obtained (Me = 41). 12 months after surgery, 1,512 (40.8%) completed questionnaires were obtained (Me = 44).

[17] We discontinued the survey 3 months after surgery at the end of 2022. For this reason, this data is not taken into account when presenting the results.



	KS Rožna dolina	OB Valdoltra	SB Brežice	SB Celje	SB Izola	SB Jesenice	SB Murska Sobota	SB Nova Gorica	SB Novo mesto	SB Ptuj	SB Slovenj Gradec	SB Trbovlje	UKC Ljubljana	UKC Maribor	Kirurgija Bitenc	Arbor Mea	MD Medicina	Total
Number of surgeries	182	1,109	89	227	0	268	191	82	606	120	160	0	209	336	20	66	39	3,704
Preoperative PROMs	30	942	51	200	0	178	172	60	431	64	108	0	29	297	11	44	0	2,617
PROMs 6 months after surgery	18	617	34	100	0	98	84	36	237	28	54	0	14	151	6	27	0	1,504
PROMs 12 months after surgery	15	609	32	100	0	109	84	35	252	26	55	0	14	152	7	22	0	1,512

Figure 21: Number of PROMs (OHS) forms obtained in primary total hip arthroplasties, by provider, patients operated on in 2023 (Source: RES).

OHS questionnaire

Patients were divided into 4 age groups: up to 55 years, 55 to 64 years, 65 to 74 years, and older than 74 years[18]. We calculated the difference between the OHS achieved 12 months after surgery and the preoperative OHS.

Women (see Figure 22) had a higher median difference between the OHS 12 months after surgery and before surgery (24 points) than men (22 points).

When analysing the differences in the OHS before and 12 months after surgery, we did not detect any significant differences by patient age (Figure 23). The median difference by age group is between 21 and 24 points.

Figure 22: Median with 95% confidence interval of the difference between the preoperative OHS score and 12 months after surgery by the gender of the patients (Source: RES).

[18] patients were devidid into these age groups after reviewing reports from other global arthroplasty registries.

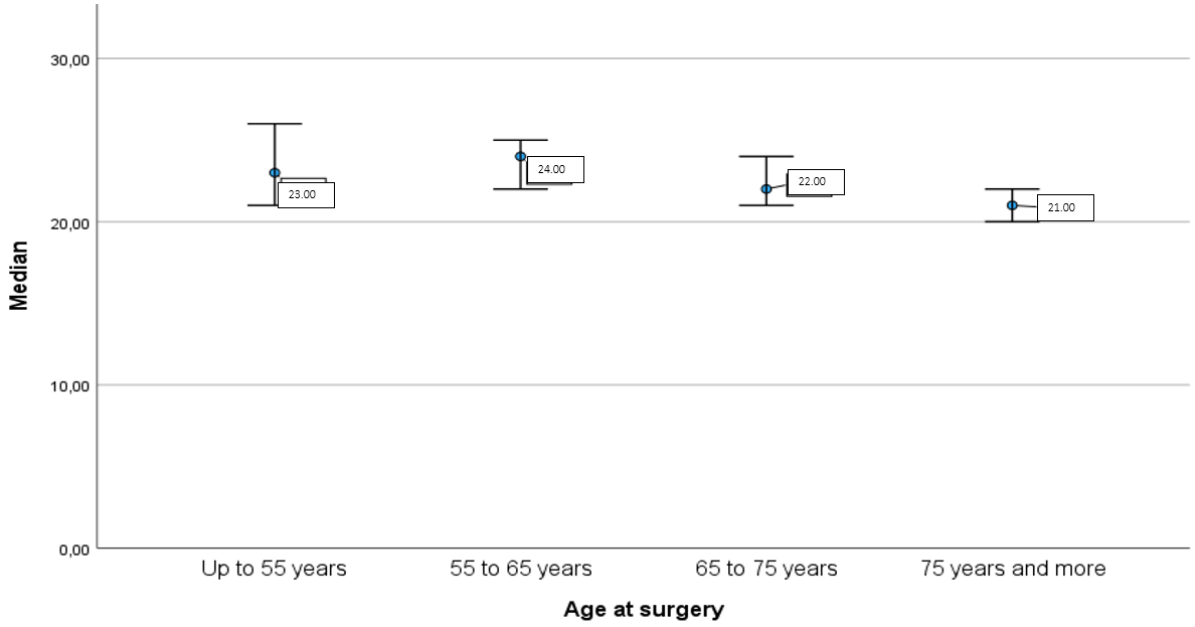


Figure 23: Median with 95% confidence interval for the difference between the preoperative OHS score and 12 months after surgery by the age of the patients (Source: RES).

EQ-5D-5L questionnaire[19]

measures the general health of patients. Patients are asked to rate their current mobility, self-care, ability to perform usual activities, pain and anxiety or depression on a scale from 1 (I have no problems at all) to 5 (I have very big problems). To weight the answers, we used a score prepared for the Slovenian population by the Institute for Economic Research (Prevolnik Rupel & Ogorevc, 2020). A lower value indicates poorer healthwhile a higher value indicates better health. The highest possible score is 1representing perfect quality of life.

Respondents were divided into 4 age groups: younger than 55 years, 55 to 64 years, 65 to 74 years and older than 74 years[20]. We calculated the difference between the EQ-5D-5L score 12 months after surgery and the preoperative EQ-5D-5L score.

There were no differences in the median EQ-5D-5L scores by gender (Figure 24). In men, the median difference ranged from 0.24 to 0.28 points, and in women, from 0.22 to 0.28 points.

There were also no differences in the median EQ-5D-5L scores by age group between the preoperative assessment and 12 months after surgery (see Figure 25).

[19] The Slovenian version of the EQ-5D-5L questionnaire is available on the RES website.
[20] Patients were devided into age groups after reviewing reports from other global arthroplasty registries.

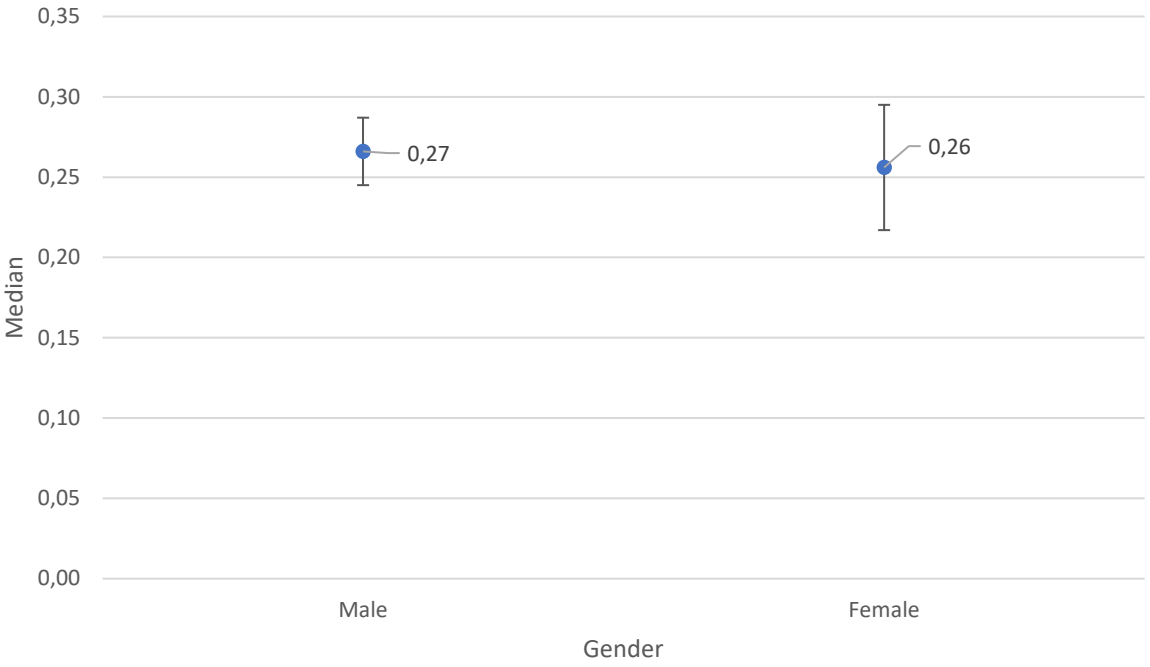


Figure 24: Median with 95% confidence interval for the difference between the preoperative EQ-5D-5L score and 12 months after surgery, by patient gender (Source: RES).

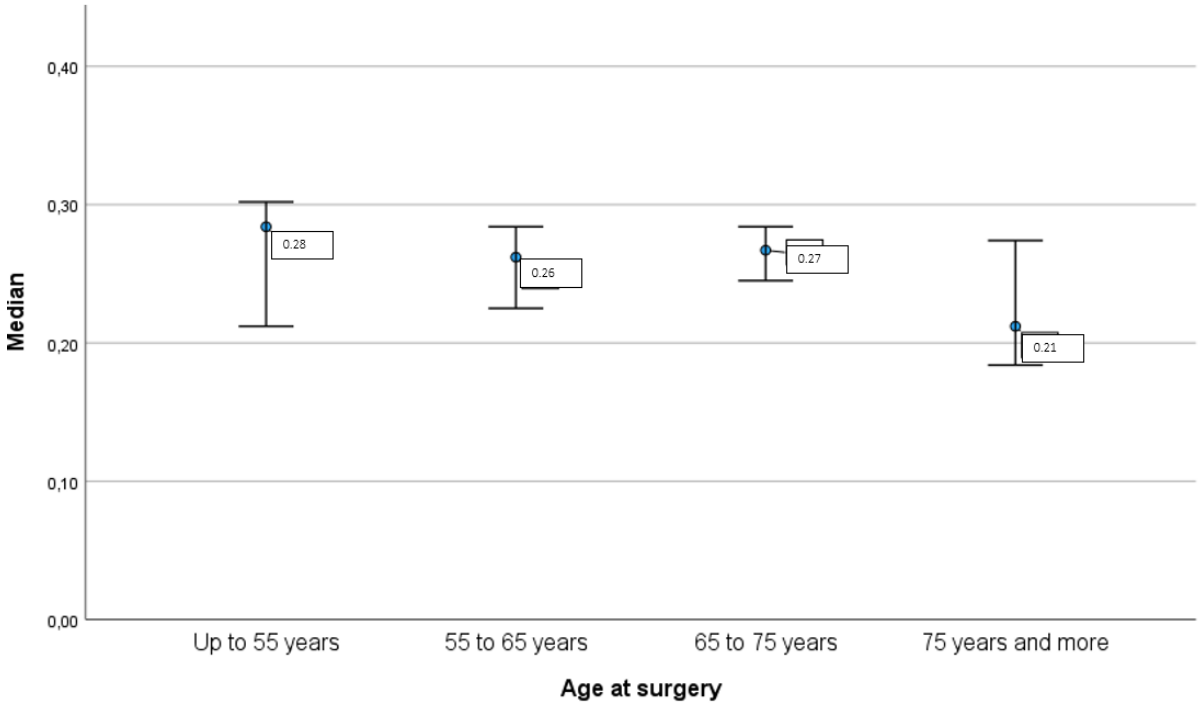


Figure 25: Median with 95% confidence interval for the difference between the EQ-5D-5L score 12 months after surgery and before surgery, according to the age of the patients (Source: RES).

Visual Analogue Scale (VAS)[21]

In the last part of the questionnaire, respondents were asked about their general health assessment on the day of the survey. They expressed this assessment on a scale from 0 (worst possible) to 100 (best possible), based on the VAS scale.

In the preoperative period, 2,586 questionnaires were completed for primary total hip arthroplasties performed between 1.1.2023 and 31.12.2023, with a median VAS score of 60. 6 months after surgery, 1,510 completed questionnaires were obtained. 12 months after, the median score was 80.

Respondents were divided into 4 age groups: younger than 55 years, 55 to 64 years, 65 to 74 years, and older than 74 years[22]. We calculated the difference between the preoperative and VAS achieved 12 months after surgery

When examining the differences in VAS scores between the preoperative period and 12 months after surgery (see Figure 26), we found a difference in the median by gender. Men had a lower median (10 < VAS < 15) than women (15 < VAS < 20).

Figure 27 shows the differences in the median VAS scores by age group. There were no differences between the age groups.

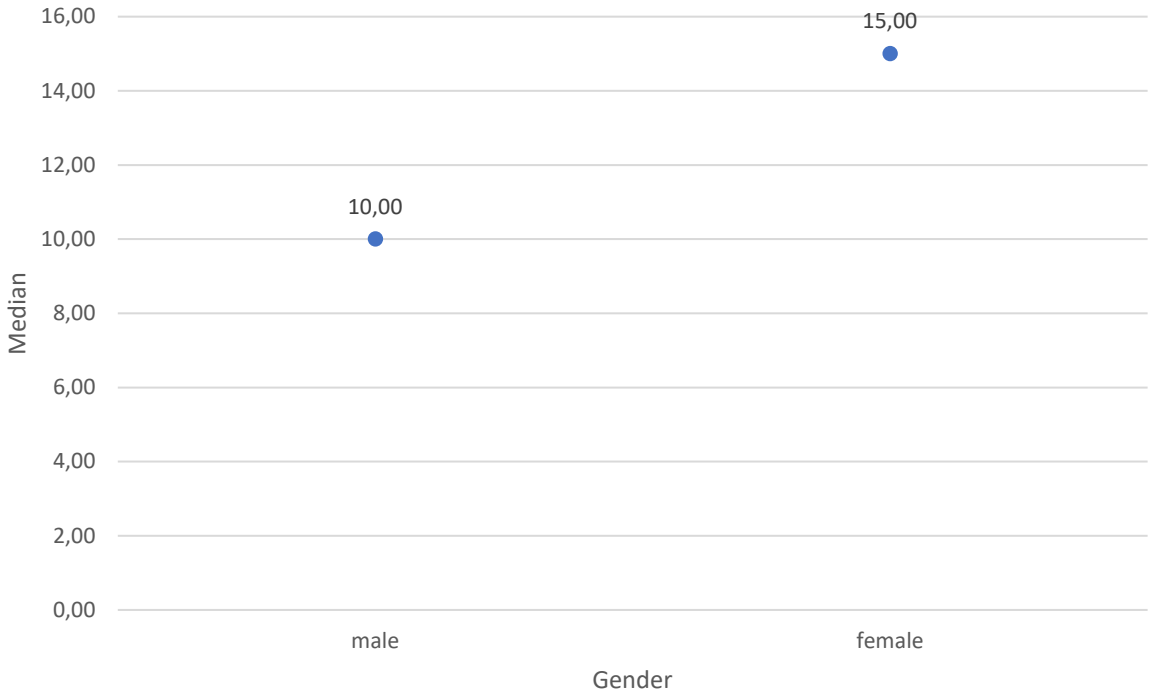


Figure 26: Median with 95% confidence interval for the difference between the VAS score before and 12 months after surgery by the gender of the patients (Source: RES).

[21] The VAS questionnaire is part of the EQ-5D-5L questionnaire, which is available on the RES website.
[22] Patients were devidedinto age groups after reviewing reports from other global arthroplasty registries.

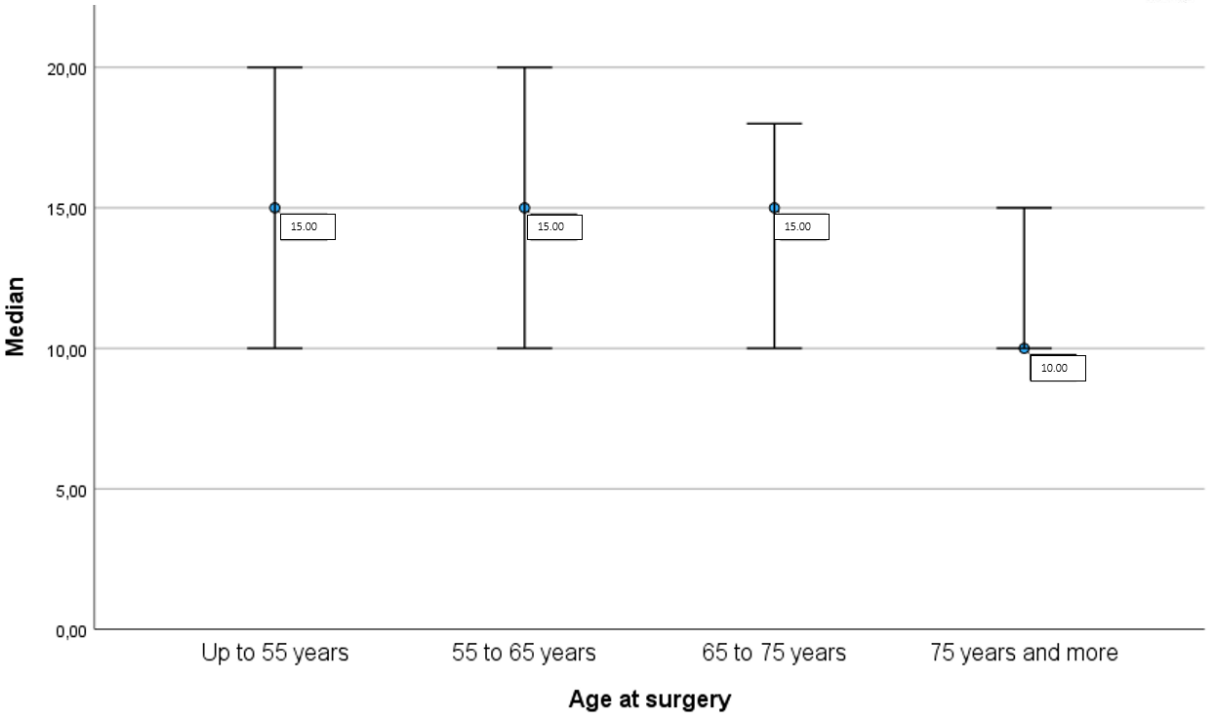


Figure 27: Median with 95% confidence interval for the difference between the VAS score 12 months after surgery and before surgery, according to the age of the patients (Source: RES).

7.2 Primary partial hip arthroplasty – data until 31. 12. 2023

We present the characteristics of primary partial hip arthroplasty separately, as these procedures are most often performed for hip fractures in hospital trauma departments.. For 2023, the RES database contains data on 797 such operations performed in the Republic of Slovenia.

We examined differences based on patient data, the provider, and surgery-related characteristics. Differences were also analysed according to patient gender, age at the time of surgery, and the institution performing the procedure. In the final part, we will present data on functionality and pain, as well as general health, before and after primary partial hip arthroplasty.

7.2.1 Compliance of the obtained data

Table 13 presents the compliance between the received primary partial hip arthroplasties forms and the surgical procedures recorded by the ZZZS, in the period from 1 January 2019 to 31 December 2023. The data received up to 17 August 2024 was analysed

In the RES database, 3,093 primary partial hip arthroplasties were recorded for the period from 1. 1. 2019 to 31. 12. 2023. For 2023 alone, data are available for 797 such operations.

KS Rožna dolina and OB Valdoltra did not perform primary partial hip arthroplasties (see table 16). SB Celje started submitting data on such surgical procedures only in 2021; SB Trbovlje did not submit any data on these surgical procedures during the entire period.

Table 16: Data on compliance of primary partial hip arthroplasties in the period from 2019 to 2023, by provider - comparison of RES and ZZZS (Source: RES and ZZZS)[23].

Compliance	2019	2020	2021	2022	2023
SB Brežice	121.43	95.45	95.65	93.55	96.43
SB Celje	0.00	0.00	8.24	98.90	96.05
SB Izola	91.80	103.13	100.00	102.53	80.65
SB Jesenice	11.29	70.42	70.59	89.83	87.95
SB Murska Sobota	100.00	91.67	89.13	102.38	111.54
SB Šempeter pri Novi Gorici	98.55	79.37	76.56	80.77	82.09
SB Novo mesto	73.68	51.16	65.52	77.14	56.82
SB Ptuj	85.29	70.00	120.83	83.87	93.75
SB Slovenj Gradec	10.00	0.00	5.56	23.33	64.29
SB Trbovlje	0.00	0.00	0.00	0.00	0.00
UKC Ljubljana	20.90	96.19	98.47	98.49	97.73
UKC Maribor	102.33	92.77	101.12	97.40	108.25
Total	48.85	71.54	79.61	90.42	89.95

7.2.2 Gender and age of patients undergoing primary partial hip arthroplasties

In 2023, a total of 515 (64.6%) primary partial hip arthroplasties were performed in women and 282 (35.4%) in men (Figure 28). The median age was 69.4 years. The youngest patient was 14.6 years old, and the oldest was 96.3 years old (Figure 29). Women (Figure 30) were slightly older (Me = 70.8 years) than men (Me = 67.7 years).

[23] The Slovenian Health Insurance Institute does not have data on partial hip endoprostheses for the Rožna dolina Hospital and the Valdoltra Hospital, nor for MD Medicine, Arbor Mea and Bitenc.

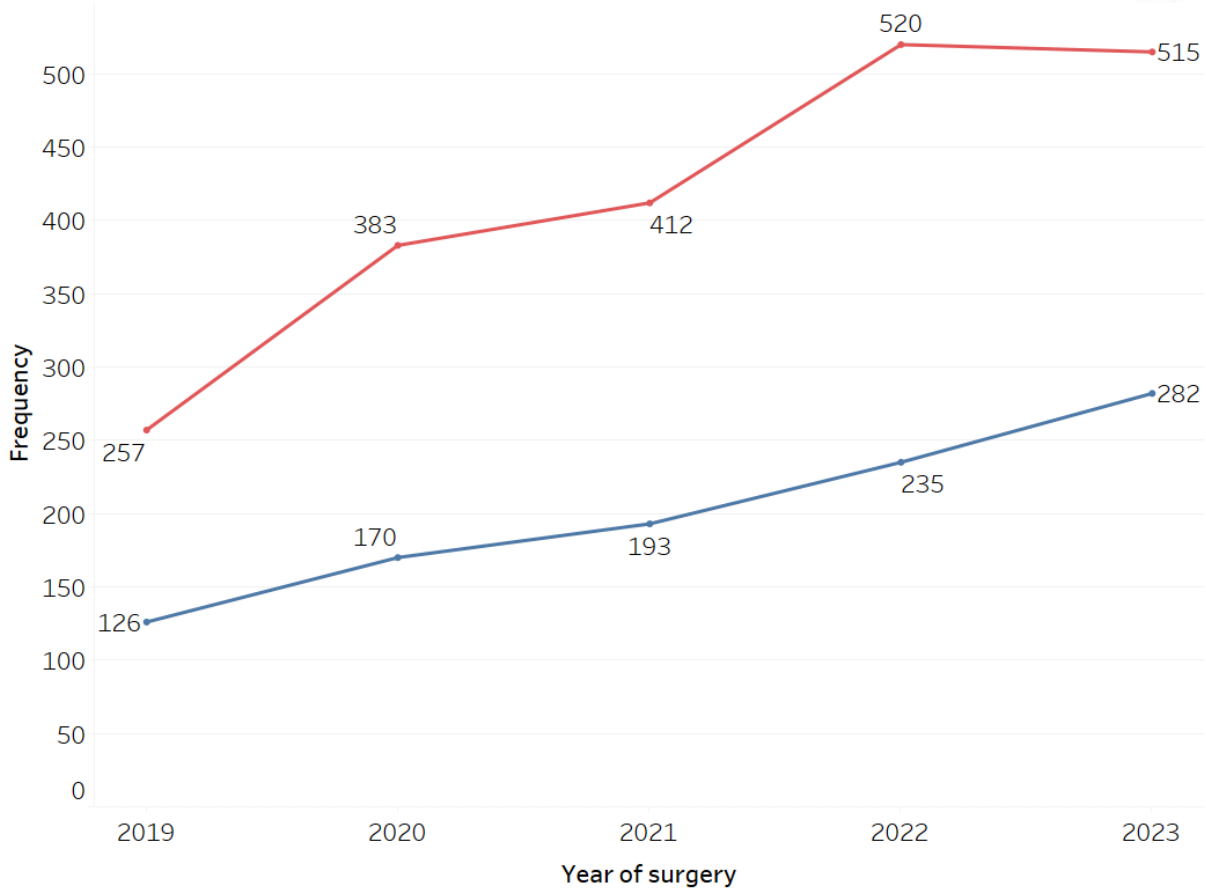


Figure 28: Primary partial hip arthroplasty between 2019 and 2023, by patient gender (Source: RES).

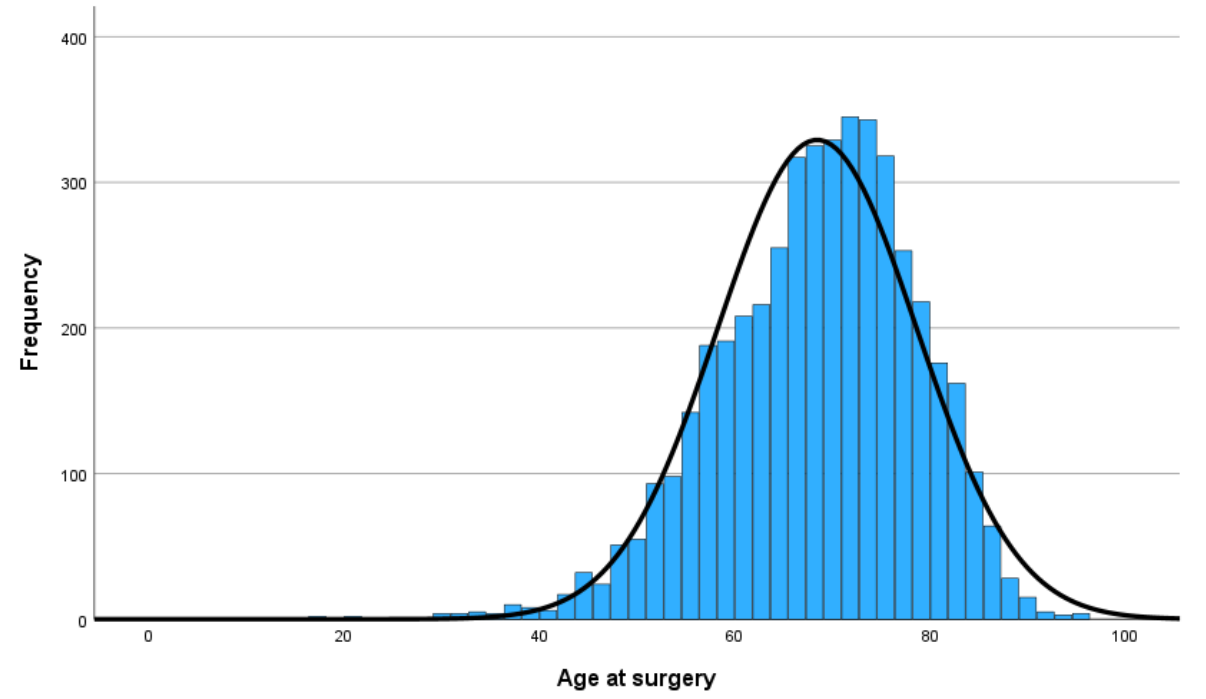


Figure 29: Primary partial hip arthroplasty in 2023, by patient age (Source: RES).

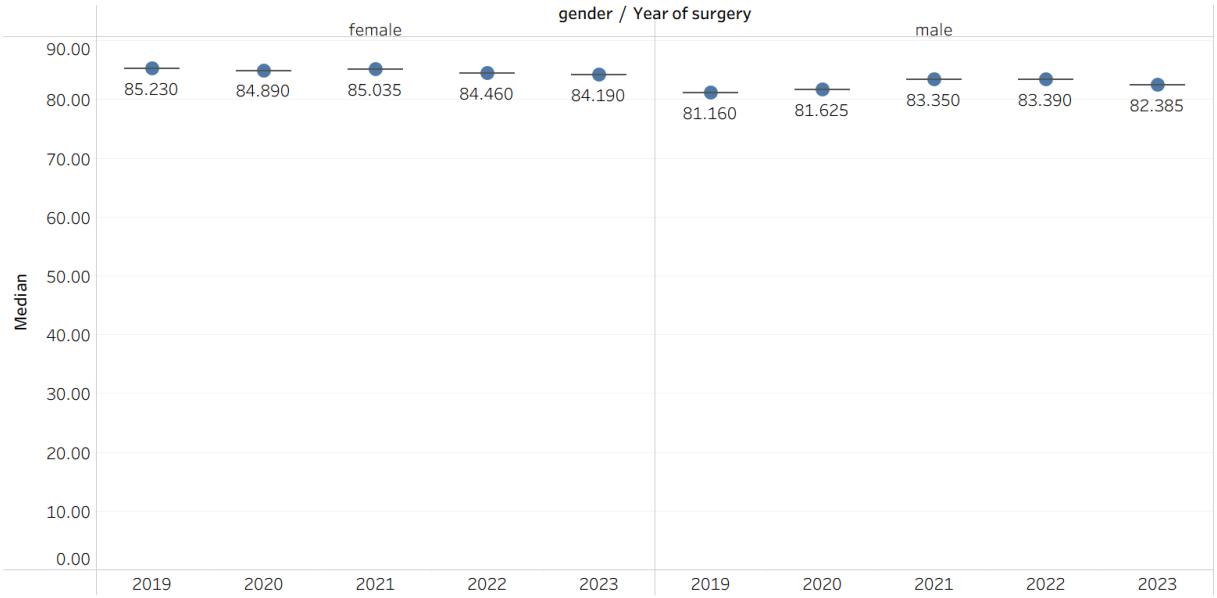


Figure 30: Age of patients undergoing partial hip arthroplasty by gender; median with 95% confidence interval (Source: RES).

7.2.3 Characteristics of the surgical procedure

The following characteristics of primary partial hip arthroplasty were analysed: healthcare provider, surgical site, diagnosis at the time of surgery, fixation of the femoral stem, surgical approach used, and previous surgical procedures.

In 2023, the highest number of primary partial hip arthroplasties (Table 17) was performed at the Traumatology Department of the University Hospital Ljubljana (258 - 32.4% I). This was followed by the Traumatology Department of the University Hospital Maribor (101 - 12.7%), Izola General Hospital (75 - 9.4%), the Celje general Hospital (73 - 9.2%), the Jesenice General Hospital (73 - 9.2%), the Murska Sobota General Hospital (58 - 7.3%) and the Nova Gorica General Hospital (55 - 6.9%). The remaining hospital performed fewer than 50 primary partial hip arthroplasties each in 2023.

In 2023, slightly more procedures were performed on the right hip (401; 50.3%) than on the left hip (396; 49.7%) (Figure 31).

The most common diagnosis in primary partial hip arthroplasties (Table 18) in 2023 was expected to be a hip fracture (in 788 cases - 98.9% of all cases). Other diagnoses were rare or absent. In 2023, the most commonly used surgical approaches in primary partial hip arthroplasties were anterior (in 35.3% of cases), antero-lateral (in 33.6% of cases) and direct lateral (in 31.1% of cases) (Figure 32). The postero-lateral surgical approach was not used.

Table 17: Primary partial hip arthroplasty between 2019 and 2023, by provider (Source: RES).

Hospital	2019	2020	2021	2022	2023
SB Brežice	17	21	22	29	27
SB Celje			7	90	73
SB Izola	56	66	54	81	75
SB Jesenice	7	50	36	53	73
SB Murska Sobota	37	44	41	43	58
SB Nova Gorica	68	50	49	63	55
SB Novo mesto	28	22	19	27	25
SB Ptuj	29	21	29	26	30
SB Slovenj Gradec	2		1	7	18
UKC Ljubljana - Ortopedija	1				
UKC Ljubljana - Travmatologija	50	202	257	261	258
UKC Maribor - Ortopedija	3		2	2	4
UKC Maribor - Travmatologija	85	77	88	73	101

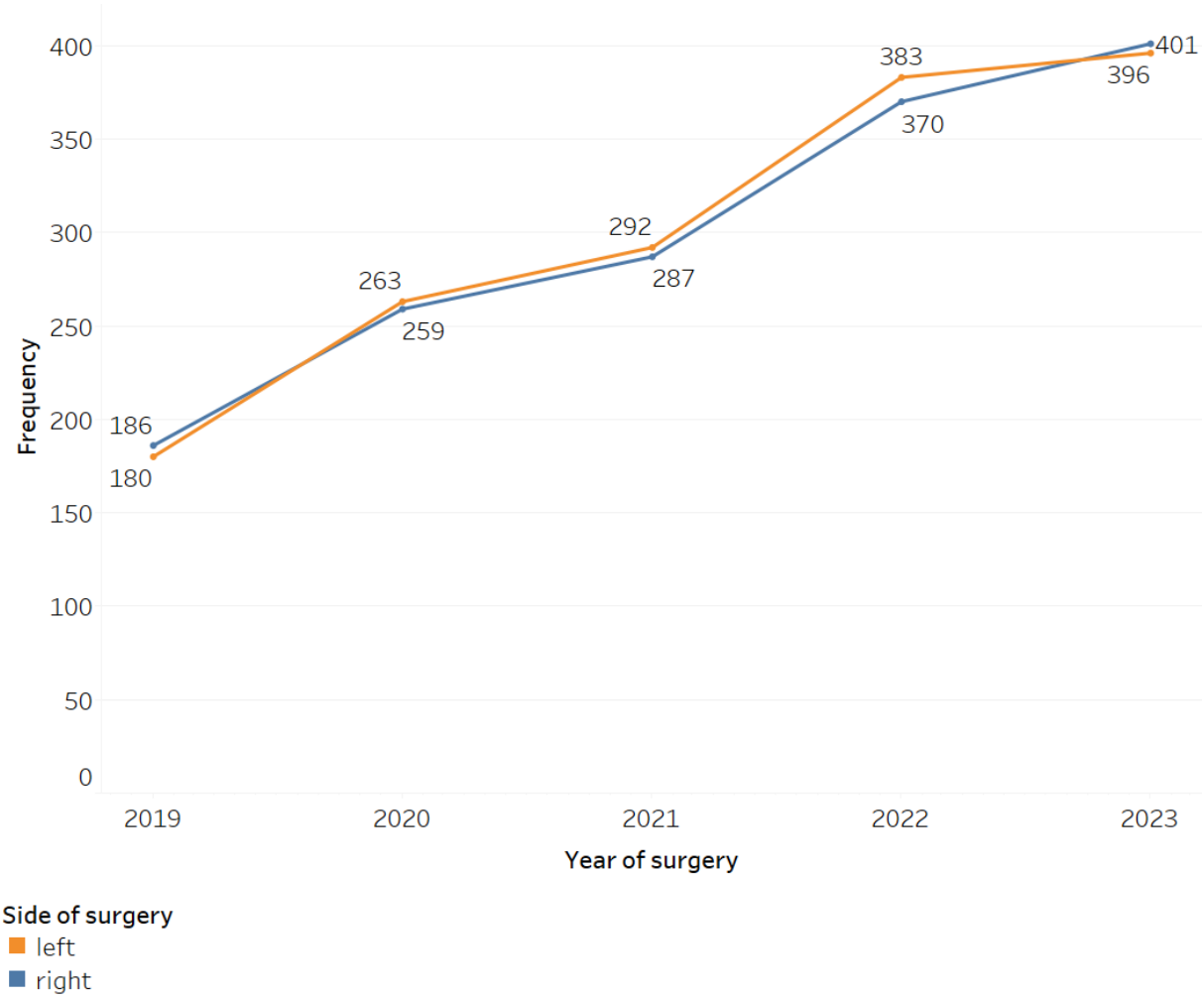


Figure 31: Primary partial hip arthroplasty between 2019 and 2023, by surgical side (Source: RES).

Table 18: Primary partial hip arthroplasty between 2019 and 2023, by diagnosis at the time of surgery (Source: RES).

Diagnosis	2019	2020	2021	2022	2023
avascular necrosis			1		
dysplasia	1			2	2
epiphysiolysis/Perthes disease	2				2
hip fracture	374	539	596	743	788
idiopathic arthrosis		3	1	5	3
Other	6	11	7	5	2

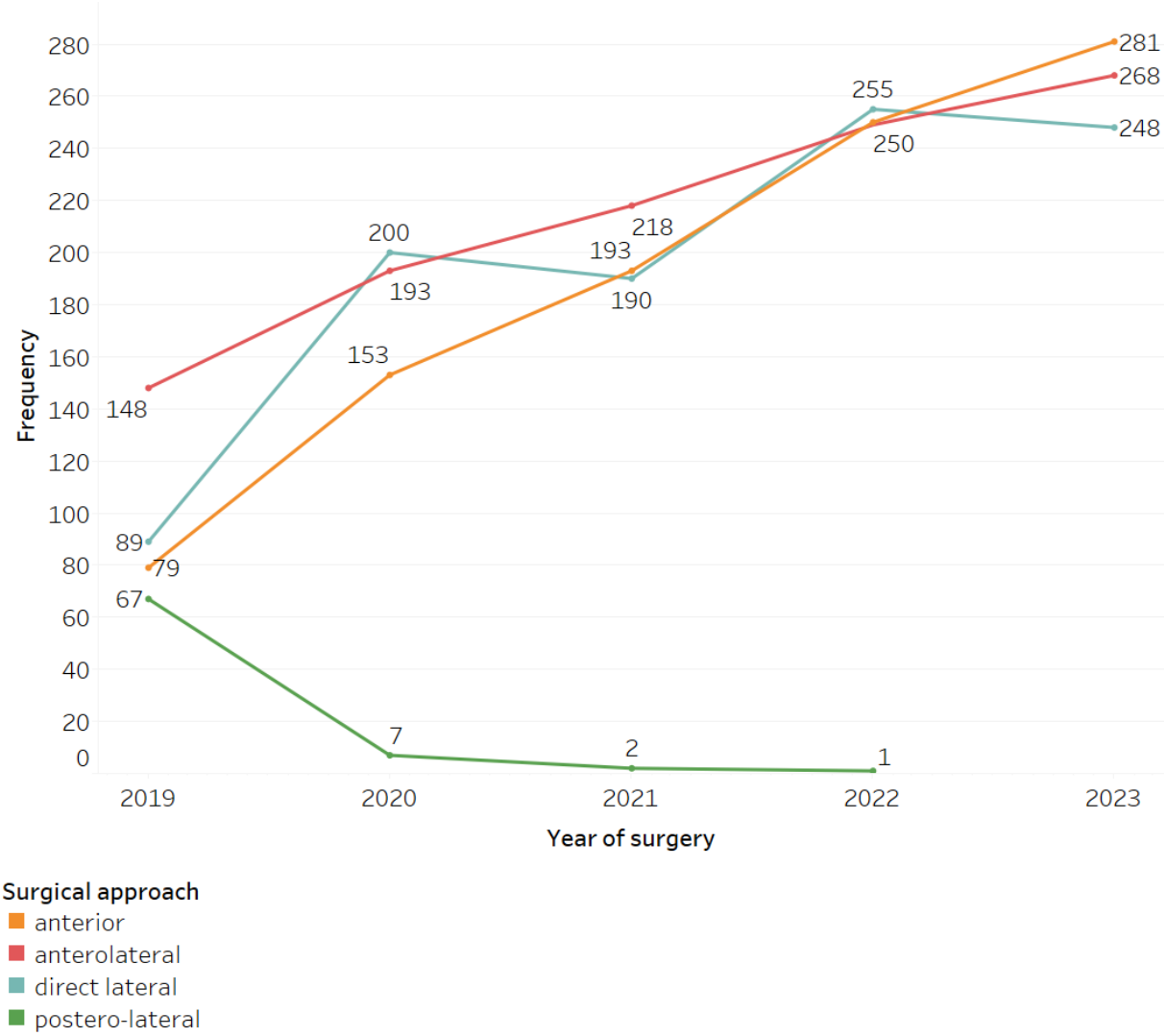


Figure 32: Primary partial hip arthroplasty between 2019 and 2023, by surgical approach (Source: RES).

Table 19: Surgical approach used in primary partial hip arthroplasty in 2023, by patient gender and age (Source: RES).

	Years 2019 - 2022					Year 2023				
	Number	f%	Age (Me)	Age (f_M%)	Age ($f_Ž$%)	Number	f%	Age (Me)	Age (f_M%)	Age ($f_Ž$%)
Anterior	675	29.4	84.7	32.9	67.1	281	35.3	84.2	34.9	65.1
Anterolateral	808	35.2	84.4	28.2	71.8	268	33.6	84.4	38.1	61.9
Direct lateral	734	32.0	83.4	33.1	66.9	248	31.1	82.2	33.1	66.9
Postero-lateral	77	3.4	84.7	40.3	59.7	0	0.0	NA	0.0	0.0

7.2.4 Characteristics of inserted primary partial hip arthroplasty

In primary partial hip arthroplasties, we focused on the manufacturer of the stem and the bipolar head of the endoprosthesis.

Figure 33 presents the manufacturers of femoral endoprosthesis in primary partial hip arthroplasties by provider in 2023.

In 2023, 636 femoral stems were cemented (79.8%), and in 161 cases (20.2%), it was uncemented (Figure 34). The median age of patients with a cemented stem was 83.4 years, and with an uncemented stem it was 83.7 years (Table 20). More females (65.6%) than males received cemented stems.

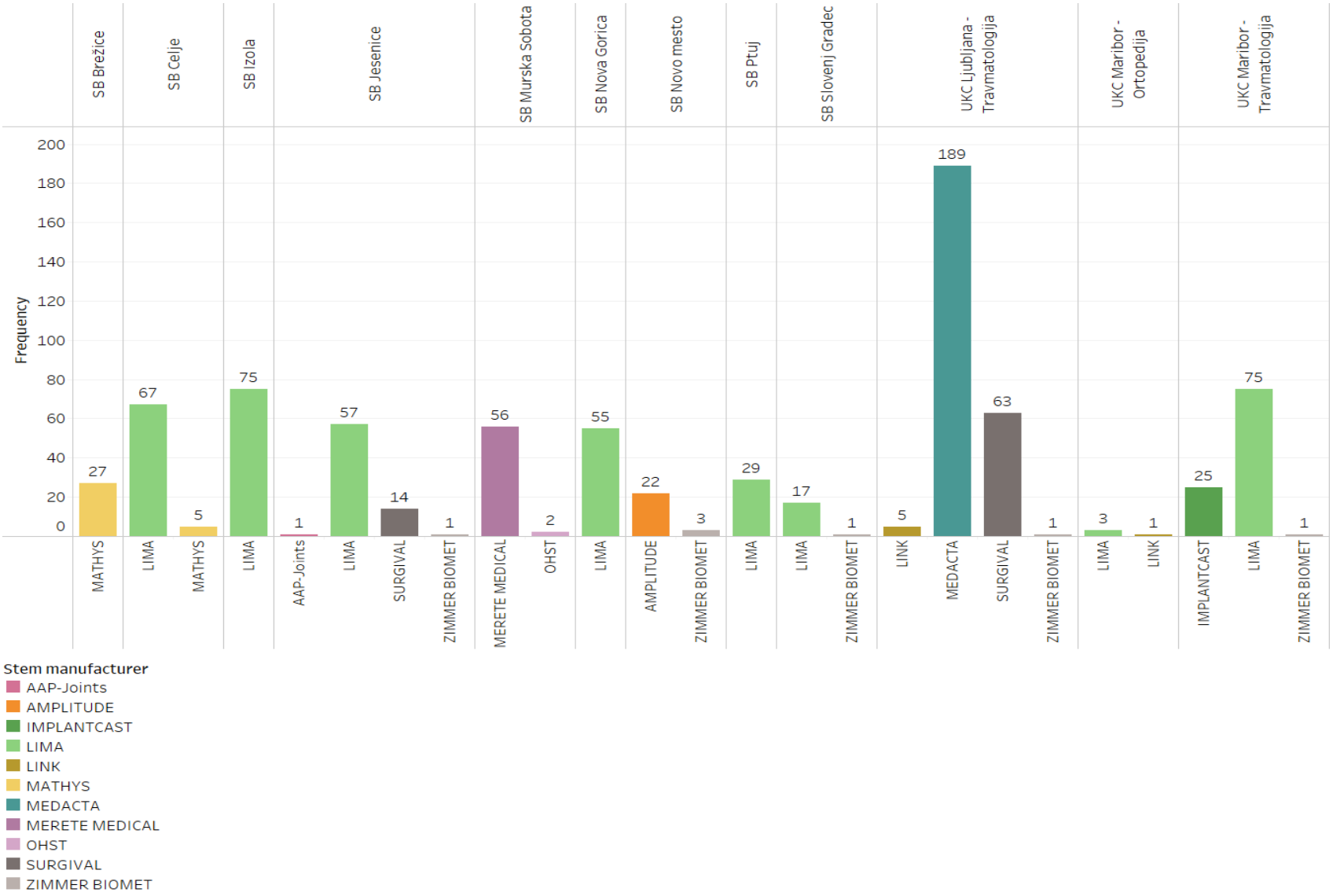


Figure 33: Primary partial hip arthroplasty between 2019 and 2023, by femoral stem manufacturer and provider (Source: RES).

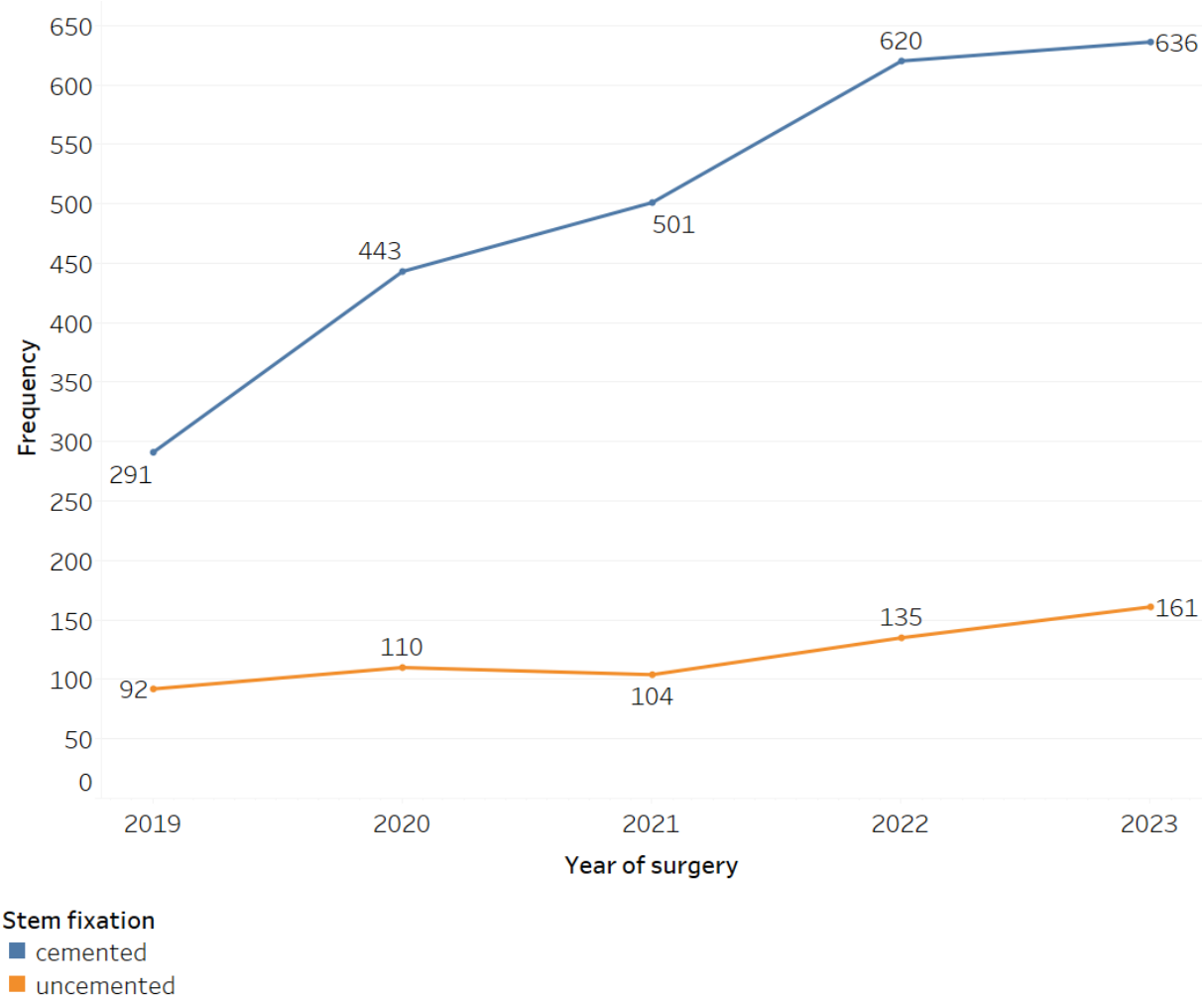


Figure 34: Primary partial hip arthroplasty between 2019 and 2023, according to femoral stem fixation (Source: RES).

Table 20: Femoral stem fixation in primary partial hip arthroplasty in 2023, according to patient gender and age (Source: RES).

	Years 2019 - 2022					Year 2023				
Stem fixation	**Number**	**f%**	**Age (Me)**	**(f_M%)**	**($f_Ž$%)**	**Number**	**f%**	**Age (Me)**	**(f_M%)**	**($f_Ž$%)**
Cemented	1,855	80.8	84.7	30.8	69.2	636	79.8	83.7	34.4	65.6
Uncemented	441	19.2	82.2	34.5	65.5	161	20.2	83.4	39.1	60.9

7.2.5 Mortality within 90 days after primary partial hip arthroplasty

In addition to the date of surgery, RES also records the date of death if applicable. One of the quality indicators is mortality within 90 days after the surgery.

As seen in Figure 35, there were 52 patient deaths within 90 days of surgery after primary partial hip arthroplasty performed in 2019, in 2020, 77 cases in 2021, 92 cases in 2022, 107, and in 2023,108.

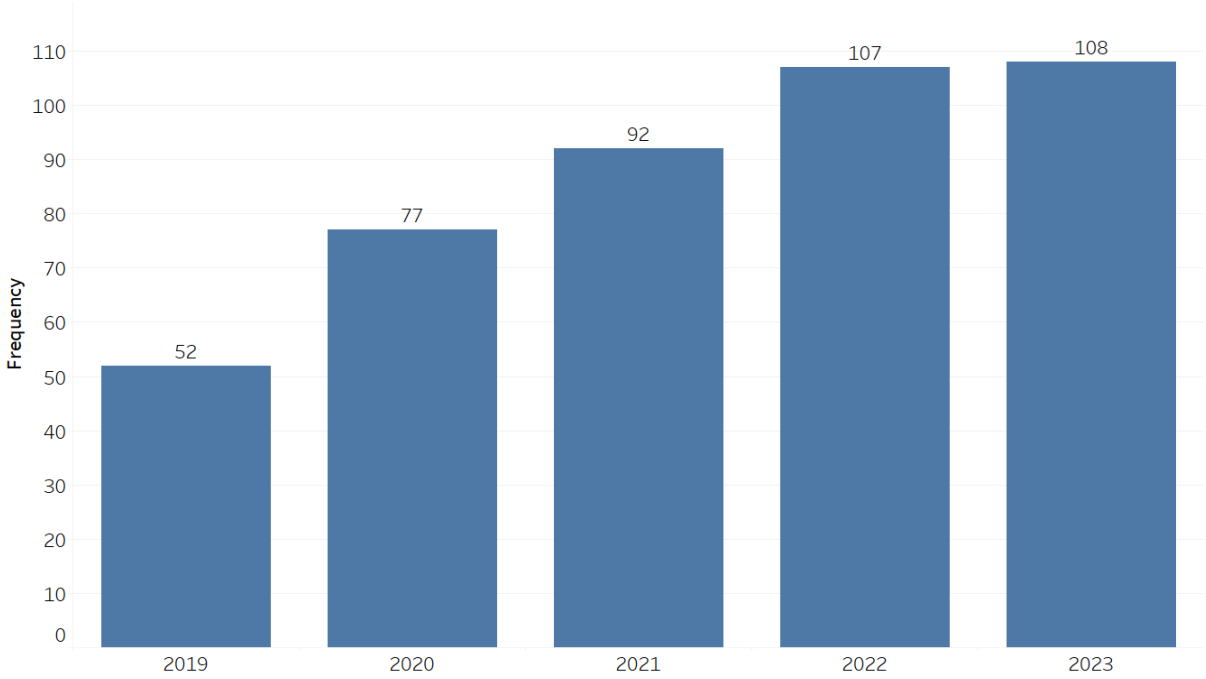


Figure 35: Number of deaths after primary partial hip arthroplasty between 2019 and 2023 (source: RES).

To calculate the mortality of patients after primary total hip arthroplasty, the following formula was used:

$$Mortality\ 90\ days\ after\ primary\ total\ hip\ arthroplasty = \frac{number\ of\ all\ deaths\ 90\ days\ after\ primary\ total\ hip\ arthroplasty}{number\ of\ all\ primary\ total\ hip\ arthroplasties} * 100$$

As seen in Figure 36, patient 90-day mortality increased between 2019 (13.58%) and 2021 (15.21%), while in 2022 it decreased to 14.17% and 13.55% in 2023. Compared to mortality after total arthroplasty, that of partial hip arthroplasty is 30 to 35 times higher.

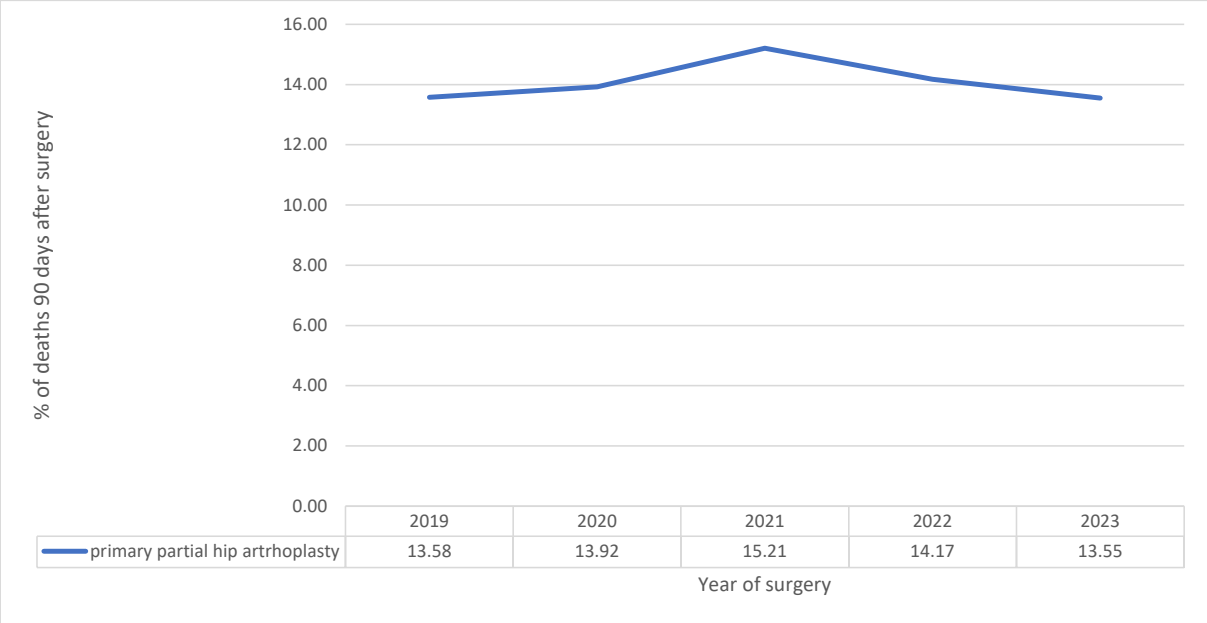


Figure 36: Mortality 90 days after primary partial hip arthroplasty (Source: RES).

7.3 Revision hip arthroplasty surgeries – data until 31.12.2023

In this section of the report, we present revisions of hip arthroplasties in the Republic of Slovenia from 2019 to 2023. In total, 1,768[24] revisions of hip arthroplasties were recorded during this period. In 2023, 402 revisions of hip endoprostheses were reported. Data collection was on 1.8.2024.

We present information on the revisionsurgical procedure according to the patient characteristics (gender, age at the time of the surgical procedure), by the healthcare provider, surgeon, characteristics of the revision surgical procedure (side of the surgical procedure, previous surgical procedure on this hip, reason for revision, scope of revision and approach used in the surgical procedure), data on the new implant (manufacturer) and the percentage of revisions by implant combinations.

7.3.1 Compliance of revision data

Discrepancies were found in compliance between the data submitted to RES and the data recorded in ZZZS because ZZZS does not record component removal (note after Girdlestone) as an independent revision surgery. In contrast, RES records each component removal as an independent revision of the hip endoprosthesis.

Compliance with revision hip arthroplasties in the Republic of Slovenia is constantly increasing between 2019 and 2023: in 2019 it was 82.2%, in 2020 81.5%, in 2021 87.2%, in 2022 90.3% and in 2023 94.4% (Table 21). During the entire period, Trbovlje General Hospital did not submit the data on revision hip arthroplasties to the RES database.

[24] In three cases, the year of revision hip arthroplasty was unknown. These were excluded from further analysis.

Table 21: Data on compliance of revision hip arthroplasties in the period from 2019 to 2023, by provider - comparison of RES and ZZZS (Source: RES and ZZZS)[25].

Compliance	2019	2020	2021	2022	2023
KS Rožna dolina		100.00	200.00	166.67	250.00
OB Valdoltra	83.92	86.90	85.32	87.84	85.62
SB Brežice	50.00	200.00	0.00	75.00	71.43
SB Celje	90.91	75.86	74.07	89.29	110.00
SB Izola	200.00	0.00	100.00	150.00	100.00
SB Jesenice	69.57	80.00	68.75	84.38	87.10
SB Murska Sobota	104.00	80.77	106.67	100.00	103.13
SB Šempeter pri Novi Gorici	44.44	73.33	50.00	85.71	80.00
SB Novo mesto	80.00	73.33	65.38	89.74	82.35
SB Ptuj	150.00	66.67	100.00	33.33	200.00
SB Slovenj Gradec	70.00	50.00	140.00	85.71	90.91
SB Trbovlje	0.00	0.00	0.00	0.00	0.00
UKC Ljubljana	75.47	79.71	93.90	97.37	106.17
UKC Maribor	92.86	89.29	100.00	74.29	100.00
Total	82.16	81.50	87.17	90.27	94.37

7.3.2 Gender and age of patients in revision hip arthroplasty surgeries

From 1.1.2019 to 31.12.2023, 1,765 revision hip arthroplasties were recorded in the RES database. Between 1.1.2023 and 31.12.2023, 402 such surgical procedures were recorded.

In 2023, 209 revision hip arthroplasties were performed in female patients (52%) and 193 in male patients (48%) (Figure 37). Male patients were younger (median between 69.8 in 2022 and 72.6 in 2023) compared to females (median around 75 years both years). The youngest patient was 30 years old at the time of the surgery, while the oldest was 96.2 years old (Figure 38).

[25] For MD Medicine, Arbor Meo and Bitenc Surgery, the ZZZS did not have records of operations performed until 2022. For this reason, we cannot calculate compliance.

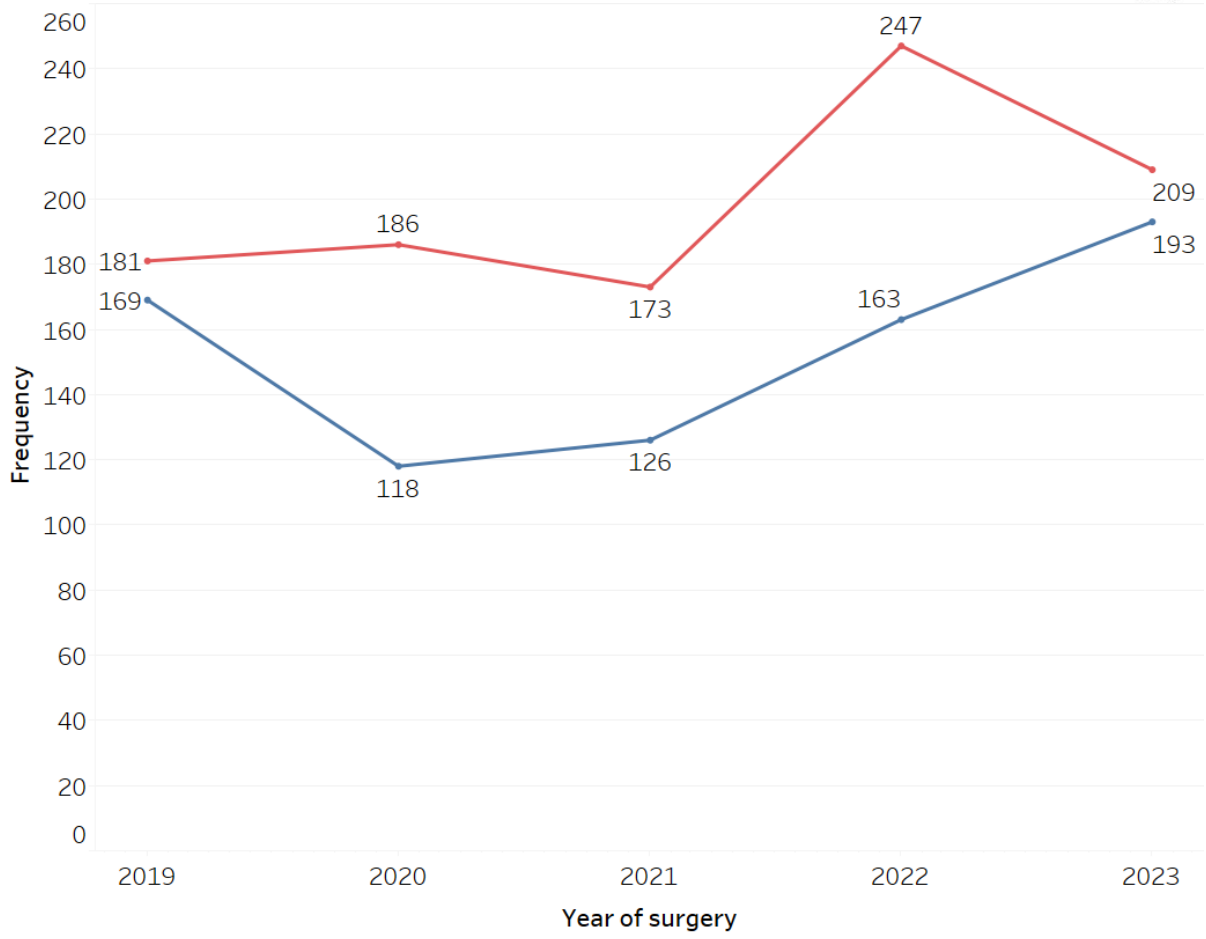


Figure 37: Revision hip arthroplasties between 2019 and 2023 by patient gender (Source: RES).

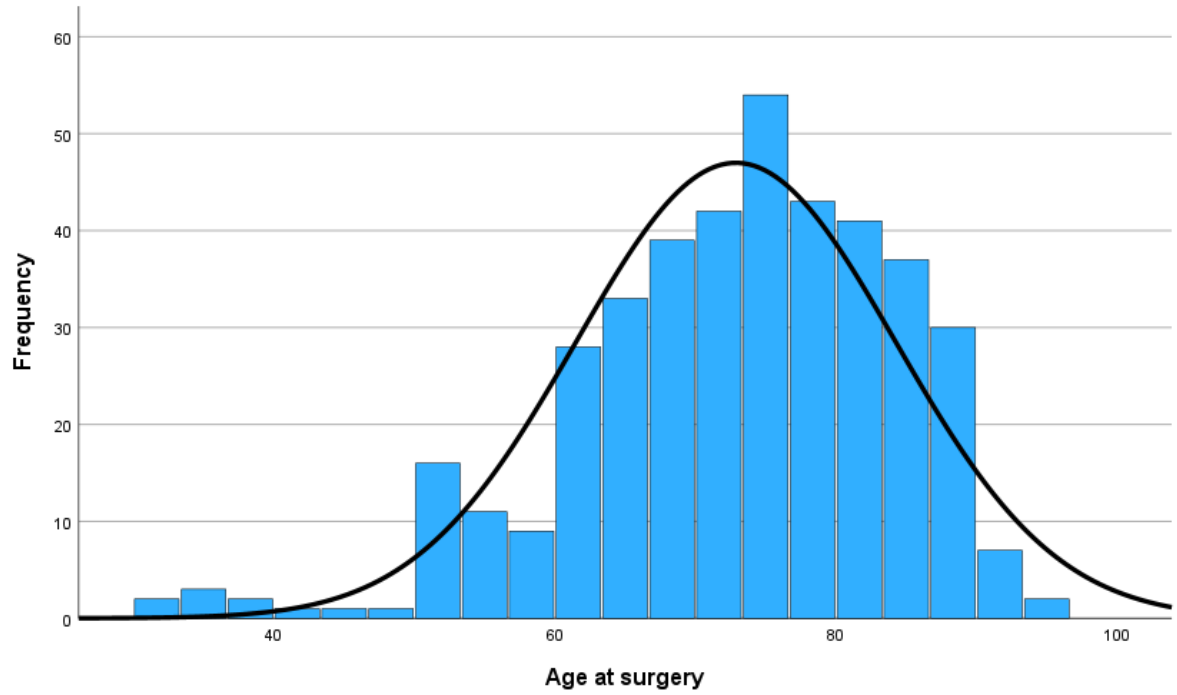


Figure 38: Revision hip arthroplasties between 2019 and 2023 according to patient age at surgery (Source: RES).

7.3.3 Characteristics of the surgical procedure in revision hip arthroplasties

Table 22 shows the providers of revision procedures between 2019 and 2023. Approximately 30% of revision hip arthroplasties in Slovenia are performed annually in the Valdoltra General Hospital. Approximately one-fifth of all procedures are performed at the Orthopaedic Clinic of the University Hospital of Ljubljana, but the share decreased to 17.9% in 2023. In the Celje General Hospital, 10.9% of all revision hip arthroplasties were performed in 2023 (previously, this share was between 6 and 8%).

The time between primary and revision arthroplasties has shortened between 2019 and 2023: in 2019, the median was 10.2 years, while in 2023, it was 6.9 years (Figure 39).

In 2023, 182 revisions (45.3%) were performed on the left hip and 220 (54.7%) on the right hip (Figure 40).

In 2023 (Figure 41), the most common reason for revision was loosening (in 125 - 31.1%). This was followed by deep infection (in 84 - 20.9%), periprosthetic fracture (in 75 - 18.7%), dislocation (in 40 - 10%), condition after component removal (in 13 - 3.2%), osteolysis (in 10 - 2.5%), implant fracture (in 10 - 2.5 and pain (in 9 - 2.2%). Other reasons for revision were reported in 36 cases (9%).

Table 22: Revision hip arthroplasties between 2019 and 2023 by surgical provider (Source: RES).

Hospital	2019	2020	2021	2022	2023
Kirurgija Bitenc					1
KS Rožna dolina		1	4	5	5
OB Valdoltra	119	126	93	130	125
SB Brežice		2		3	5
SB Celje	28	22	20	25	44
SB Izola	4		1	6	2
SB Jesenice	17	12	11	27	27
SB Murska Sobota	28	21	32	21	33
SB Nova Gorica	8	11	5	6	8
SB Novo mesto	17	22	17	35	28
SB Ptuj	3	2	1	1	2
SB Slovenj Gradec	7	5	7	12	10
UKC Ljubljana - ortopedija	78	50	65	87	72
UKC Ljubljana - travmatološki oddelek	3	5	12	24	14
UKC Maribor - ortopedija	37	24	27	22	22
UKC Maribor - travmatološki oddelek	1	1	4	6	4

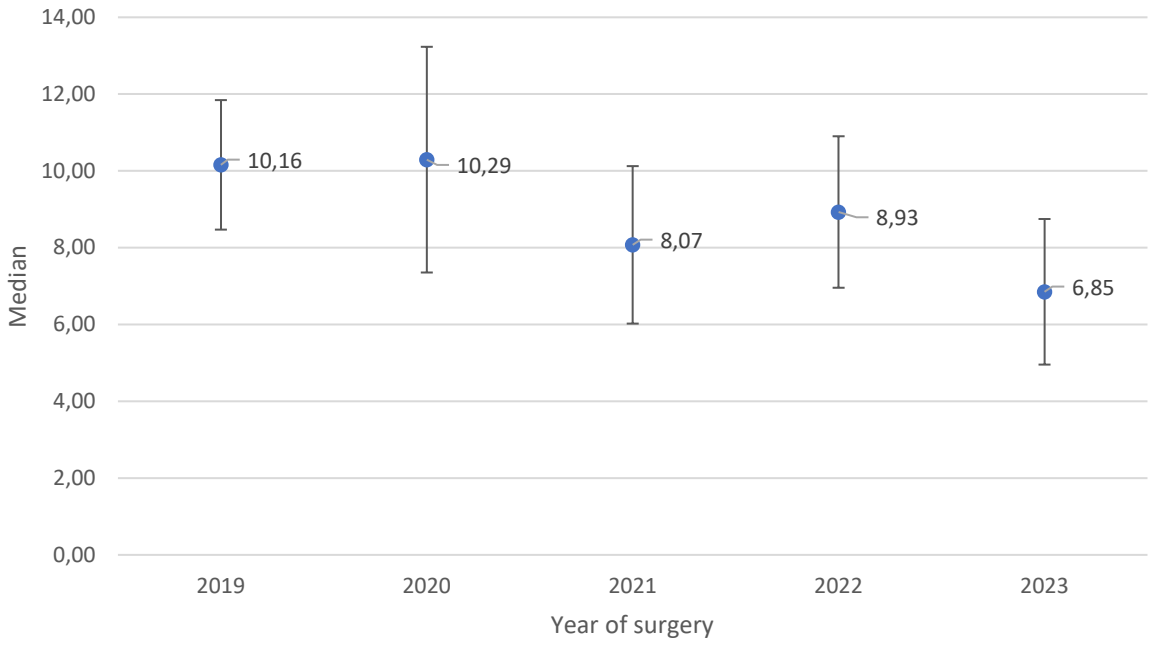


Figure 39: Time from primary hip arthroplasty to first hip revision from 2019 to 2023 (Source: RES).

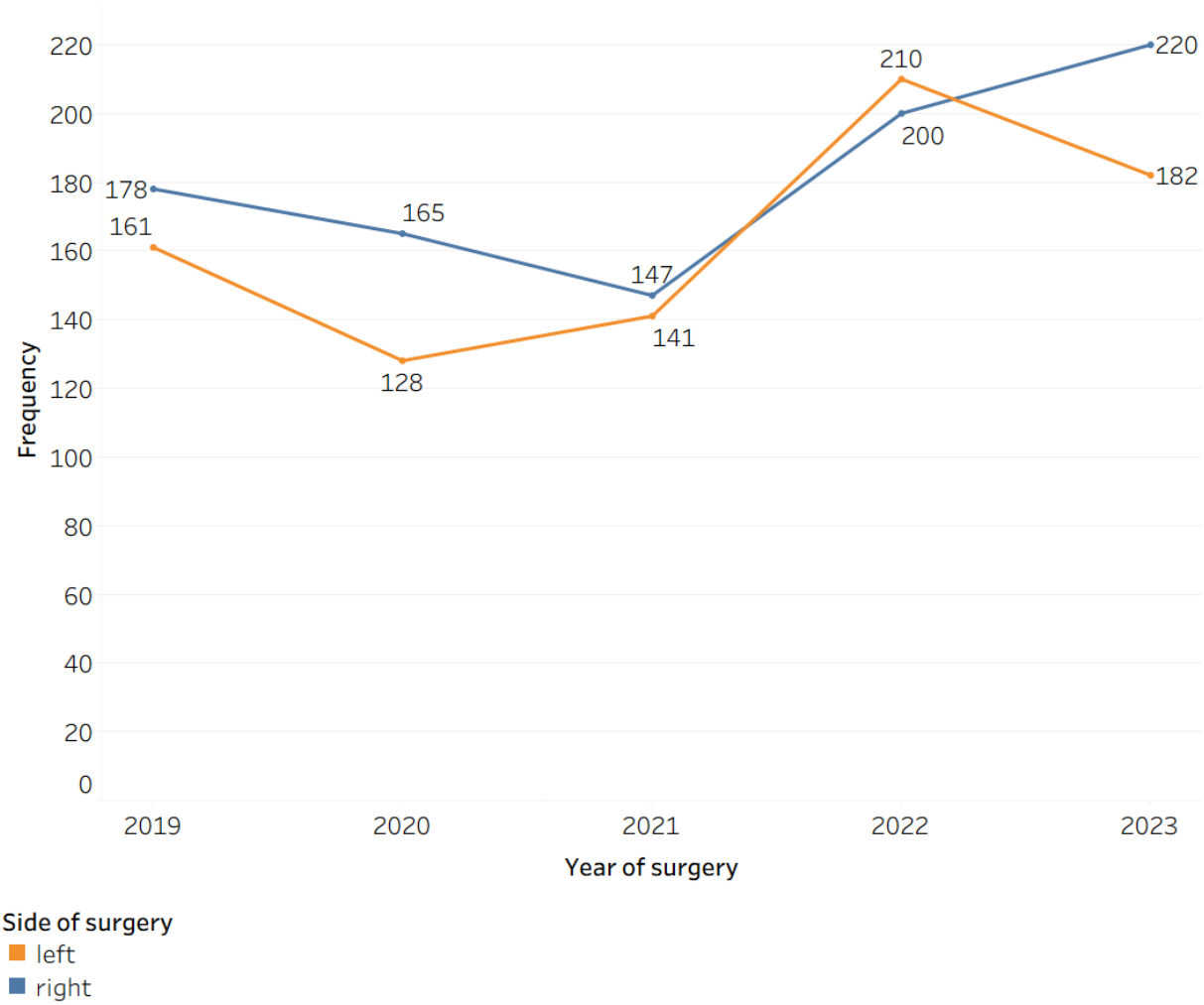


Figure 40: Revision hip arthroplasty between 2019 and 2023 by surgical side (Source: RES).

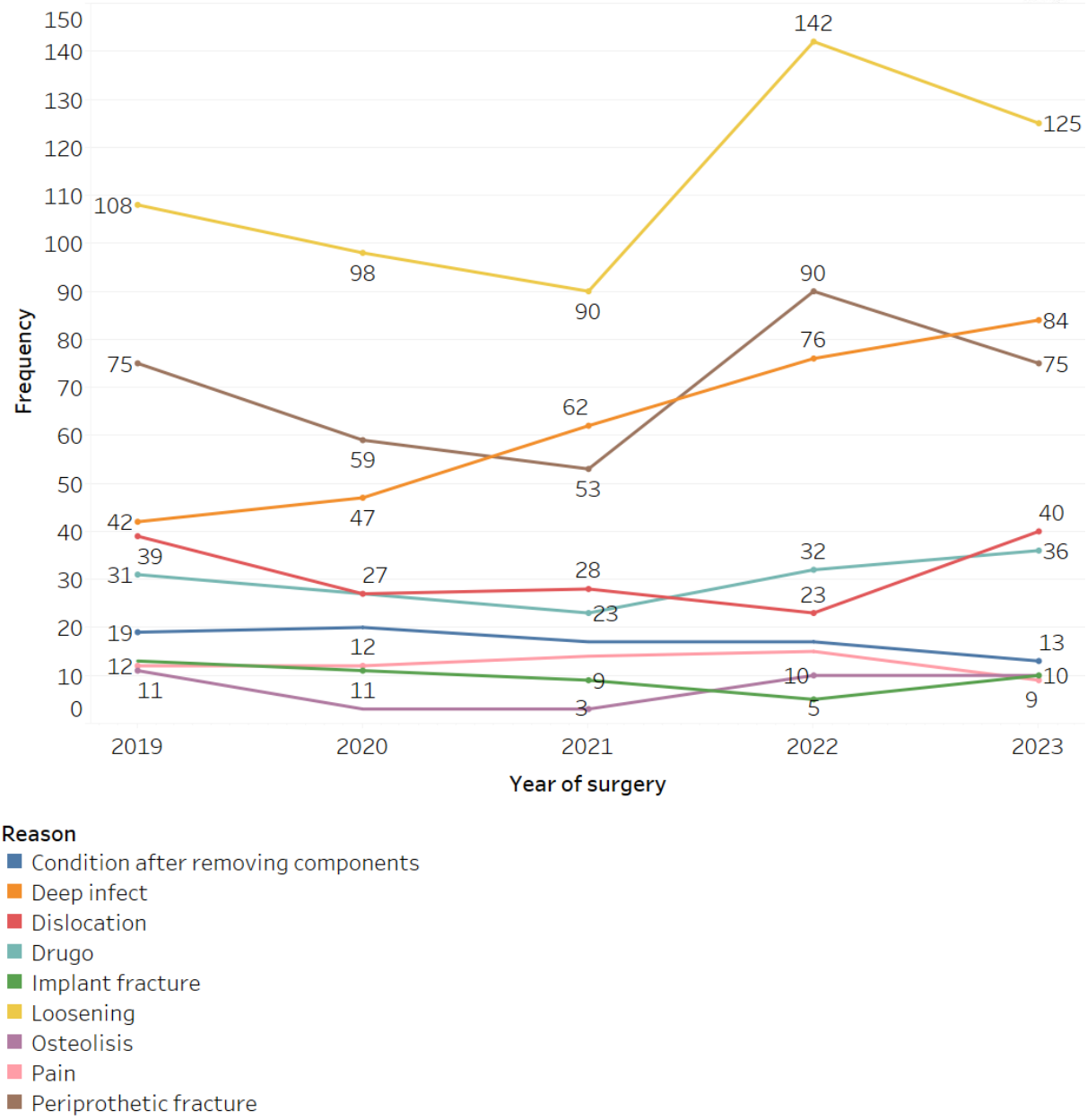


Figure 41: Hip arthroplasty revisions between 2019 and 2023 by reason of revision (Source: RES).

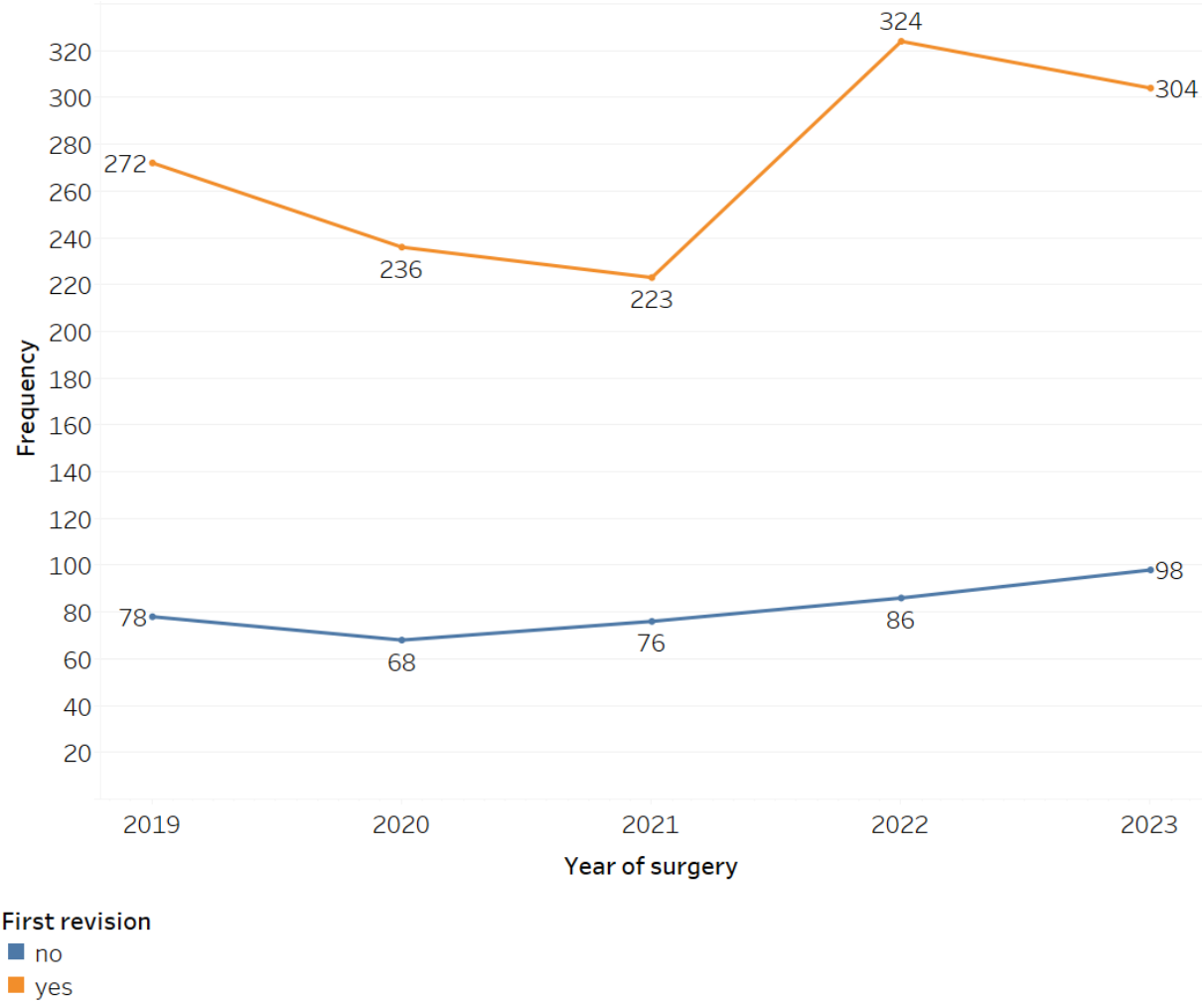


Figure 42: Revision hip arthroplasty between 2019 and 2023, by type of previous surgery (Source: RES).

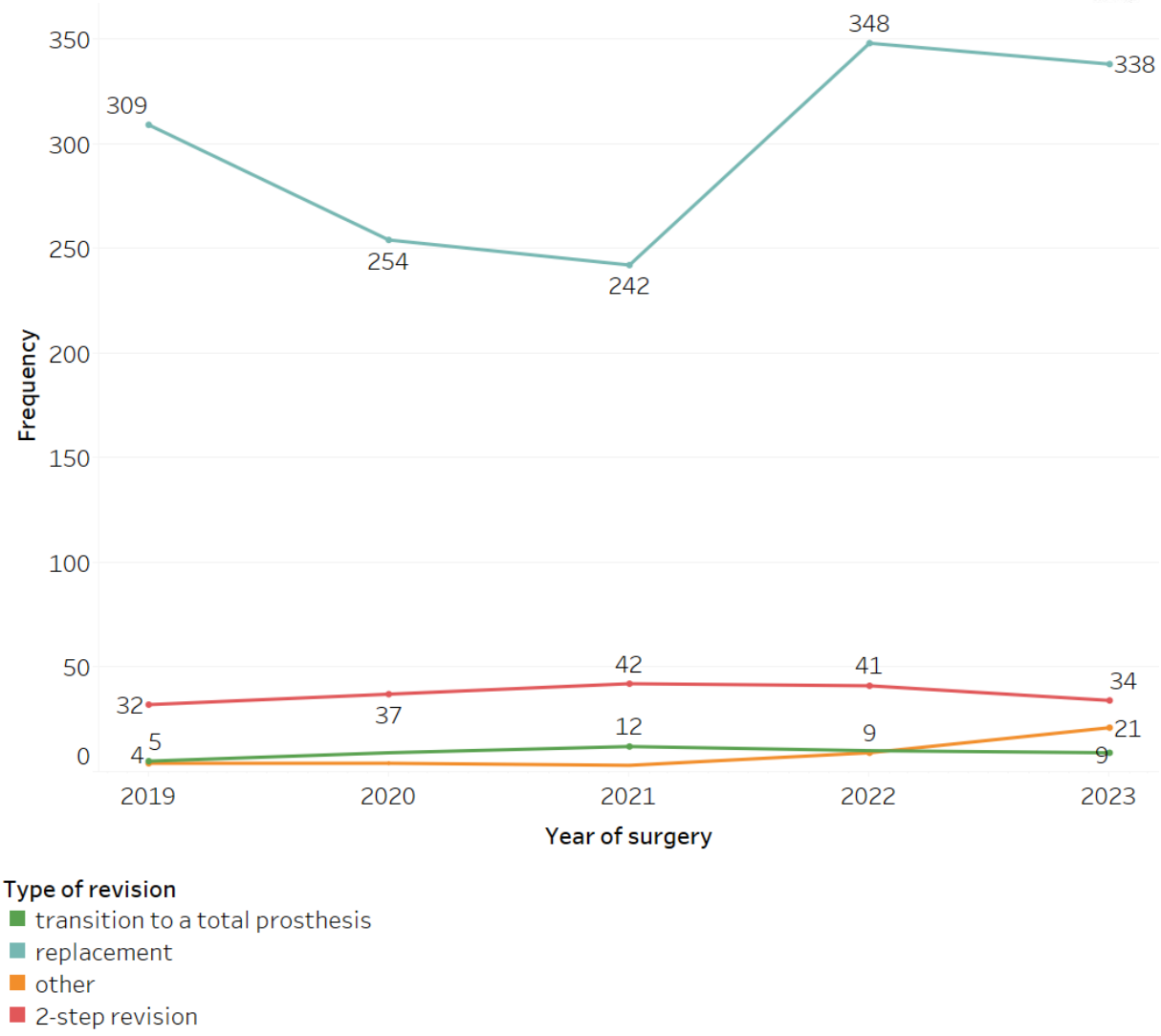


Figure 43: Revision hip arthroplasty between 2019 and 2023, by revision volume[26] (Source: RES).

[26] In two cases from 2022, we do not have data on the extent of revision hip arthroplasty.

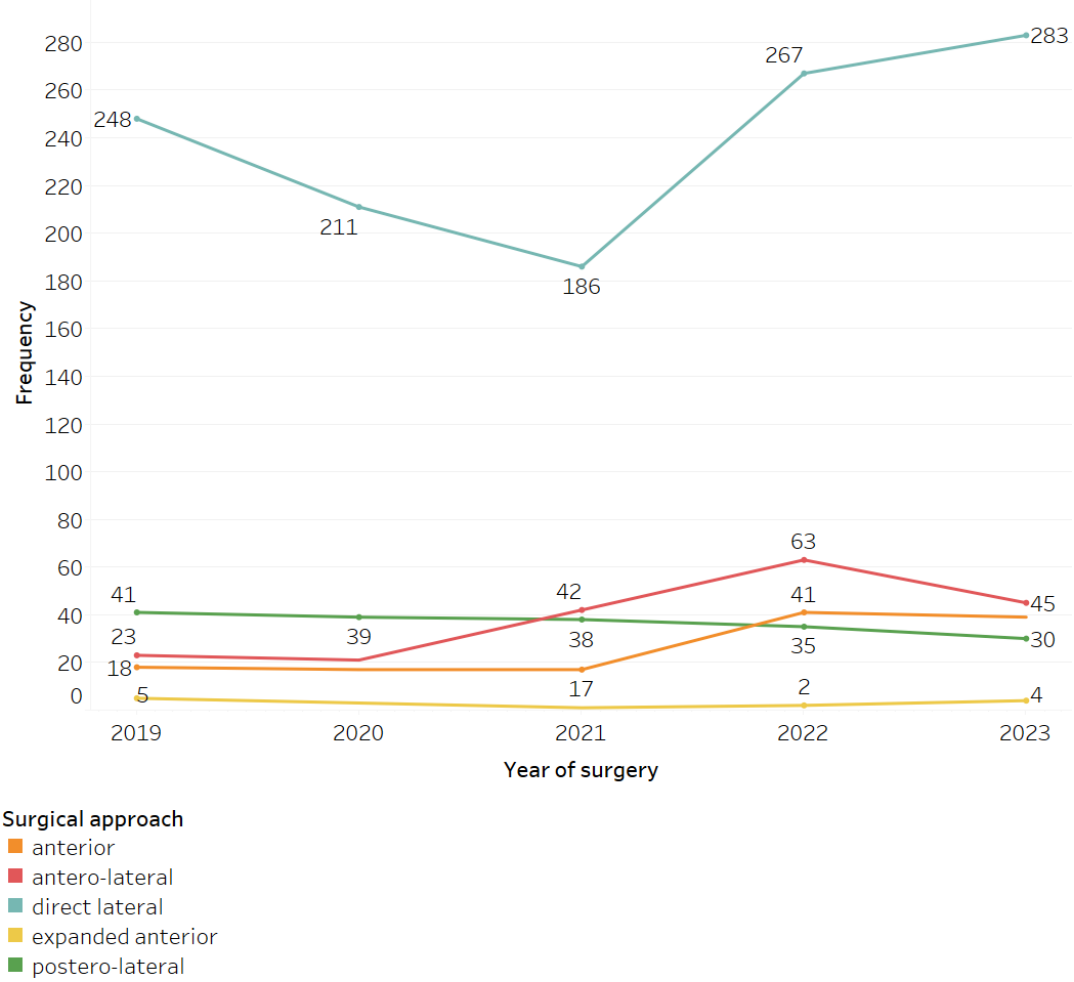


Figure 44: Revision hip arthroplasty between 2019 and 2023, by surgical approach[27] (Source: RES).

In 2023, the first revisions of hip arthroplasty were performed in 304 or 75.6% of cases (Figure 42). Among the previous surgical procedures, the most common were replacement of the endoprosthesis head (in 50 cases), replacement of the femoral part of the endoprosthesis (in 32 cases), replacement of the acetabular part of the endoprosthesis (in 30 cases), replacement of the insert in 24 cases, replacement of the entire endoprosthesis (20 cases), removal of the endoprosthesis (13 cases), replacement of the neck (5 cases), replacement of the ring in 3 cases) and other hip procedures (18 cases).

In 2023, 402 revision hip arthroplasties were performed, of which 338 (84.1%) were replacements, 34 two-stage revisions and 9 transitions to total endoprosthesis (Figure 43). In 21 cases, other types of revision hip precursors were performed.

As shown in Figure 44, in 2023, the direct-lateral surgical approach was used in 70.6% of cases. This is followed by the anterolateral (11.2%), anterior (9.7% o) and postero-lateral surgical approach (7.5%), while the extended anterior approach was used in four cases.

[27] Data on the surgical approach are missing for 15 cases in 2019, 16 cases in 2020, 15 cases in 2021, 2 cases in 2022, and 1 case in 2023.

7.4 Survival analysis of total hip replacements – data until 31.12.2023

In this chapter, we present the survival of primary total hip arthroplasties. The analysis includes implants inserted between January 1, 2019, and December 31, 2023, with at least 100 recorded stem-cup combinations. The time from the primary surgery to the first revision is analysed, where the first revision is defined as any reoperation for any reason, regardless of its extent (replacement of the entire endoprosthesis or only part of it). Implant combinations in patients who died during the observation period or did not have an event (first revision) at the end of the follow-up are considered censored.

The Kaplan-Meier method is used to estimate survival at time t (function S(t)). The estimates are presented as cumulative revision rates, i.e., 1-S(t), at 1, 2 and 3 years after the primary implantation.

Table 23: Number and % of primary hip implant combinations (stem-cup) by year (Source: RES).

Year	2019-2023		2019		2020		2021		2022		2023	
Stem-cup (manufacturer)	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
All endoprostheses	**18,817**		**3,691**		**3,051**		**3,333**		**4,118**		**4,624**	
Corail - Pinnacle (DePuy)	3,775	20.1	597	16.2	615	20.2	742	22.3	887	21.5	934	22.7
Zweymuller Alloclassic - Allofit (Zimmer Biomet)	2,853	15.2	709	19.2	627	20.6	568	17	458	11.1	491	11.9
H-MAX S fem stem - Delta PF cup (Lima)	2,603	13.8	576	15.6	407	13.3	349	10.5	572	13.9	699	17
Apta-Fix Uncemented Stem - Fixa Larus (Adler Ortho)	991	5.3	241	6.5	183	6	165	5	233	5.7	169	4.1
Taperloc Complete Microplasty - Allofit (Zimmer Biomet)	866	4.6	150	4.1	164	5.4	155	4.7	194	4.7	203	4.9
Evok fem stem - Saturne II Dual Mobility (Amplitude)	849	4.5	138	3.7	102	3.3	152	4.6	213	5.2	244	5.9
TwinSys fem stem - RM Pressfit Vitamys (Mathys)	539	2.9	37	1	53	1.7	96	2.9	178	4.3	175	4.2
Evok fem stem - Freeliner cup (Amplitude / Evolutis)	507	2.7	70	1.9	65	2.1	105	3.2	145	3.5	122	3
Avenir Muller Uncemented - Allofit (Zimmer Biomet)	468	2.5	0	0	9	0.3	142	4.3	153	3.7	164	4
Exception Uncemented - Avantage DM Uncemented Cup (Zimmer Biomet)	346	1.8	67	1.8	38	1.2	72	2.2	80	1.9	89	2.2
Taperloc Complete Uncemented Stem - Allofit (Zimmer Biomet)	322	1.7	75	2	70	2.3	59	1.8	67	1.6	51	1.2
CBH - RM Pressfit Vitamys (Mathys)	298	1.6	27	0.7	44	1.4	78	2.3	109	2.6	40	1
Zweymuller Alloclassic - Allofit-S IT (Zimmer Biomet)	243	1.3	75	2	37	1.2	46	1.4	31	0.8	54	1.3
Optimys - RM Pressfit Vitamys (Mathys)	224	1.2	0	0	7	0.2	12	0.4	29	0.7	176	4.3
EcoFit stem - EcoFit Cup Epore (Implantcast)	212	1.1	75	2	68	2.2	11	0.3	20	0.5	38	0.9
Minima S std - Delta PF cup (Lima)	204	1.1	0	0	23	0.8	29	0.9	62	1.5	90	2.2
SP II Cemented Stem - Interplanta (Link)	172	0.9	57	1.5	27	0.9	26	0.8	34	0.8	28	0.7
SP II Cemented Stem - Allofit (Link / Zimmer Biomet)	166	0.9	21	0.6	32	1	32	1	37	0.9	44	1.1
C2 Uncemented Stem - Delta PF cup (Lima)	132	0.7	30	0.8	24	0.8	29	0.9	33	0.8	16	0.4
Tri-Lock - Pinnacle (DePuy)	131	0.7	96	2.6	8	0.3	1	0	9	0.2	17	0.4

Taperloc Complete Microplasty - G7 Uncemented Acetabular Component (Zimmer Biomet)	125	0.7	32	0.9	22	0.7	16	0.5	28	0.7	27	0.7
Taperloc Complete Microplasty - Allofit-S IT (Zimmer Biomet)	124	0.7	38	1	13	0.4	31	0.9	35	0.8	7	0.2
Evok fem stem - Pinnacle (Amplitude / DePuy)	120	0.6	58	1.6	30	1	21	0.6	4	0.1	7	0.2
Quadra-H - Versafitcup CC acet shell (Medacta)	117	0.6	13	0.4	25	0.8	25	0.8	35	0.8	19	0.5
Evok fem stem - Stellar cup (Amplitude / Evolutis)	110	0.6	0	0	0	0	0	0	0	0	110	2.7
Taperloc Complete Microplasty - Delta PF cup (Zimmer Biomet / Lima)	108	0.6	34	0.9	29	1	36	1.1	7	0.2	2	0

The most frequently inserted combination during the entire period was the Corail – Pinnacle (DePuy), with 3,775 cases (20.1%). This was followed by the Zweymuller Alloclassic – Allofit (Zimmer Biomet) (15.2%) and the H-MAX S fem stem – Delta PF cup (Lima) (13.8%). All other combinations were inserted in less than 10% of cases (Table 23).

Table 24: One-, two-, and three-year cumulative revision rate of primary hip implant combinations (stem-cup) with 95% confidence interval (CI) (Source: RES).

Stem - cup (manufacturer)	Number of primaries	Number of first revisions	Age Median (IQR)	% of prostheses in women	Cumulative % of revisions (95% CI)		
					1 Year	2 Years	3 Years
All endoprostheses	**18,817**	**377**	**69 (61-76)**	**54**	**1.71 (1.53 - 1.91)**	**1.99 (1.79 - 2.22)**	**2.26 (2.03 - 2.51)**
Corail - Pinnacle (DePuy)	3,775	49	67 (59-73)	50	1.17 (0.86 - 1.58)	1.29 (0.96 - 1.73)	1.44 (1.07 - 1.95)
Zweymuller Alloclassic - Allofit (Zimmer Biomet)	2,853	70	70 (63-76)	56	1.92 (1.47 - 2.51)	2.34 (1.83 - 3)	2.83 (2.24 - 3.59)
H-MAX S fem stem - Delta PF cup (Lima)	2,603	29	70 (63-76)	53	1.01 (0.68 - 1.49)	1.07 (0.73 - 1.57)	1.17 (0.79 - 1.73)
Apta-Fix Uncemented Stem - Fixa Larus (Adler Ortho)	991	42	69 (61-75)	52	3.44 (2.46 - 4.81)	4.21 (3.07 - 5.76)	4.4 (3.22 - 6.02)
Taperloc Complete Microplasty - Allofit (Zimmer Biomet)	866	10	66 (58-72)	51	1.07 (0.56 - 2.04)	1.07 (0.56 - 2.04)	1.07 (0.56 - 2.04)
Evok fem stem - Saturne II Dual Mobility (Amplitude)*	849	16	75 (70-80)	67	1.92 (1.16 - 3.17)	1.92 (1.16 - 3.17)	1.92 (1.16 - 3.17)
TwinSys fem stem - RM Pressfit Vitamys (Mathys)	539	7	73 (67-79)	57	1.17 (0.53 - 2.58)	1.67 (0.74 - 3.74)	1.67 (0.74 - 3.74)
Evok fem stem - Freeliner cup (Amplitude / Evolutis)	507	10	64 (57-69)	43	1.47 (0.7 - 3.06)	1.8 (0.89 - 3.61)	2.7 (1.4 - 5.18)
Avenir Muller Uncemented - Allofit (Zimmer Biomet)	468	8	69 (61-75)	67	1.73 (0.87 - 3.43)	1.73 (0.87 - 3.43)	1.73 (0.87 - 3.43)
Exception Uncemented - Avantage DM Uncemented Cup (Zimmer Biomet)	346	8	71 (64-77)	63	2.54 (1.27 - 5.03)	2.54 (1.27 - 5.03)	2.54 (1.27 - 5.03)
Taperloc Complete Uncemented Stem - Allofit (Zimmer Biomet)	322	6	69 (62-74)	57	1.69 (0.71 - 4.03)	1.69 (0.71 - 4.03)	2.36 (1.03 - 5.39)
CBH - RM Pressfit Vitamys (Mathys)	298	5	69 (61-76)	49	*0.67 (0.17 - 2.66)*	*1.77 (0.65 - 4.83)*	*2.58 (1.02 - 6.41)*
Zweymuller Alloclassic - Allofit-S IT (Zimmer Biomet)	243	5	57 (51-62)	44	2.08 (0.87 - 4.92)	2.08 (0.87 - 4.92)	2.08 (0.87 - 4.92)
Optimys - RM Pressfit Vitamys (Mathys)	224	3	66 (59-73)	46	1.55 (0.5 - 4.76)	1.55 (0.5 - 4.76)	1.55 (0.5 - 4.76)
EcoFit stem - EcoFit Cup Epore (Implantcast)	212	8	67 (60-72)	41	1.92 (0.72 - 5.04)	3.89 (1.85 - 8.06)	4.57 (2.29 - 9.03)
Minima S std - Delta PF cup (Lima)	204	4	64 (57-71)	32	2.06 (0.78 - 5.41)	2.06 (0.78 - 5.41)	2.06 (0.78 - 5.41)
SP II Cemented Stem - Interplanta (Link)	172	3	80 (76-84)	69	1.16 (0.29 - 4.57)	1.16 (0.29 - 4.57)	1.16 (0.29 - 4.57)
SP II Cemented Stem - Allofit (Link / Zimmer Biomet)	166	4	81 (76-85)	84	2.09 (0.67 - 6.37)	2.09 (0.67 - 6.37)	2.09 (0.67 - 6.37)
C2 Uncemented Stem - Delta PF cup (Lima)	132	1	73 (66-78)	70	0.8 (0.11 - 5.54)	0.8 (0.11 - 5.54)	0.8 (0.11 - 5.54)
Tri-Lock - Pinnacle (DePuy)	131	3	64 (57-71)	50	0.82 (0.12 - 5.68)	0.82 (0.12 - 5.68)	1.8 (0.45 - 7.05)
Taperloc Complete Microplasty - G7 Uncemented Acetabular Component (Zimmer Biomet)	125	0	60 (52-66)	30	0	0	0
Taperloc Complete Microplasty - Allofit-S IT (Zimmer Biomet)	124	1	60 (53-68)	27	0.81 (0.11 - 5.59)	0.81 (0.11 - 5.59)	0.81 (0.11 - 5.59)
Evok fem stem - Pinnacle (Amplitude / DePuy)	120	3	70 (65-73)	61	1.7 (0.43 - 6.64)	1.7 (0.43 - 6.64)	1.7 (0.43 - 6.64)

Quadra-H - Versafitcup CC acet shell (Medacta)	117	3	69 (62-74)	60	2.58 (0.84 - 7.78)	2.58 (0.84 - 7.78)	2.58 (0.84 - 7.78)
Evok fem stem - Stellar cup (Amplitude / Evolutis)	110	1	66 (59-73)	55	1.85 (0.26 - 12.43)		
Taperloc Complete Microplasty - Delta PF cup (Zimmer Biomet / Lima)	108	1	68 (60-74)	27	0	0	1.75 (0.25 - 11.81)

During the entire period, out of a total of 18,817 primary hip replacements, 377 (2%) underwent a first revision. The median age of patients at the time of primary replacement was 69 years, and 54% of the replacements were performed in women. The estimated cumulative revision rates were 1.71% at one year, 1.99% at two years, and 2.26% at three years. Detailed cumulative revision rates for individual implant combinations are presented in Table 24.

Table 25 shows the replacements by reason for revision. Of the 16,605 endoprostheses that were implanted in more than 100 cases, 300 (1.8%) underwent a first revision. The most common reason for revision was infection (40.7%), followed by periprosthetic fracture (21.3%), loosening (15.3%), dislocation (10.3%), other reasons (8.7%), pain (3.3%), and implant fracture (0.3%).

Table 25: Number of primary hip implant combinations by reason for revision in the period 2019-2023 (Source: RES).

Stem-cup (manufacturer)	Number of first revisions	Number of primaries	% of revisions	Infection	Periprosthetic fracture	Loosening	Dislocation	Pain	Implant fracture	Other
Total	**300**	**16,605**	**1.8**	**122**	**64**	**46**	**31**	**10**	**1**	**26**
Corail - Pinnacle (DePuy)	49	3,775	1.3	26	5	8	4	0	0	6
Zweymuller Alloclassic - Allofit (Zimmer Biomet)	70	2,853	2.5	30	15	15	7	1	0	2
H-MAX S fem stem - Delta PF cup (Lima)	29	2,603	1.1	10	11	2	3	0	1	2
Apta-Fix Uncemented Stem - Fixa Larus (Adler Ortho)	42	991	4.2	10	10	4	8	4	0	6
Taperloc Complete Microplasty - Allofit (Zimmer Biomet)	10	866	1.2	7	0	1	1	0	0	1
Evok fem stem - Saturne II Dual Mobility (Amplitude)*	16	849	1.9	10	5	0	1	0	0	0
TwinSys fem stem - RM Pressfit Vitamys (Mathys)	7	539	1.3	4	1	0	1	1	0	0
Evok fem stem - Freeliner cup (Amplitude / Evolutis)	10	507	2.0	2	3	3	0	0	0	2
Avenir Muller Uncemented - Allofit (Zimmer Biomet)	8	468	1.7	2	6	0	0	0	0	0
Exception Uncemented - Avantage DM Uncemented Cup (Zimmer Biomet)	8	346	2.3	4	2	2	0	0	0	0
Taperloc Complete Uncemented Stem - Allofit (Zimmer Biomet)	6	322	1.9	1	0	2	0	0	0	3
CBH - RM Pressfit Vitamys (Mathys)	5	298	1.7	0	0	3	0	1	0	1
Zweymuller Alloclassic - Allofit-S IT (Zimmer Biomet)	5	243	2.1	4	0	0	0	0	0	1
Optimys - RM Pressfit Vitamys (Mathys)	3	224	1.3	0	2	0	0	0	0	1
EcoFit stem - EcoFit Cup Epore (Implantcast)	8	212	3.8	2	1	2	2	0	0	1
Minima S std - Delta PF cup (Lima)	4	204	2.0	2	1	0	1	0	0	0
SP II Cemented Stem - Interplanta (Link)	3	172	1.7	2	0	1	0	0	0	0
SP II Cemented Stem - Allofit (Link / Zimmer Biomet)	4	166	2.4	3	0	1	0	0	0	0
C2 Uncemented Stem - Delta PF cup (Lima)	1	132	0.8	0	0	0	1	0	0	0
Tri-Lock - Pinnacle (DePuy)	3	131	2.3	1	0	1	0	1	0	0
Taperloc Complete Microplasty - G7 Uncemented Acetabular Component (Zimmer Biomet)	0	125	0.0	0	0	0	0	0	0	0
Taperloc Complete Microplasty - Allofit-S IT (Zimmer Biomet)	1	124	0.8	0	0	0	1	0	0	0
Evok fem stem - Pinnacle (Amplitude / DePuy)	3	120	2.5	1	1	0	0	1	0	0
Quadra-H - Versafitcup CC acet shell (Medacta)	3	117	2.6	0	1	1	1	0	0	0
Evok fem stem - Stellar cup (Amplitude / Evolutis)	1	110	0.9	1	0	0	0	0	0	0
Taperloc Complete Microplasty - Delta PF cup (Zimmer Biomet / Lima)	1	108	0.9	0	0	0	0	1	0	0

7.4.1 Bearing surface head - cup

Table 26: Number and % of primary endoprostheses by bearing surface by year (Source: RES).

Year	2019-2023		2019		2020		2021		2022		2023	
Bearing surface	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
All endoprostheses	**18,817**		**3,691**		**3,051**		**3,333**		**4,118**		**4,624**	
Metal+PE	351	1.9	93	2.5	58	1.9	49	1.5	73	1.8	78	1.7
Metal+XLPE	4,006	21.3	811	22	778	25.5	747	22.4	833	20.2	837	18.1
Ceramic+PE	998	5.3	198	5.4	168	5.5	172	5.2	197	4.8	263	5.7
Ceramic+XLPE	10,919	58	1,989	53.9	1,670	54.7	1,942	58.3	2,480	60.2	2,838	61.4
Ceramic+ceramic	1,108	5.9	326	8.8	216	7.1	159	4.8	197	4.8	210	4.5
Double mobility	1,435	7.6	274	7.4	161	5.3	264	7.9	338	8.2	398	8.6

During the entire period, the most frequently *inserted prostheses were those with a ceramic+XLPE bearing surface, 10,919 (58%). This was followed by metal+XLPE surfaces (21.3%) and dual mobility (7.6%) (Table 26).*

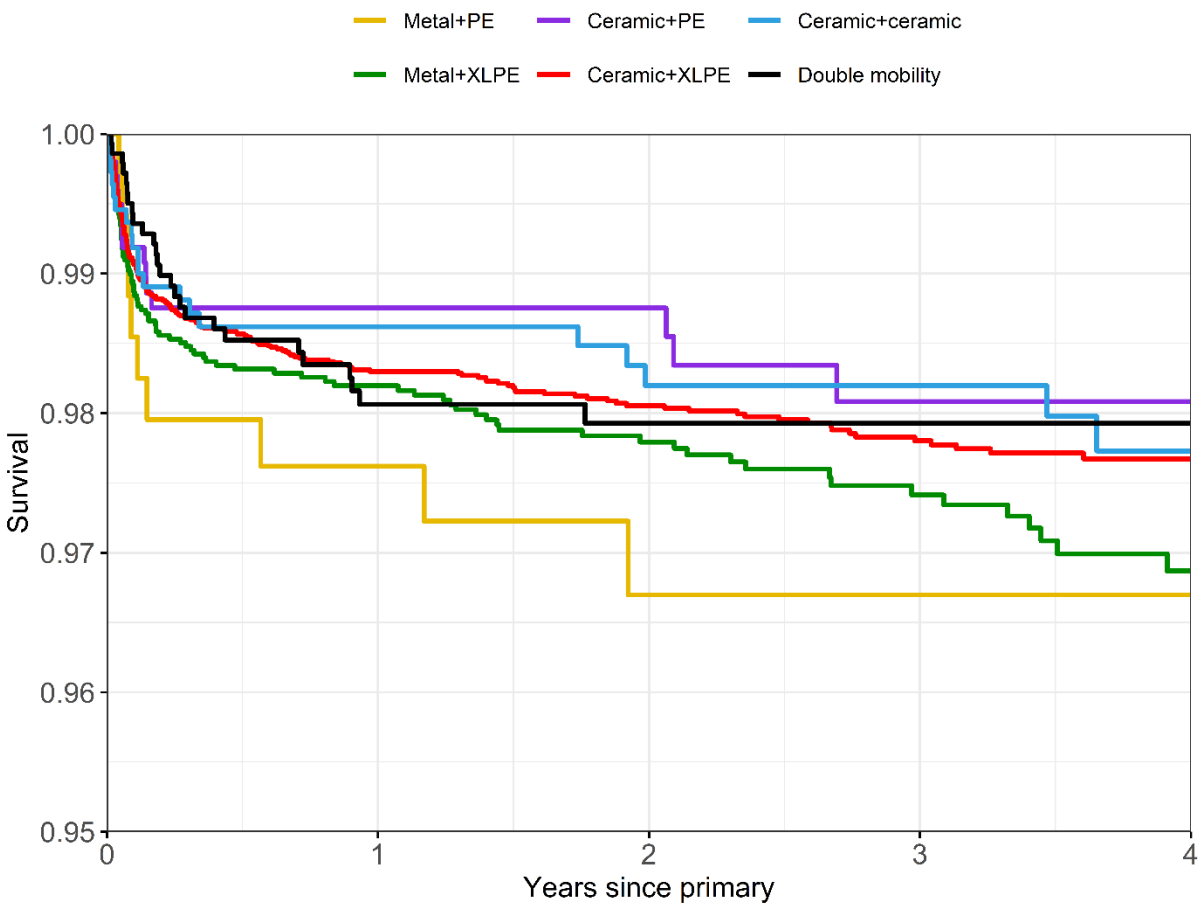


Figure 45: Kaplan-Meier survival curve of primary endoprostheses by bearing surface (Source: RES).

As shown in Figure 45 shows implants with ceramic+PE bearing surface had the best estimated 1- and 2-year survival, while ceramic+ceramic had the best 3-year survival. The bearing surface metal+PE had the poorest survival.

Table 27 confirms this by calculating the cumulative % of revisions. The lowest cumulative % of revisions is observed for ceramic+PE (1.25% at the first two years), and for ceramic+ceramic (1.8% at three years), while the highest is for metal+PE (2.38% at one year and 3.3% at two and three years).

Table 27: One-, two- and three-year cumulative revision rate of primary endoprostheses by head-cup bearing surface, with 95% confidence interval (CI) (Source: RES).

Bearing surface	Number of primaries	Number of first revisions	Age Median (IQR)	% of prostheses in women	Cumulative % of revisions (95% CI)		
					1 Year	2 Years	3 Years
All endoprostheses	**18,817**	**377**	**69 (61-76)**	**54**	**1.71 (1.53 - 1.91)**	**1.99 (1.79 - 2.22)**	**2.26 (2.03 - 2.51)**
Ceramic+PE	351	12	78 (73-83)	72	2.38 (1.2 - 4.71)	3.3 (1.76 - 6.15)	3.3 (1.76 - 6.15)
Metal+ XLPE	4,006	97	75 (71-80)	60	1.8 (1.43 - 2.28)	2.21 (1.77 - 2.74)	2.59 (2.09 - 3.21)
Ceramic+PE	998	15	69 (62-76)	54	1.25 (0.71 - 2.18)	1.25 (0.71 - 2.18)	1.92 (1.12 - 3.28)
Ceramic+XLPE	10,919	207	66 (59-72)	51	1.7 (1.47 - 1.97)	1.95 (1.69 - 2.24)	2.2 (1.91 - 2.54)
Ceramic+Ceramic	1,108	20	60 (51-67)	43	1.38 (0.83 - 2.28)	1.8 (1.13 - 2.87)	1.8 (1.13 - 2.87)
Double mobility	1,435	26	74 (69-79)	65	1.94 (1.31 - 2.86)	2.07 (1.41 - 3.05)	2.07 (1.41 - 3.05)

7.4.2 Endoprosthesis fixation

Table 28: Number and % of primary endoprostheses by endoprosthesis fixation by years (Source: RES).

Year	2019-2023		2019		2020		2021		2022		2023	
Fixation of the prosthesis	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
All prostheses	**18,817**		**3,691**		**3,051**		**3,333**		**4,118**		**4,624**	
Uncemented	17,742	94.3	3,456	93.6	2,877	94.3	3,143	94.3	3,901	94.7	4,365	94.4
Cemented	432	2.3	126	3.4	87	2.9	73	2.2	69	1.7	77	1.7
Hybrid (cem. stem / uncem. acetabulum)	392	2.1	42	1.1	50	1.6	63	1.9	97	2.4	140	3
Reverse hybrid	251	1.3	67	1.8	37	1.2	54	1.6	51	1.2	42	0.9

Throughout the entire period and in each year, the majority of implanted prostheses were uncemented (over 90%). All remaining fixations are presented in more detail in Table 28.

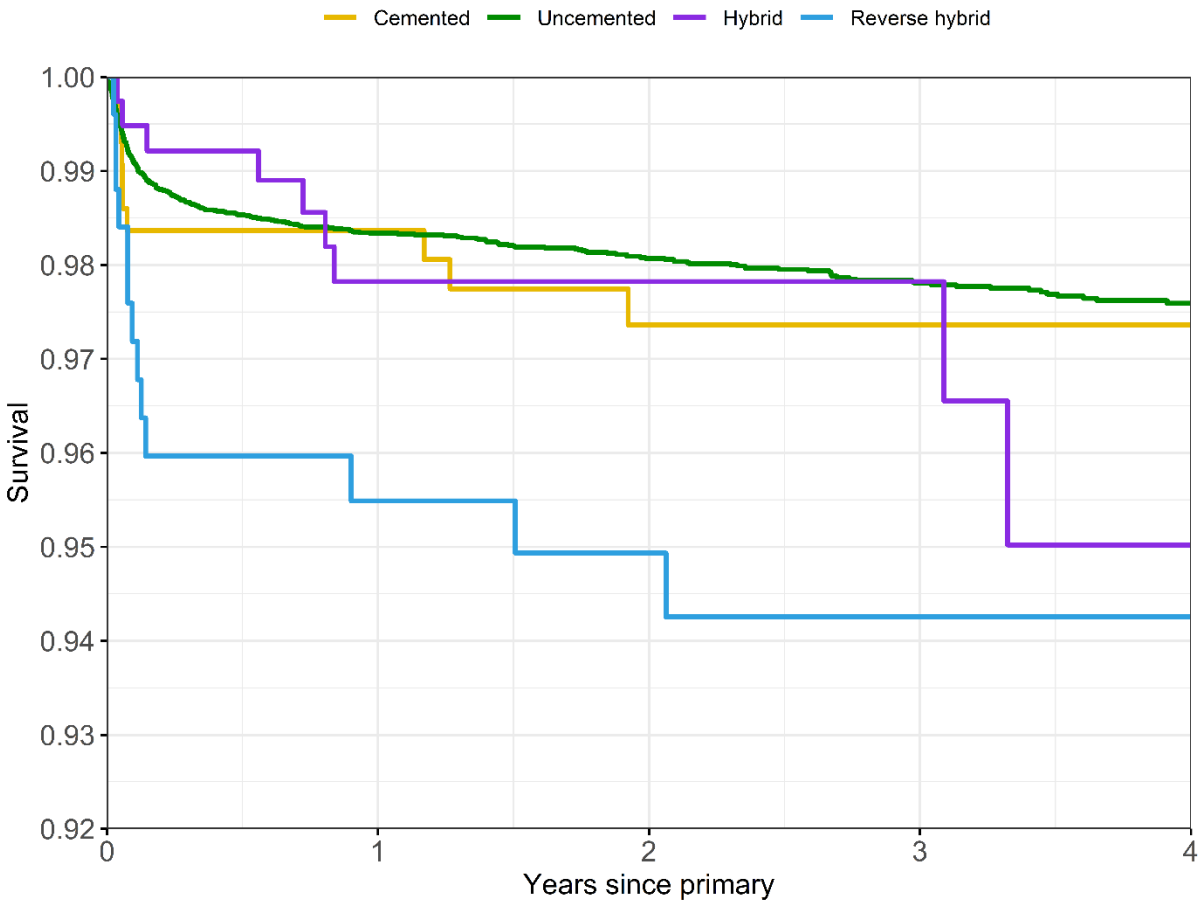


Figure 46: Kaplan-Meier survival curve of primary endoprostheses by prosthesis fixation (Source: RES).

Figure 46 shows a higher estimated survival for uncemented prostheses compared to the others. Conversely, the lowest survival rate is observed with reverse hybrid fixation.

Table 29: One-, two- and three-year cumulative revision rate of primary endoprostheses by fixation with 95% confidence interval (CI) (Source: RES).

Fixation	Number of primaries	Number of first revisions	Age Median (IQR)	% of prostheses in women	Cumulative % of revisions (95% CI)		
					1 Year	2 Years	3 Years
All prostheses	18,817	377	69 (61-76)	54	1.71 (1.53 - 1.91)	1.99 (1.79 - 2.22)	2.26 (2.03 - 2.51)
Uncemented	17,742	344	69 (61-75)	53	1.66 (1.48 - 1.87)	1.93 (1.73 - 2.16)	2.2 (1.96 - 2.46)
Cemented	432	11	80 (76-84)	73	1.63 (0.78 - 3.4)	2.64 (1.41 - 4.9)	2.64 (1.41 - 4.9)
Hybrid (cem. stem / uncem. acetabulum)	392	9	79 (73-84)	80	2.18 (1.03 - 4.55)	2.18 (1.03 - 4.55)	2.18 (1.03 - 4.55)
Reverse hybrid	251	13	72 (67-78)	70	4.51 (2.52 - 8.01)	5.07 (2.9 - 8.78)	5.74 (3.34 - 9.78)

The cumulative revision % of uncemented, cemented, hybrid, and reverse hybrid prostheses is shown in Table 29.

7.4.3 Endoprosthesis head size

Table 30: Number and % of primary endoprostheses by head size by year (Source: RES).

Year	2019-2023		2019		2020		2021		2022		2023	
Head size	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
All prostheses	18,817		3,691		3,051		3,333		4,118		4,624	
Double mobility	1,442	7.7	281	7.6	161	5.3	264	7.9	338	8.2	398	8.6
≤ 28 mm	1,923	10.2	459	12.4	326	10.7	322	9.7	403	9.8	413	8.9
32 mm	9,926	52.8	1,940	52.6	1,748	57.3	1,805	54.2	2,101	51	2332	50.4
36 mm	5,526	29.4	1,011	27.4	816	26.7	942	28.3	1,276	31	1481	32

Throughout the entire period and in each year, the most frequently inserted head size was 32 mm (more than 50%). Head sizes are presented in more detail in Table 30.

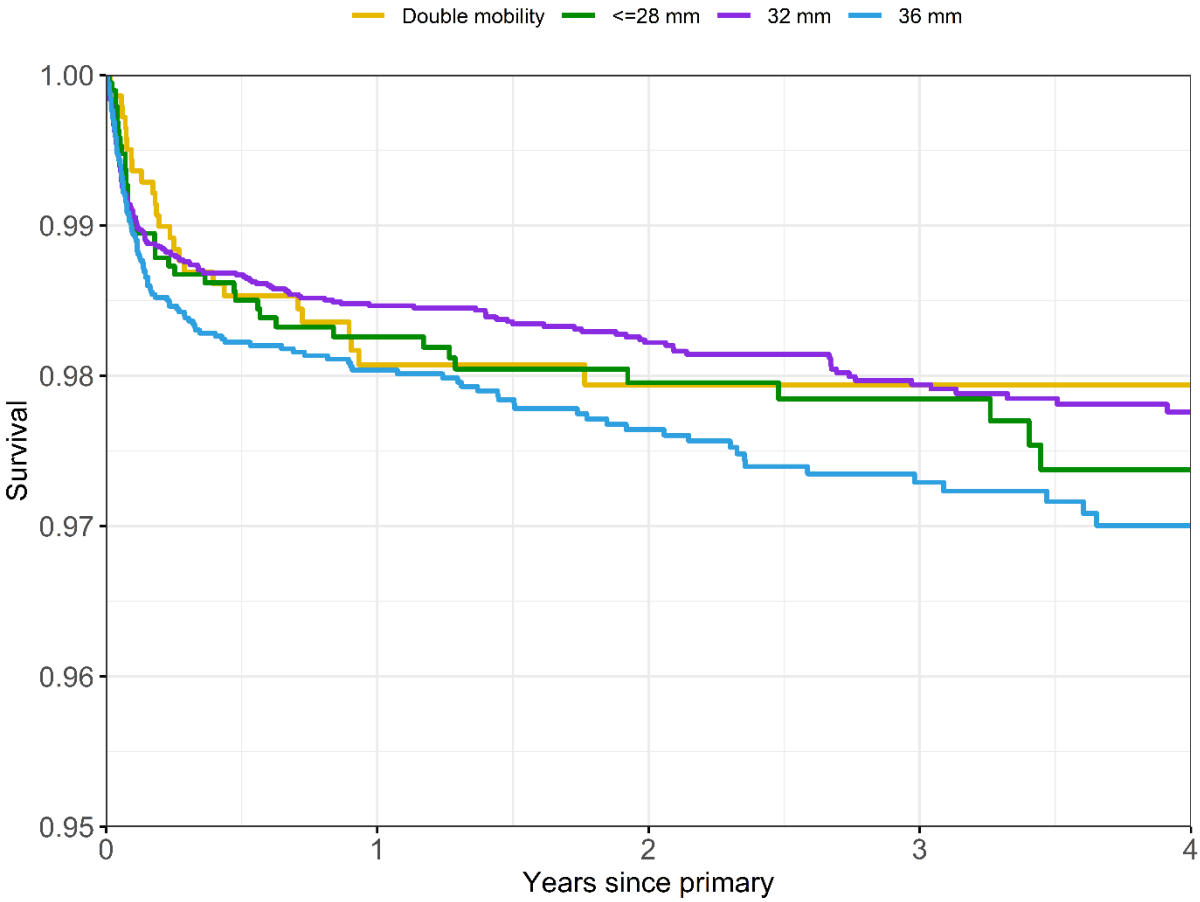


Figure 47: Kaplan-Meier survival curve of primary prostheses by head size (Source: RES).

Figure 47 shows the estimated survival by head size. Cumulative revision rates are in Table 31.

Table 31: One-, two- and three-year cumulative % of primary prosthesis revisions by head size with 95% confidence interval (CI) (Source: RES).

Head size	Number of primaries	Number of first revisions	Age Median (IQR)	% of prostheses in women	Cumulative % of revisions (95% CI)		
					1 Year	2 Years	3 Years
All prostheses	**18,817**	**377**	**69 (61-76)**	**54**	**1.71 (1.53 - 1.91)**	**1.99 (1.79 - 2.22)**	**2.26 (2.03 - 2.51)**
Double mobility	1,442	27	74 (69-79)	66	1.93 (1.3 - 2.84)	2.06 (1.4 - 3.03)	2.06 (1.4 - 3.03)
≤ 28 mm	1,923	40	70 (62-76)	90	1.74 (1.23 - 2.45)	2.05 (1.48 - 2.83)	2.15 (1.56 - 2.98)
32 mm	9,926	182	69 (62-76)	58	1.53 (1.31 - 1.8)	1.78 (1.52 - 2.08)	2.06 (1.76 - 2.4)
36 mm	5,526	128	67 (60-74)	31	1.96 (1.62 - 2.38)	2.36 (1.96 - 2.83)	2.71 (2.26 - 3.25)

7.5 Summary of the RES registry analysis for hip arthroplasty

In 2023, the compliance between the data of the Health Insurance Institute of Slovenia (ZZZS) and the Registry of Endoprostheses of Slovenia (RES) remained at a very high level, confirming the reliability and quality of both data sources.

The incidence of operations continues to increase - for total hip prostheses (THP) it was 218 per 100,000 population, and for total or partial knee prostheses it is 193 per 100,000 population. Slovenia is gradually approaching the standards of Western European countries.

The main reason for operations remains idiopathic osteoarthrosis (OA), recorded in 80.3% of cases in 2023. This represents an increase compared to the average between 2019 and 2022 (77.8%). The share of other diagnoses is gradually decreasing. Surgical approaches are also changing – the proportion of anterior approaches continues to increase, reaching 44% in 2023 (compared to 35.8% in 2019-2022). The use of other approaches is decreasing. The type of prostheses used remains largely unchanged – uncemented prostheses represent 94.4% of all insertions. The use of hybrid prostheses increases, while the proportion of fully cemented prostheses continues to decrease. The share of prostheses with dual mobility heads increased slightly in 2023 compared to 2019-2022. reaching 8.6% of all implanted prostheses. The use of more modern materials is also increasing – ceramic heads combined with XLPE were used in 61.4% of cases (compared to 56.8% in 2019-2022). 36 mm heads are increasingly used more their share is increasing by 4% in 2023 compared with previous years.

Mortality within 90 days after surgery remains virtually unchanged. As expected, mortality after partial hip replacement is significantly higher - approximately 30 times higher, compared to total hip replacement.

The results of PROMs (Patient Reported Outcome Measures) show that women had lower Oxford Hip Score (OHS) values before surgery than men. The worst 12-month postoperative results were recorded in patients older than 74 years. According to EQ-5D-5L data, quality of life before surgery was lower in women, but after 12 months, the results were comparable between the genders.

- The survival analysis of implants showed that two implant combinations had a 3-year revision rate approximately twice the overall average of 2.26%; Apta-Fix Uncemented Stem – Fixa Larus (Adler Ortho); a 3-year revision rate of 4.4 (95% CI: 3.22–6.02) and

- EcoFit stem – EcoFit Cup Epore (Implantcast):3-year revision rate of 4.57 (95% CI: 2.29–9.03).

8 Knee arthroplasty

In this chapter, we focus on knee arthroplasties performed in the Republic of Slovenia in the period from 1. 1. 2019 to 31. 12. 2023. We analysed the data received by 22.10.2024.

First, we present the compliance of the obtained data. This is followed by results on the patient demographic, characteristics of the surgical procedure, the data on the implanted and removed materials, and the results from the questionnaires on functionality, pain, and general health before and after the knee arthroplasty. than we provide an analysis of the survival of knee implants for the period from 1.1.2019 to 31.12.2023. At the end of the chapter, we will provide the final findings regarding knee arthroplasties in the period from 2019 to 2023.

8.1 Primary knee arthroplasties - data until 31 December 2023

We present the characteristics of primary knee arthroplasties (both total and partial). In the period from 1.1.2019 to 31.12.2023, a total of 16,070 forms were received. Out of those 13,983 total and 2,087 partial knee arthroplasties. For the year 2023, the RES database has data on 3,546 primary total and 551 primary partial knee arthroplasties.

We examined differences according to patients' characteristics, the healthcare provider and surgical procedure characteristics. We analysed differences by gender, age of the patients the healthcare provider. In the final part, we will present data on functionality and pain and general health before and after primary knee arthroplasties.

8.1.1 Compliance of the obtained data

Table 32 shows compliance (ratio between completed forms in the RES database and records of the number of knee arthroplasties registered by the Health Insurance Institute of Slovenia-ZZZS) for each year, by knee arthroplasty providers in the Republic of Slovenia. It should be noted that the RES database contains data on individual surgical procedures by the side of the surgical procedure (in the case of simultaneous surgical procedures on both knees, two separate cases are recorded), while the ZZZS records data on surgical procedures performed regardless of the side of the surgical procedure (in the case of simultaneous surgical procedures on the both knees, only one case is recorded). This may lead to discrepancies in the number of recorded surgeries. The discrepancy therefore arises due to different case handling methodologies, due to non-reporting of data to the RES database, and also due to reporting of cases that the ZZZS does not record (self-payers, foreigners, payers through conventions).

The ZZZS does not distinguish between primary knee arthroplasties and revision knee arthroplasties. For this reason, compliance is presented for all knee arthroplasties together.

From Table 32, it can be seen that the ZZZS has recorded 3,306 primary knee arthroplasties in 2023, while RES recorded 3,592 primary knee arthroplasties (136.8%). Primary knee arthroplasties are not performed in SB Izola and SB Trbovlje. The number of primary knee arthroplasties in the RES database is consistently slightly higher than in the ZZZS database, due to different case handling methodologies. In 2023, the only exceptions were SB Brežice, SB Jesenice, SB Novo mesto, UKC Ljubljana, UKC Maribor, Kirurgija Bitenc and Arbor Mea, where slightly fewer cases are recorded in the RES database than in the ZZZS database. Compliance could not be calculated for Arbor Mea, MD Medicina and Kirurgija Bitenc (Table 33), since until 2023, the ZZZS did not record their procedures. The number of data in both databases differs minimally, which allows us to conclude that we have achieved a census of data on primary knee arthroplasties performed in 2023 in the RES database. This enables us to draw conclusions covering all surgical procedures of this type performed in Slovenia in 2023.

Table 32: Primary knee arthroplasty between 2019 and 2023, by provider (Source: RES).

Hospital	2019	2020	2021	2022	2023
Arbor Mea				3	84
Kirurgija Bitenc		3	79	67	110
KS Rožna Dolina	108	81	126	206	176
MD medicina				10	22
OB Valdoltra	851	755	889	968	1,046
SB Brežice	43	55	76	109	104
SB Celje	241	185	146	285	381
SB Jesenice	210	161	227	280	292
SB Murska Sobota	221	189	177	237	295
SB Nova Gorica	229	161	70	138	133
SB Novo mesto	337	230	379	479	501
SB Ptuj	134	84	75	154	169
SB Slovenj Gradec	84	76	80	92	164
UKC Ljubljana - Ortopedija	403	274	241	279	274
UKC Maribor - Ortopedija	330	222	161	273	346

Table 33: Data on reporting compliance for primary and revision knee endoprostheses between 2019 and 2023 in the Republic of Slovenia, by the surgical provider - comparison of RES and ZZZS.

Compliance	2019	2020	2021	2022	2023
KS Rožna dolina	100.00	101.25	103.28	135.53	101.73
OB Valdoltra	101.19	100.94	102.54	108.40	101.26
SB Brežice	104.88	90.16	104.11	99.09	95.41
SB Celje	100.42	100.00	97.33	100.35	100.00
SB Jesenice	99.06	98.77	105.58	107.28	98.65
SB Murska Sobota	102.31	102.16	103.51	105.80	104.61
SB Šempeter pri Novi Gorici	103.15	98.17	90.91	92.62	100.76
SB Novo mesto	96.84	99.14	95.71	110.88	92.10
SB Ptuj	103.08	105.00	92.59	101.99	100.60
SB Slovenj Gradec	100.00	100.00	103.90	103.37	100.61
UKC Ljubljana	96.41	95.80	94.88	98.94	99.64
UKC Maribor	97.35	96.94	100.00	97.85	99.71
Kirurgija Bitenc	NP	NP	NP	NP	93.22
Arbor Mea	NP	NP	NP	NP	74.34
MD Medicina	NP	NP	NP	NP	NP
Total	99.75	99.48	103.10	108.29	99.10

8.1.2 Gender and age of patients in primary knee arthroplasties

In 2023, 2460 (60%) primary knee arthroplasties were performed in female patients and 1637 (40%) in male patients in the Republic of Slovenia (Figure 48). Between 2019 and 2023, the median age of patients at the time of surgery was 70.3 years. The youngest patient was 13.6 years old, and the oldest was 94.2 years old (Figure 49).

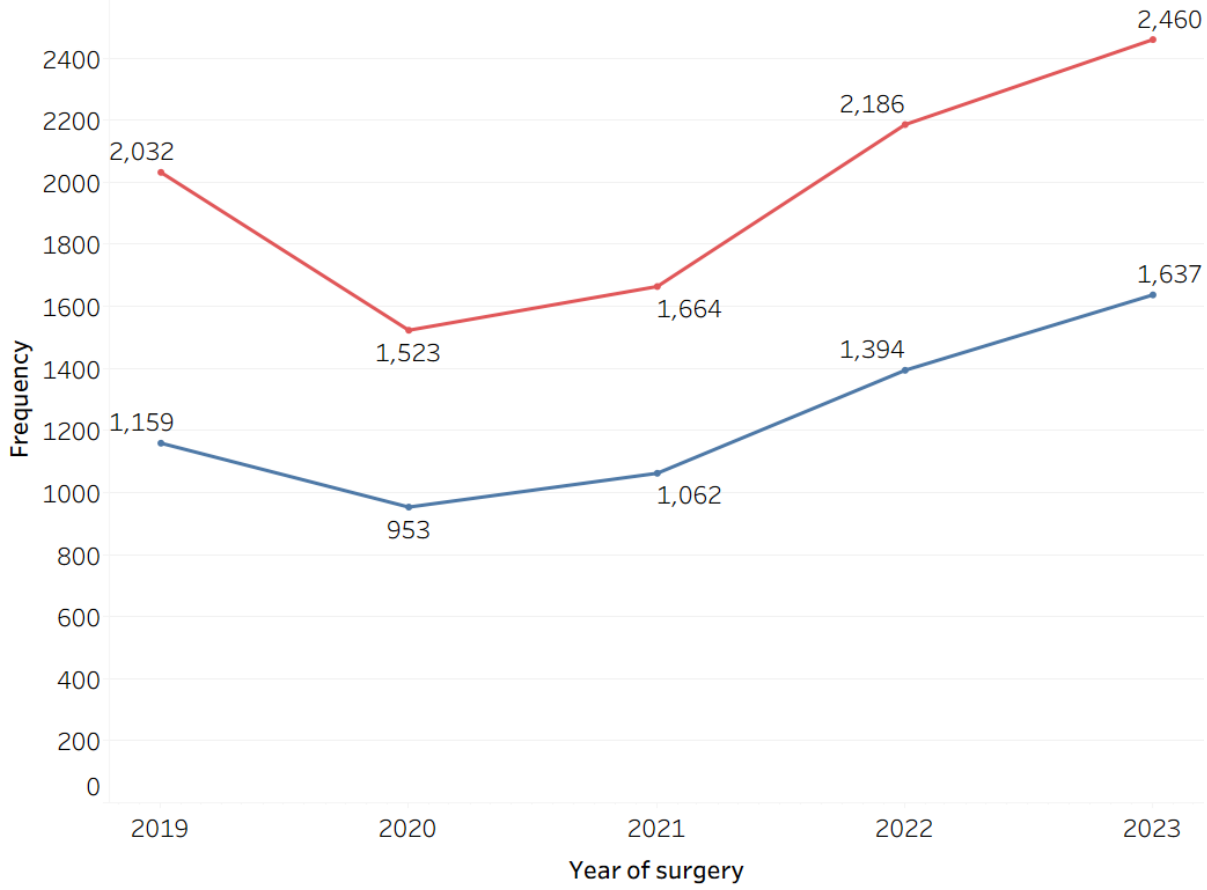


Figure 48: Primary knee arthroplasty between 2019 and 2023, by patient gender (Source: RES).

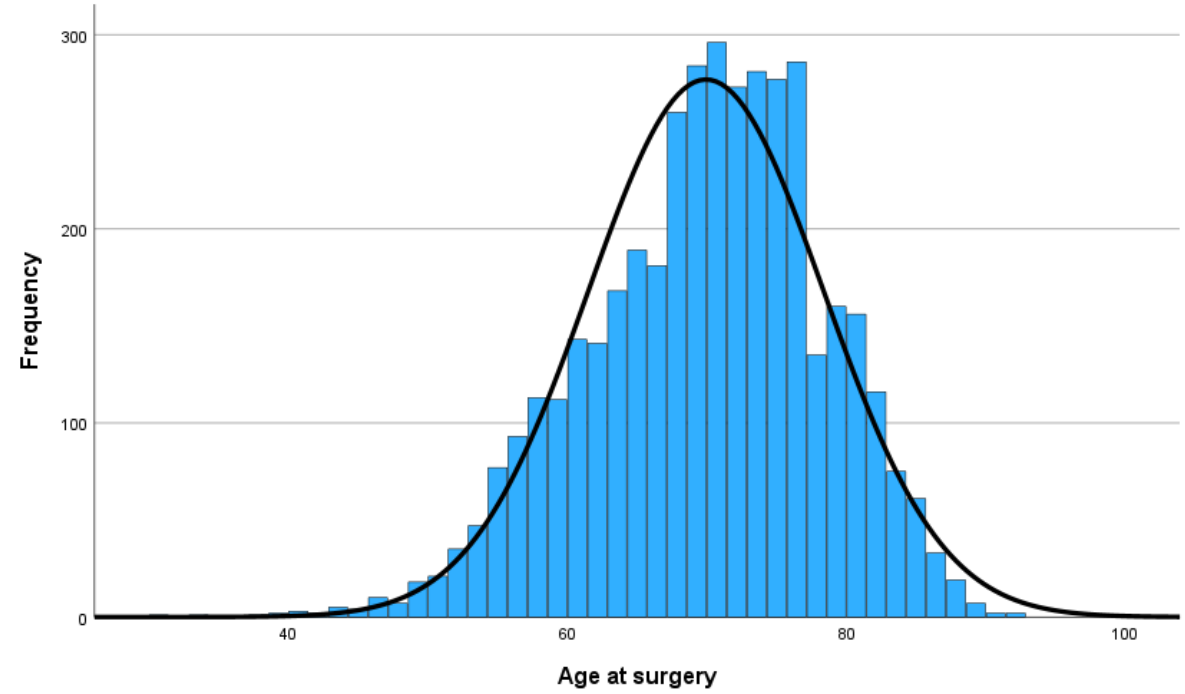


Figure 49: Primary knee arthroplasty in 2023, by patient age at surgery (Source: RES).

8.1.3 Characteristics of the surgical procedure in primary knee arthroplasties

In analysing characteristics of surgical procedure, we focused on the healthcare provider, the side of the procedure, the preoperative diagnosis, the type of endoprosthesis, the fixation of the endoprosthesis, the surgical approach, and previous surgical procedures.

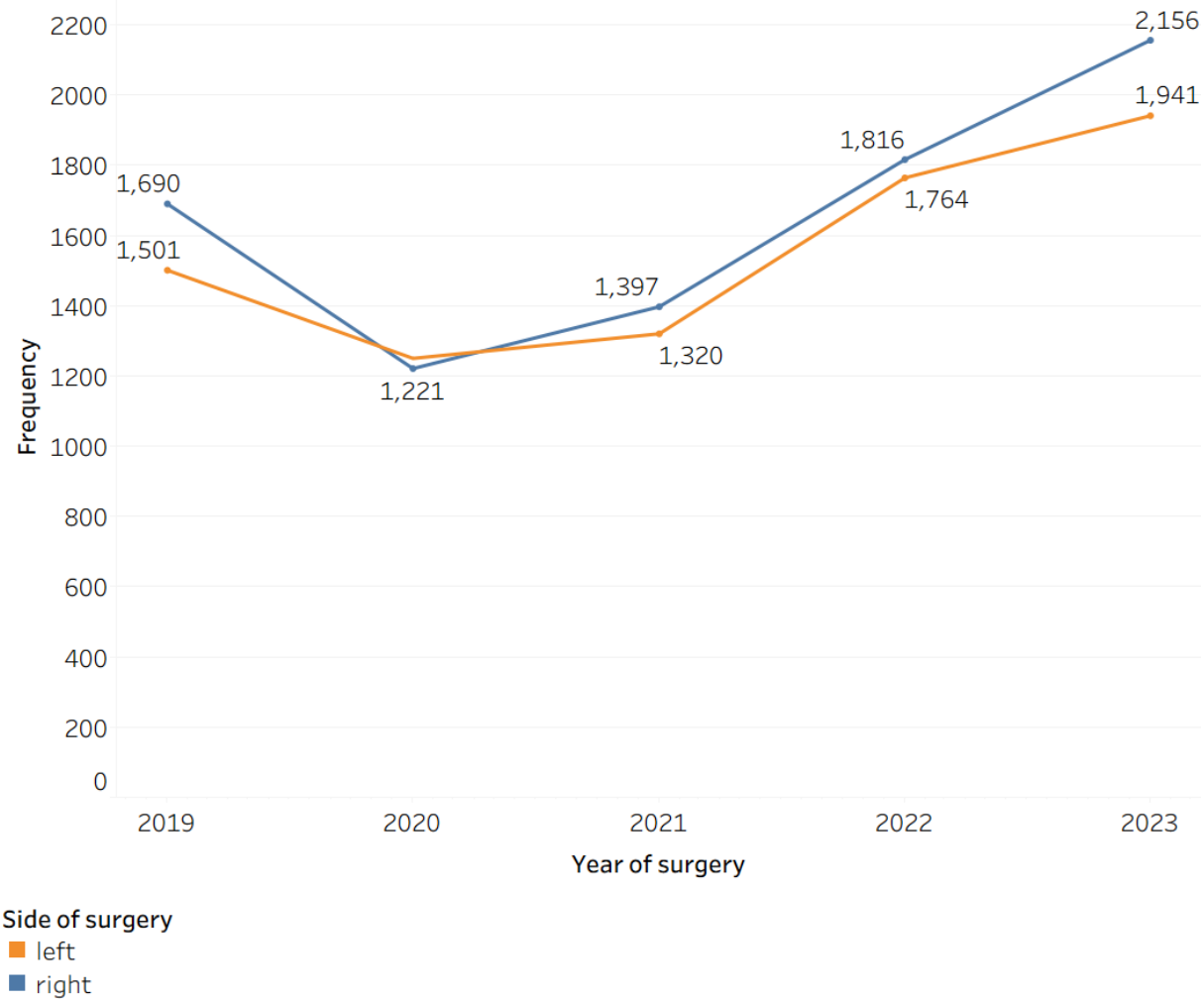


Figure 50: Primary knee arthroplasty between 2019 and 2023, by surgical side[28] (Source: RES).

[28] In 2020, we do not have data on the side of the operation in the RES database for 5 operations and in 2021 for 9 operations.

Table 34: Primary knee arthroplasties in 2023, by surgical diagnosis, by gender and age of patients (Source: RES).

	Years 2019 to 2022					Year 2023				
Diagnosis	**Number**	**f%**	**Age (Me)**	**Age (f_M%)**	**Age (f_2%)**	**Number**	**f%**	**Age (Me)**	**Age (f_M%)**	**Age (f_2%)**
Primary arthrosis	10,700	89.4	70.5	36.8	63.2	3,643	88.9	70.9	38.9	61.1
Sequelae of a fracture	238	2.0	66.6	54.2	45.8	84	2.1	72.0	45.2	54.8
Primary unicondylar arthrosis	258	2.2	67.0	48.1	51.9	85	2.1	69.0	44.7	55.3
Rheumatoid / Uric / Psoriatic arthritis	234	2.0	66.7	33.3	66.7	82	2.0	68.1	41.5	58.5
Sequelae of meniscal damage	174	1.5	64.5	67.8	32.2	62	1.5	67.9	51.6	48.4
Sequelae of torn ligaments	164	1.4	59.6	64.6	35.4	68	1.7	61.0	73.5	26.5
Avascular necrosis	117	1.0	72.2	29.1	70.9	50	1.2	73.3	32.0	68.0
Other	84	0.7	NA	48.9	51.1	22	0.5	NA	47.8	52.2

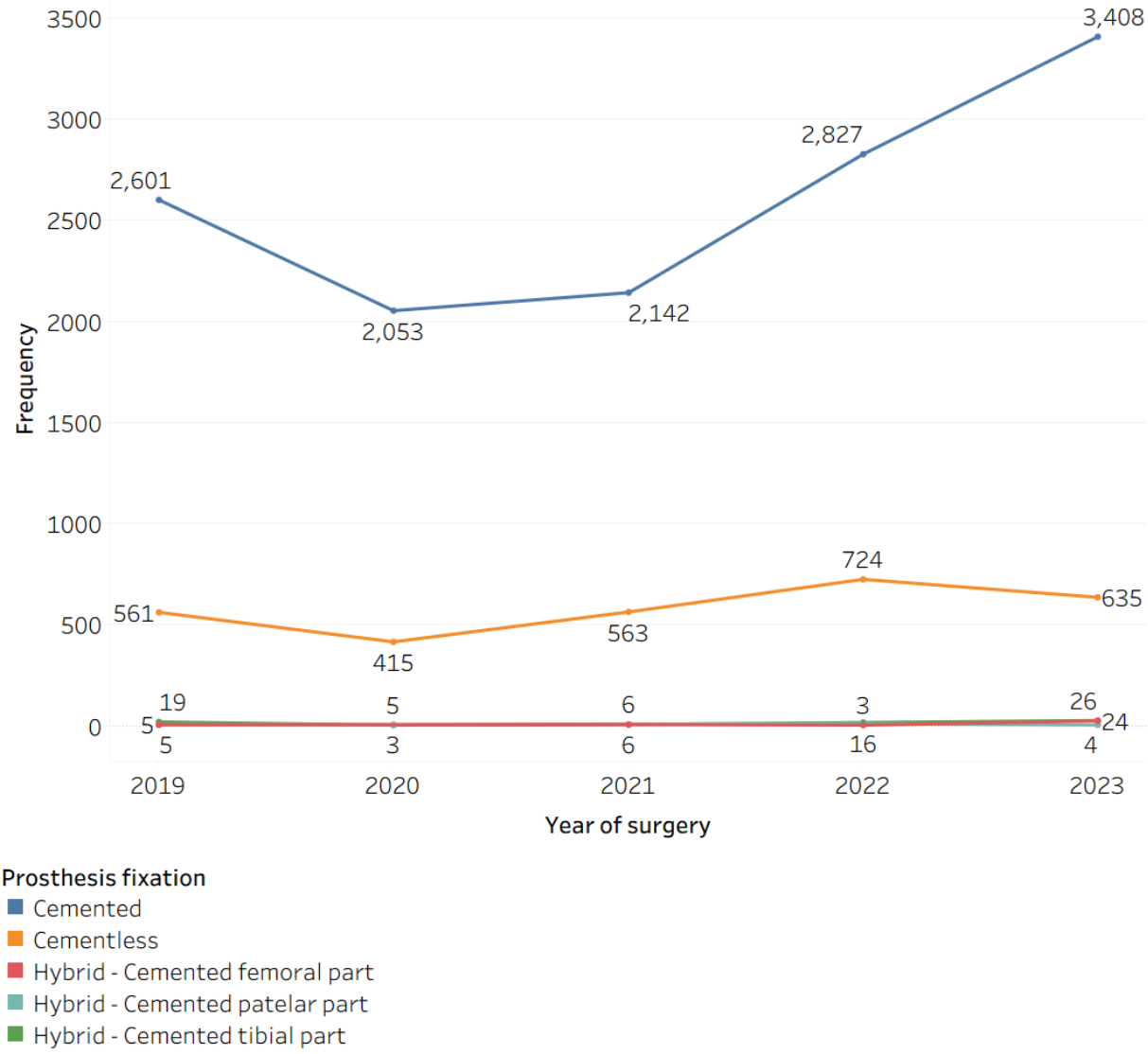


Figure 51: Primary knee arthroplasty between 2019 and 2023, by prosthesis fixation (Source: RES).

Table 35: Primary knee arthroplasty in 2023, by prosthesis fixation, and gender and age of patients (Source: RES).

	Years 2019 to 2022					Year 2023				
	Number	f%	Age (Me)	Age (f_M%)	Age ($f_Ž$%)	Number	f%	Age (Me)	Age (f_M%)	Age ($f_Ž$%)
Cemented	9,623	80.4	70.3	37.1	62.9	3,408	83.2	70.7	39.3	60.7
Uncemented	2,263	18.9	69.0	42.0	58.0	635	15.5	69.5	43.6	56.4
Hybrid	87	0.7	65.6	50.6	49.4	54	1.3	71.8	38.9	61.1

In 2023, 3,546 primary total and 551 primary partial endoprostheses were performed.

The highest number of primary knee arthroplasties in 2023 (Table 34) was performed at the General Orthopaedic Hospital Valdoltra (25.5%). followed by Novo mesto General Hospital (12.2%), Celje General Hospital (9.3%), the Orthopaedic Department of the University Hospital Maribor (8.4%), the Murska Sobota General Hospital (7.2%), Jesenice General Hospital (7.1%)

and the Orthopaedic Department of the University Hospital Ljubljana (6.7%). The remaining providers performed fewer than 5% of primary knee arthroplasties each in 2022.

In 2023 (Figure 50), 2,156 (52.6%) primary right knee arthroplasties and 1,941 (47.4%) primary left knee arthroplasties were performed.

The majority of all primary knee arthroplasties in Slovenia in 2023 (88.9%) were performed due to primary arthrosis (Table 34). Other diagnoses accounted for less than 3% of cases each. Table 34 shows that in 2023, the oldest patients were those who were primarily operated on due to posttraumatic arthrosis (Me = 72 years) and primary arthrosis (Me = 70.9 years), while the youngest patients were those undergoing surgery as sequelae of torn ligaments (Me = 61 years). A higher proportion of women (90.4%) than men (86.6%) had primary knee arthroplasty due to primary arthrosis.

In 2023, cemented endoprostheses represented 83.2% of all cases in the RES database, 15.5% were uncemented, 0.6% were hybrid with a cemented tibial part, 0.1% were hybrid with a cemented patellar part, and 0.6% were reverse hybrid with a cemented femoral part (Figure 51). A slightly higher proportion of women (84.1%) than men (81.8%) received a cemented endoprosthesis (Table 35). The median age of patients was very similar in the case of cemented (Me = 70.7 years) and uncemented (Me = 69.1 years) endoprostheses.

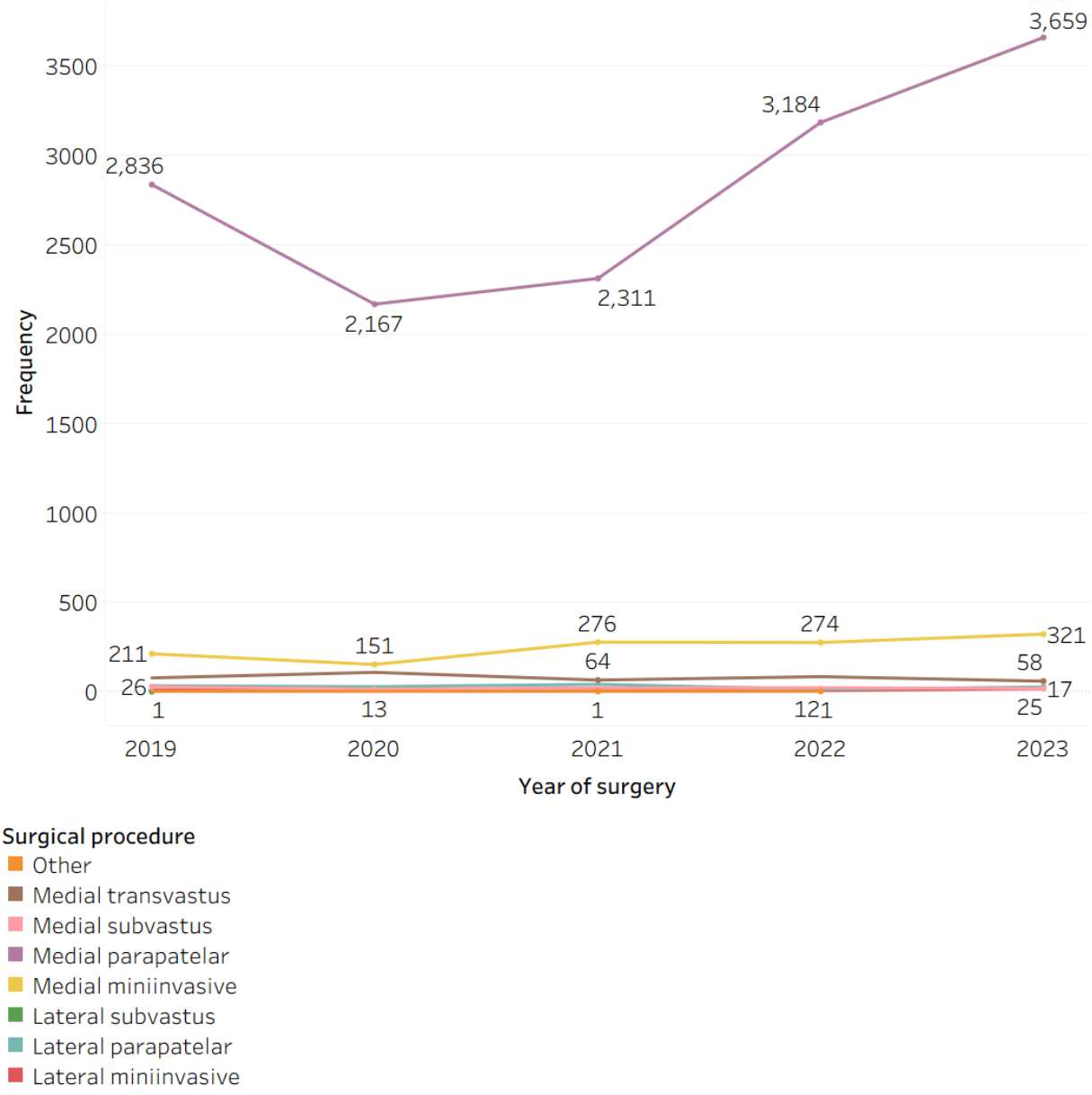


Figure 52: Primary knee arthroplasties between 2019 and 2023, by surgical approach[29] (Source: RES).

For 2023, the medial parapatellar approach was used in 89.3% primary knee arthroplasties Figure 52). The medial minimally invasive approach was used in 7.8% of cases. Other surgical approaches were used in less than 1% of cases each. The medial parapatellar approach was used more often in women (in 90% of cases) than in men (in 88.3% of cases) (Table 36), while the medial minimally invasive approach was more common in men (in 8.9% of cases) than in women (in 7.1% of cases). The median age of patients was 70.8 years for patients with the medial parapatellar, 68.6 years for the medial transvastus, and 69 years for the medial minimally invasive surgical approach.

3678 (89.8%) patients had no previous operations on the operated knee before primary knee arthroplasty in 2023. 151 (3.7%) had arthroscopy, 128 (3.1%) meniscectomy, 54 (1.3%) osteosynthesis, 55 (1.3%) anterior cruciate ligament reconstruction, while other previous

[29] In the RES database, we do not have data on the surgical approach used in one case in 2021 and one case in 2023.

operations occurred in smaller numbers. From Table 37, we can see that men are more likely to have had previous operations prior to prosthesis implantation. Patients without prior operations were older (Me=71.1 years) than those with previous procedures, and the youngest patients were those with previous cruciate ligament reconstruction (Me = 58.9 years).

Table 36: Primary knee arthroplasties in 2023, by surgical approach, and gender and age of patients (Source: RES).

	Years 2019 to 2022					Year 2023				
	Number	f%	Age (Me)	(f_M%)	($f_Ž$%)	Number	f%	Age (Me)	(f_M%)	($f_Ž$%)
Medial parapatelar	10,498	87.7	70.4	37.9	62.1	3,659	89.3	70.8	39.5	60.5
Medial miniinvasive	912	7.6	68.7	43.4	56.6	321	7.8	69.0	45.6	54.4
Medial transvastus	330	2.8	68.5	38.5	61.5	58	1.4	69.1	43.1	56.9
Other	232	1.9	NA	30.6	69.7	58	1.4	NA	34.5	65.5

Table 37: Primary knee arthroplasty in 2023, according to previous surgeries[30] on the operated knee, by gender and age of patients (Source: RES).

	Years 2019 to 2022					Year 2023				
	Number	f%	Age (Me)	(f_M%)	($f_Ž$%)	Number	f%	Age (Me)	(f_M%)	($f_Ž$%)
None	10,696	89.3	70.7			3,678	89.8	71.1		
Arthroscopy	493	4.1	65.1	46.5	53.5	151	3.7	65.3	42.5	57.5
Meniscectomy	416	3.5	64.9	60.7	39.3	128	3.1	67.1	48.1	51.9
Osteosynthesis	183	1.5	64.9	52.5	47.5	54	1.3	70.4	51.8	48.2
Anterior cruciate ligament reconstruction	115	1.0	59.3	68.4	31.6	55	1.3	58.9	70.9	29.1
Other	70	0.6	NA	55.7	44.3	75	0.8	NA	52.0	48.0

In 2023, 86.6% of primary knee arthroplasties in the Republic of Slovenia were total and 13.4% were partial (Figure 54). The median age of patients (Table 38) was slightly higher for primary total (Me = 70.8 years) compared to primary partial knee arthroplasties (Me = 67.6 years).

[30] Individuals may have had multiple prior surgeries.

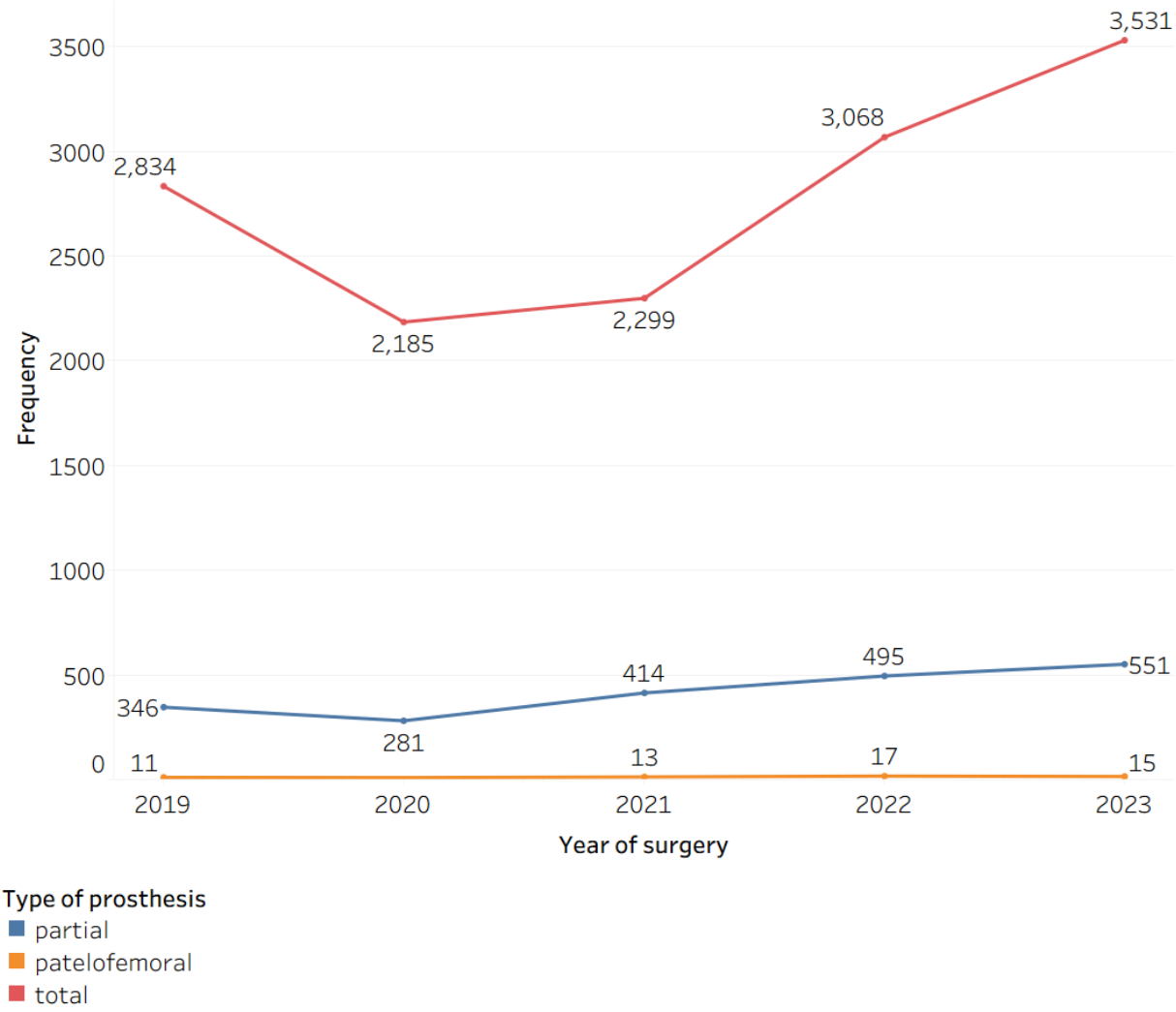


Figure 53: Primary knee arthroplasty between 2019 and 2023, by prosthesis type (Source: RES).

Table 38: Primary knee arthroplasty in 2023, by prosthesis type, gender and age of patients (Source: RES).

	Years 2019 to 2022					Year 2023				
	Number	f%	Age (Me)	Age (f_M%)	Age ($f_Ž$%)	Number	f%	Age (Me)	Age (f_M%)	Age ($f_Ž$%)
Primary partial	1,536	12.8	67.9	44.7	55.3	551	13.4	68.6	45.7	54.1
Primary total	10,437	87.2	70.5	37.2	62.8	3,546	86.6	71.0	39.1	70.9

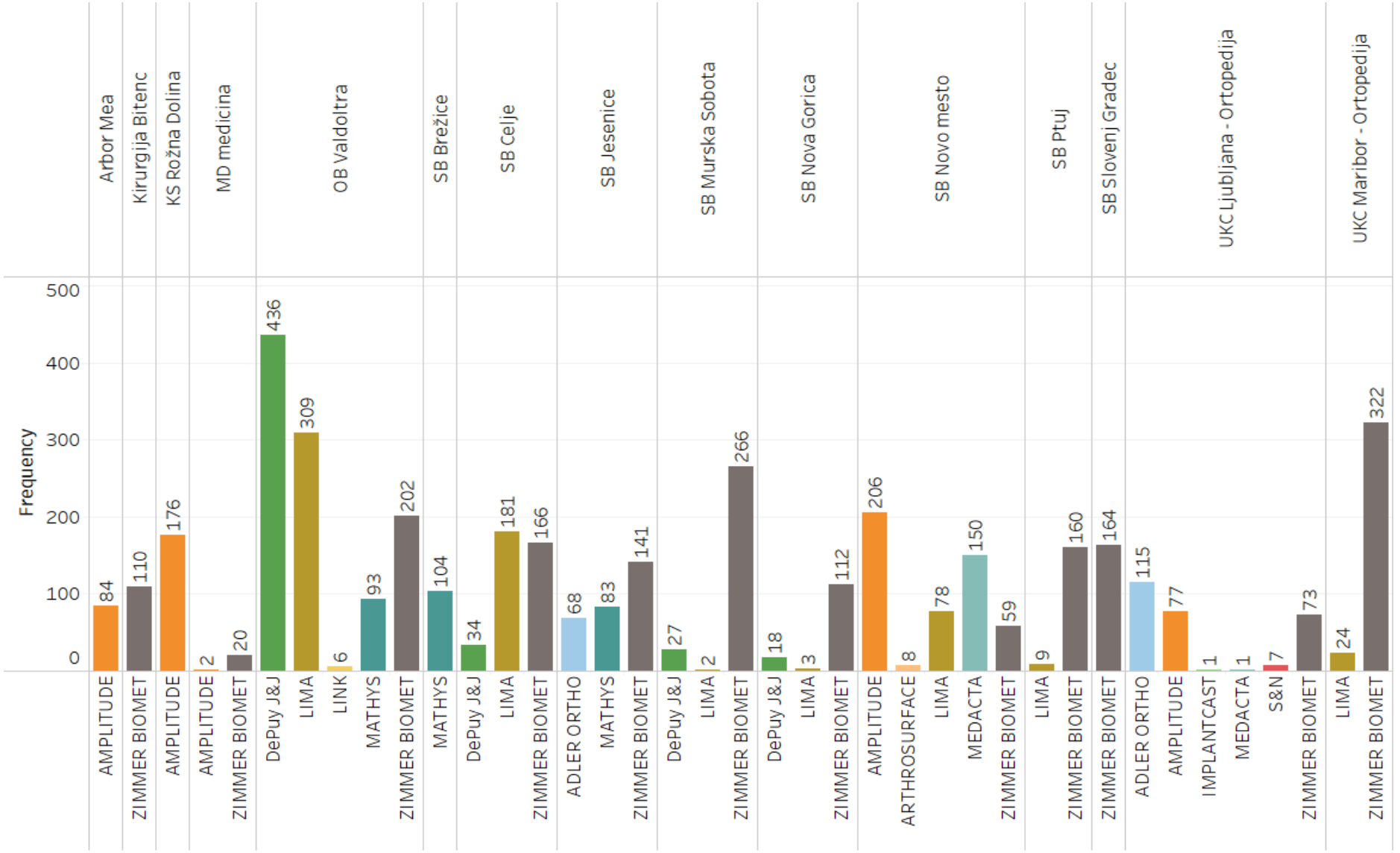


Figure 54: Primary knee arthroplasty according to the manufacturer of the femoral part of the endoprosthesis, by healthcare provider (Source: RES).

8.1.4 Mortality 90 days after primary knee arthroplasty

In addition to the date of surgery, RES also records the date of death, if applicable, in its database. Mortality within 90 days after the surgery is one of the quality indicators.

As shown in Figure 55, 4 patient deaths occurred within 90 days of surgery in 2019, 8 cases in 2020, 2 in 2021, 7 in 2022, and 8 in 2023.

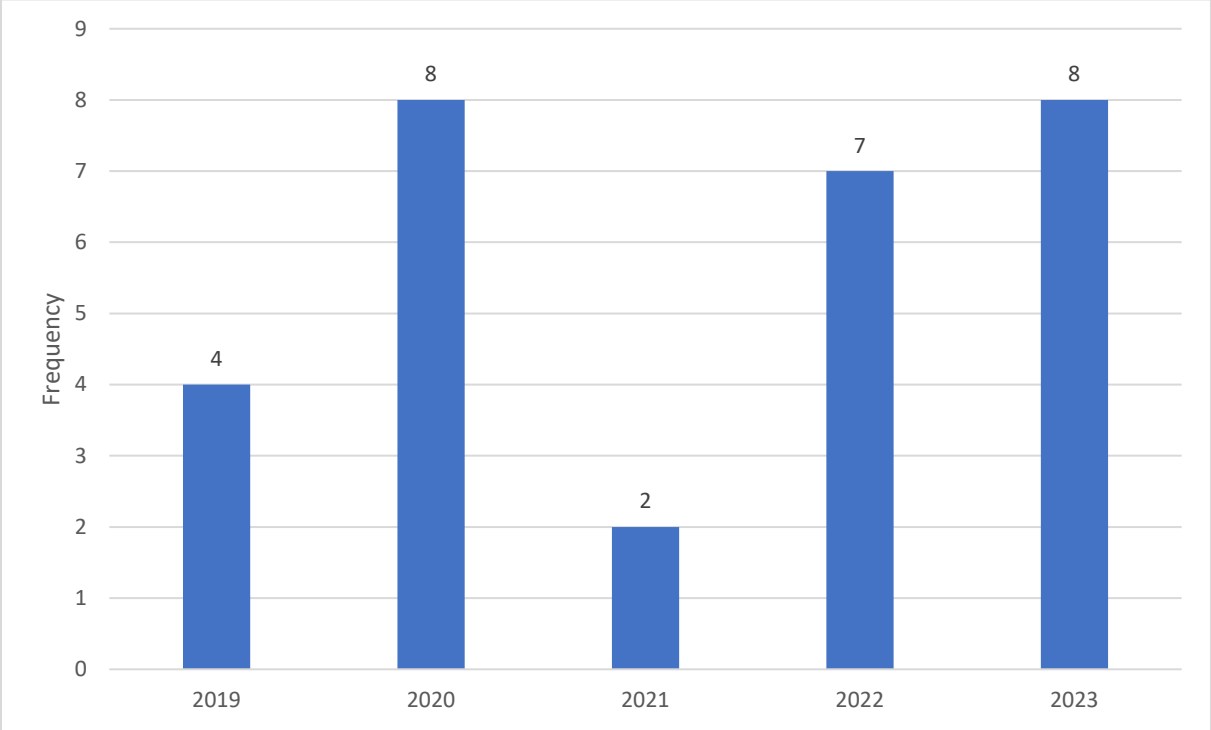


Figure 55: Number of deaths after primary knee arthroplasty between 2019 and 2023 (source: RES).

. The following formula was used to calculate the 90 days mortality of patients after primary total knee arthroplasty

$$Mortality\ 90\ days\ after\ primary\ knee\ arthroplasty = \frac{number\ of\ all\ deaths\ 90\ days\ after\ primary\ knee\ arthroplasty}{number\ of\ all\ primary\ knee\ arthroplasties} * 100$$

From Figure 56, we can see that 90 mortality after primary knee arthroplasty increased between 2019 (0.13%) and 2020 (0.32%), decreased in 2021 to 0.07% and 0.19% in both 2022 and 2023.

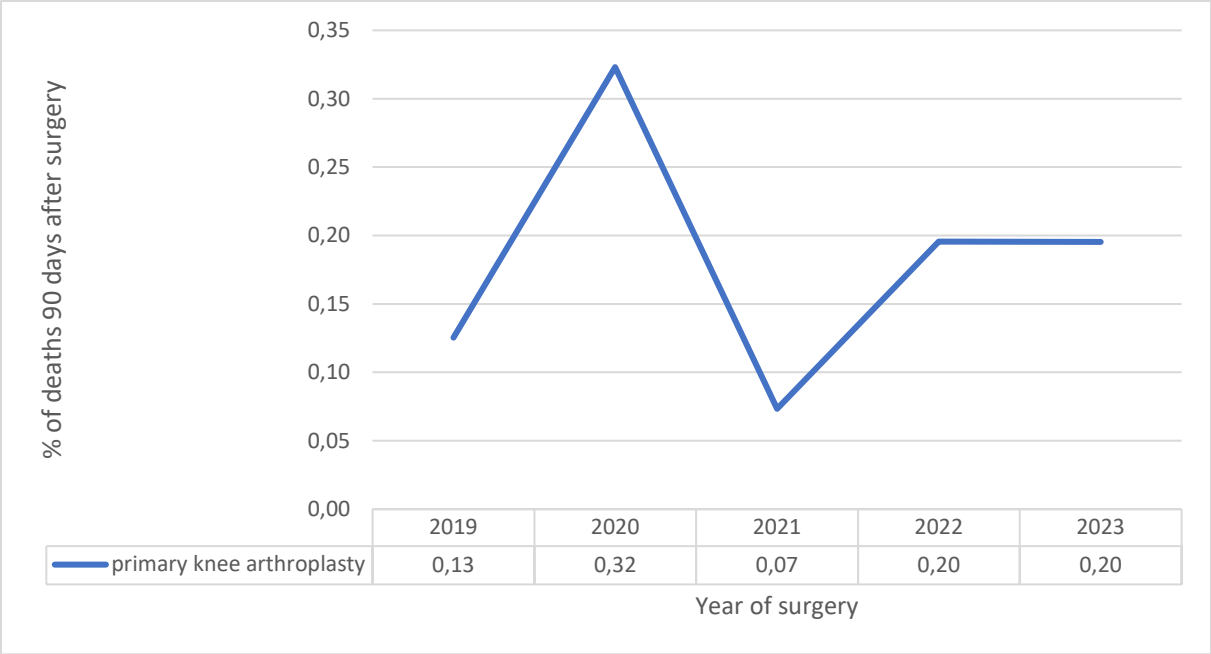


Figure 56: Mortality 90 days after primary knee arthroplasty (Source: RES).

8.1.5 Self-assessment of health and quality of life of patients – PROMs questionnaires before and after primary knee arthroplasties in patients with a diagnosis of idiopathic osteoarthrosis

Patients completed the questionnaires before surgery, the first group 3 months later[31], and subsequently 6 months and 12 months later.

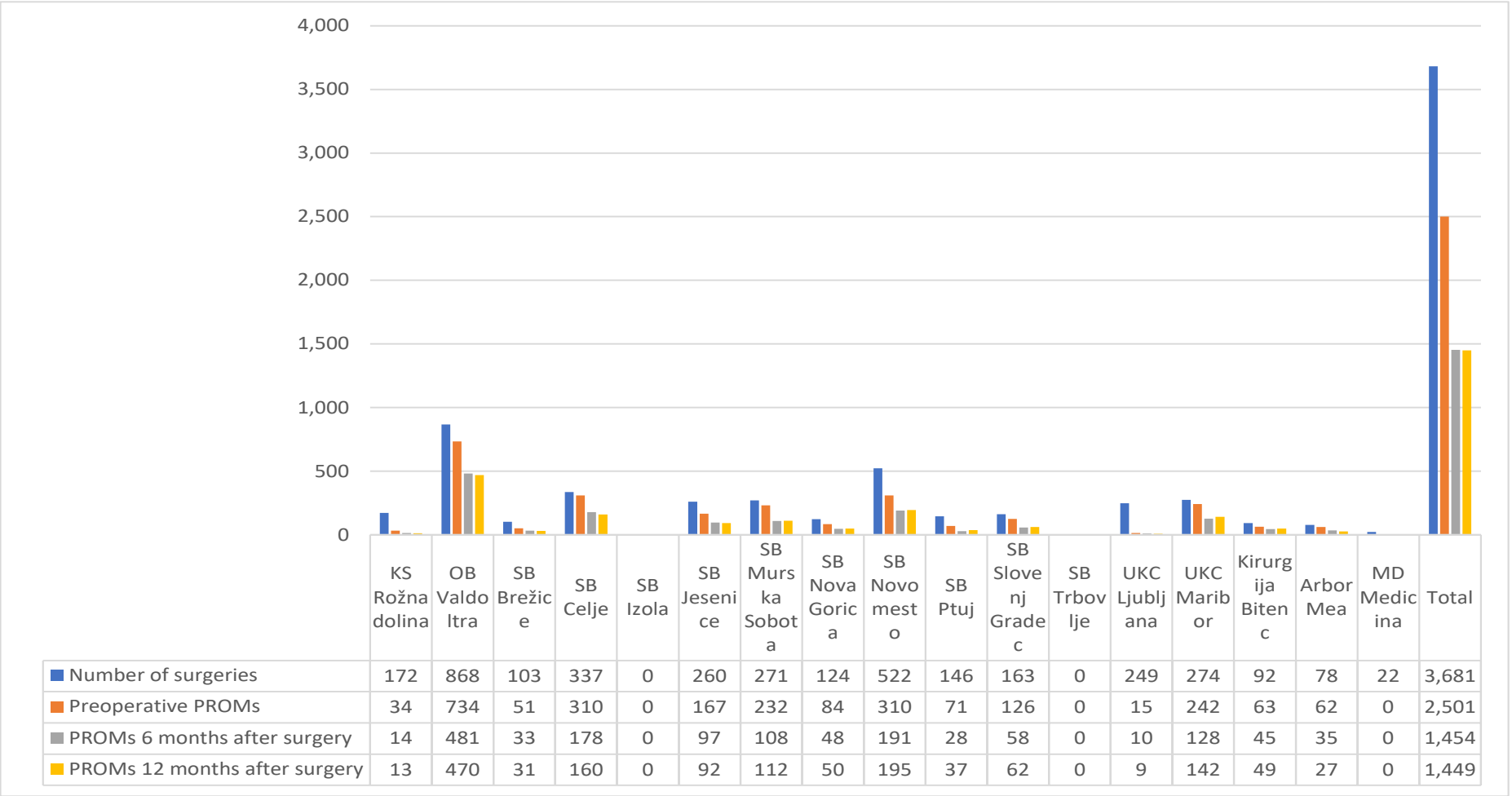
The analysis included patients with a diagnosis of idiopathic arthrosis. We analysed the data received before 7.3.2025. The database contained 4,097 primary knee arthroplasty procedures performed between 1.1.2023 and 31.12.2023, of which 3,681 procedures were due to idiopathic osteoarthrosis.

Oxford Knee Score (OKS) questionnaire

We used the OKS questionnaire. It consists of 12 questions that are measured on a 5-point scale, with 0 indicating no problems đ and 4 indicating severe problems. We calculated the OKS value according to the OECD methodology (OECD, 2019). The sum of the responses to 12 questions can range from 0 (complete loss of function and severe pain) to 48 (full function of the operated knee without pain).

In the preoperative period (see Figure 57), 2501 OKS questionnaires (67.9%) were completed. In the 6-month postoperative period, 1454 (39.5%) OKS questionnaires were completed and 1449 (39.3%) at 12 months.

[31] We discontinued the survey 3 months after surgery at the end of 2022. For this reason, 3 month data were not analyzed and presented.



	KS Rožna dolina	OB Valdoltra	SB Brežice	SB Celje	SB Izola	SB Jesenice	SB Murska Sobota	SB Nova Gorica	SB Novo mesto	SB Ptuj	SB Slovenj Gradec	SB Trbovlje	UKC Ljubljana	UKC Maribor	Kirurgija Bitenc	Arbor Mea	MD Medicina	Total
Number of surgeries	172	868	103	337	0	260	271	124	522	146	163	0	249	274	92	78	22	3,681
Preoperative PROMs	34	734	51	310	0	167	232	84	310	71	126	0	15	242	63	62	0	2,501
PROMs 6 months after surgery	14	481	33	178	0	97	108	48	191	28	58	0	10	128	45	35	0	1,454
PROMs 12 months after surgery	13	470	31	160	0	92	112	50	195	37	62	0	9	142	49	27	0	1,449

Figure 57: Number of PROMs (OKS) obtained in primary knee arthroplasties, by healthcare provider, for 2023 (Source: RES).

Respondents were divided into 4 age groups: younger than 55 years, 55 to 64 years, 65 to 74 years, and older than 74 years. We calculated the difference between the OKS score achieved 12 months after surgery and the preoperative OKS score.

In both men and women, the median improvement in OKS before and 12 months after surgery was 18 points (Figure 58).

The greatest difference was observed in the age group 55-65 years (19 points), but there was no statistically significant difference compared to other age groups (Figure 59).

Figure 58: Median with 95% confidence interval for the difference between the OKS score 12 months after surgery and before surgery, according to patient gender (Source: RES).

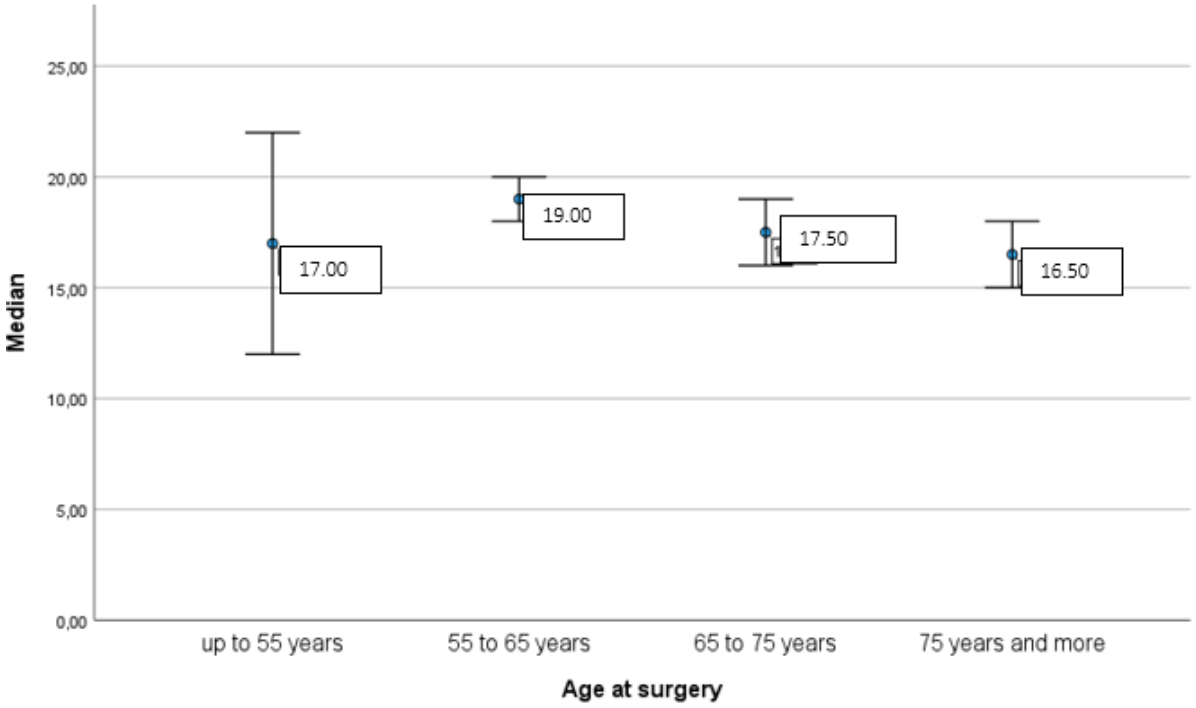


Figure 59: Median with 95% confidence interval for the difference between the OKS score before and 12 months after surgery, by the age of the patients (Source: RES).

EQ-5D-5L questionnaire[32]

We also analysed the results of the EQ-5D-5L score, which measures the general health of patients. Responses were weighted using values prepared for the Slovenian population at the Institute of Economics (Prevolnik Rupel & Ogorevc, 2020). A lower score indicates poorer and a higher value indicates better general health. We present the median difference between the preoperative and 12-month postoperative scores.

No statistically significant difference in median changes was observed between genders for the EQ-5D-5L questionnaire (Figure 60).

No statistically significant difference in median changes was observed between age groups before and 12 months after surgery (Figure 61).

[32] The Slovenian version of the EQ-5D-5L questionnaire is available on the RES website.

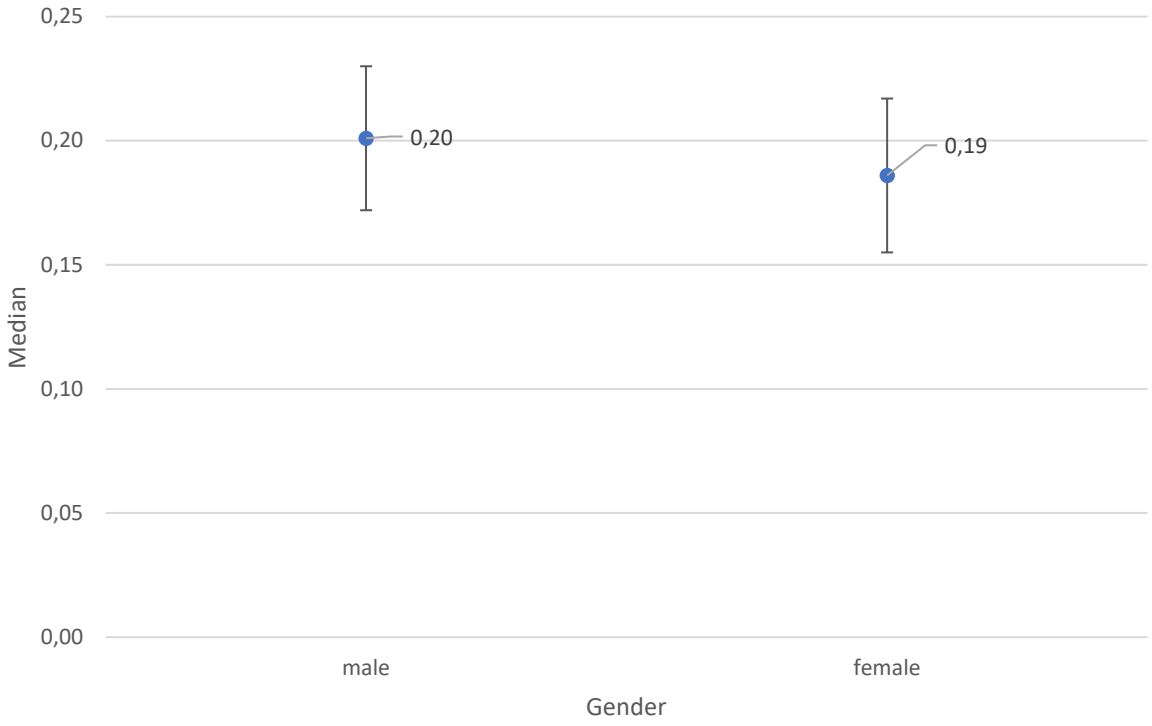


Figure 60: EQ-5D-5L score with 95% confidence interval in median of the difference by gender (Source: RES).

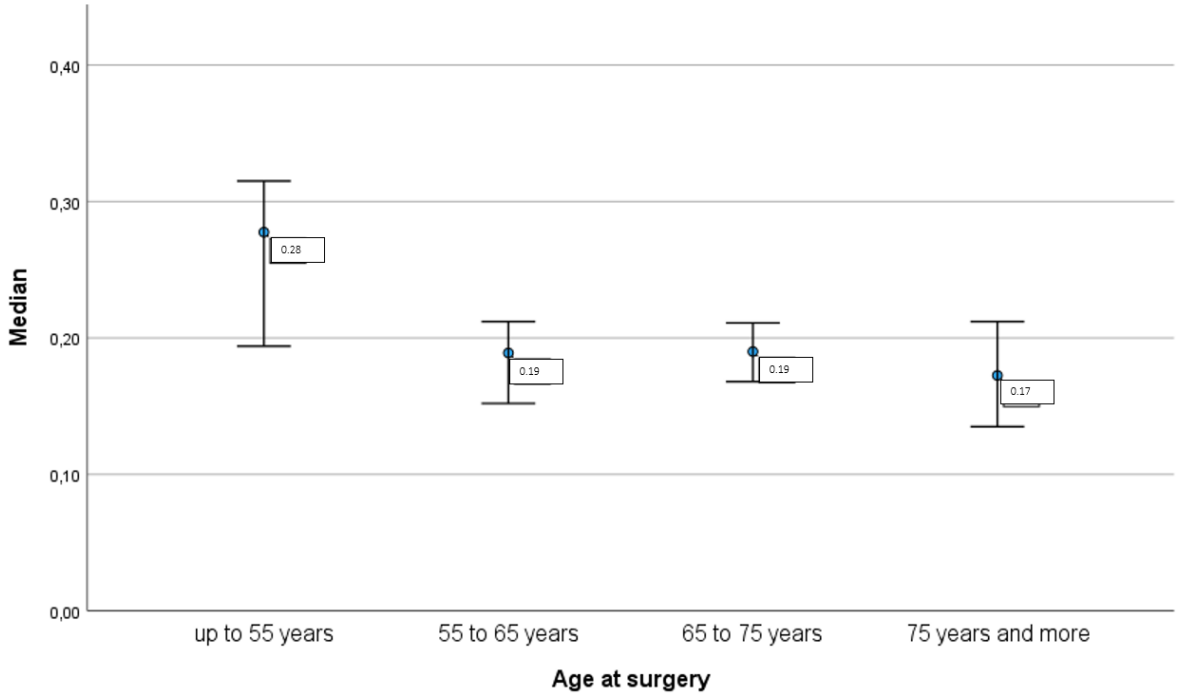


Figure 61: EQ-5D-5L score with 95% confidence interval in median of the difference by age at surgery (Source: RES).

Visual Analogue Scale (VAS)[33].

The VAS questionnaire is part of the EQ-5D-5L questionnaire and assesses health status on the day of the survey, with 0 being the worst possible health, and 100 the best possible health. We calculated the difference between the preoperative and 12-month postoperative scores.

We examined gender differences using 95% confidence intervals for the median (see Figure 62). The median improvement for men was 5, and for women, 10 points.

There is no statistically significant difference in the median difference in the VAS score value before and 12 months after surgery between the individual age groups.

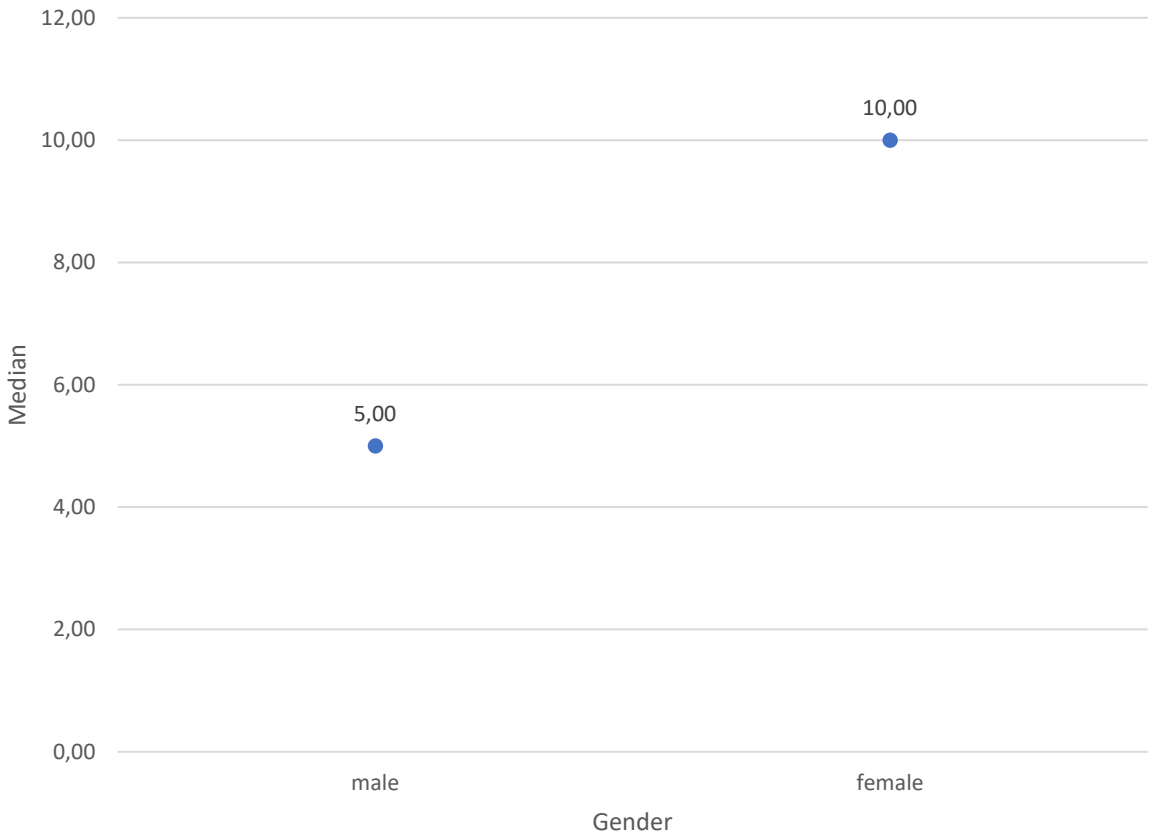


Figure 62: The improvement of health assessment on the day of completing the survey, 12 months after the surgery, with a 95% confidence interval for the median by gender (Source: RES).

[33] The VAS questionnaire is part of the EQ-5D-5L questionnaire, which is available on the RES website.

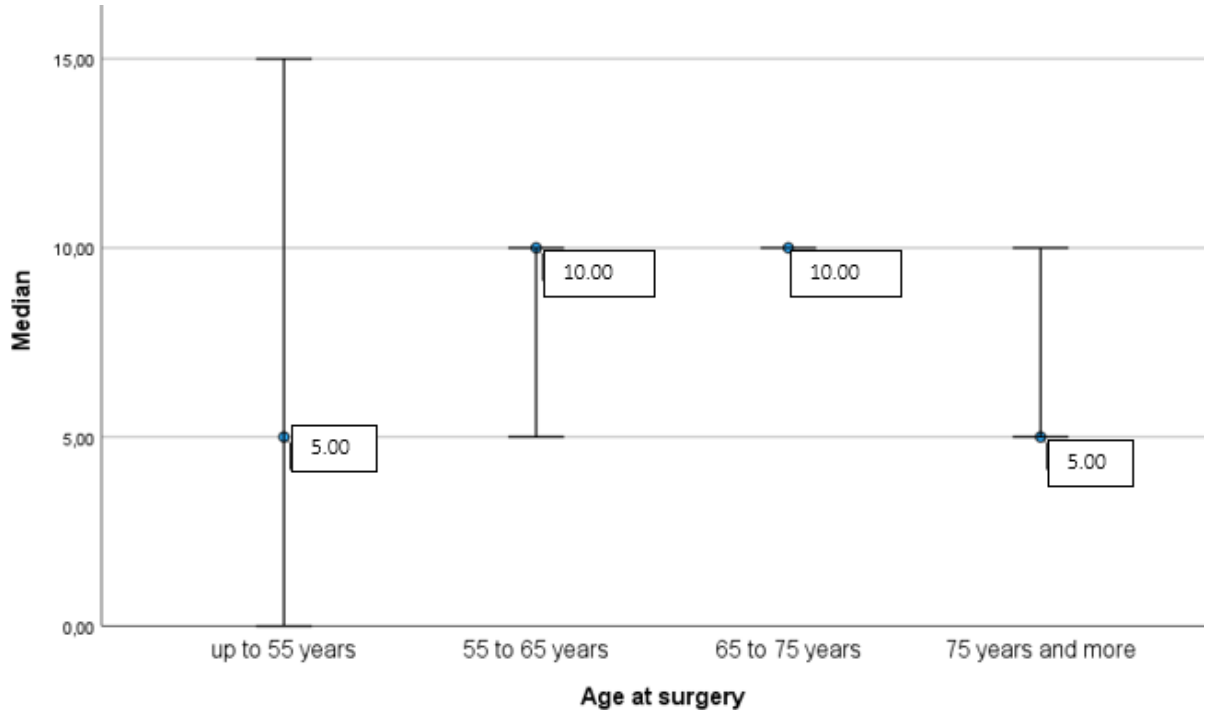


Figure 63: The improvement of the median, 95% confidence interval, of health assessment, 12 months after the surgery, by age at surgery (Source: RES).

8.2 Revision knee endoprostheses - data until 31. 12. 2023

In this part of the report, we present data on revisions of knee endoprostheses in the Republic of Slovenia from 2019 to 2023. According to the RES database, 1,194 revisions were recorded during this period, of which 305 were performed between 1 January 2023 to 31 December 2023. The analysis includes data entered in the RES database up to 22 October 2024. We will provide information on the current surgical procedure according to the patient's characteristics (gender, age at the time of surgery), the healthcare provider, characteristics of the revision surgical procedure (side of the surgical procedure, previous surgeries on this knee, reason for revision, scope of revision and approach used in the surgical procedure), characheristics of the new implant (manufacturer) and proportion of revisions of individual implant combinations.

8.2.1 Compliance of the obtained data

In 2019, the compliance between the RES database and the data from the ZZZS was 109.9%, in 2020 it decreased to 99.4%, while in 2021 it rose to 113.6%, in 2022 to 115.1% and in 2023 it was 112.6% (Table 39). The compliance rate above 100% is due to the different methodology used in defining the unit of measurement: in RES, the unit is an individual endoprosthesis, while for ZZZS the unit is an individual surgical procedure. In 2023, compliance of SB Brežice was poor, but it has been exemplary in previous years.

Table 39: Revisions by number of performed revision knee arthroplasties between 2019 and 2023 in the Republic of Slovenia, according to the surgical provider - comparison of RES and ZZZS.

Compliance	2019	2020	2021	2022	2023
KS Rožna dolina	100.00	100.00	33.33	NP	125.00

OB Valdoltra	108.64	101.35	101.08	110.53	112.50
SB Brežice	0.00	0.00	100.00	200.00	66.67
SB Celje	106.67	63.64	100.00	137.50	85.00
SB Jesenice	52.94	45.45	86.67	92.31	87.50
SB Murska Sobota	76.92	116.67	200.00	128.57	130.00
SB Šempeter pri Novi Gorici	84.62	83.33	105.56	83.33	100.00
SB Novo mesto	83.33	75.00	90.00	84.62	88.89
SB Ptuj	200.00	NP	NP	NP	NP
SB Slovenj Gradec	107.69	166.67	128.57	100.00	180.00
UKC Ljubljana	176.92	161.11	169.57	143.33	146.67
UKC Maribor	155.56	100.00	128.57	110.00	127.27
Kirurgija Bitenc	NP	NP	NP	NP	122.22
Total	109.90	99.40	113.62	115.11	112.55

8.2.2 Gender and age of patients in revision knee arthroplasties

We examined the gender and age of patients undergoing revision knee arthroplasty in the Republic of Slovenia between 2019 and 2023.

In 2023, 167 (54.8%) revision knee arthroplasties were performed in women and 138 (45.2%) in men (Figure 64).

The median age of patients undergoing revision knee arthroplasties between 2019 and 2023 was 70.6 years. The youngest patient was 29.6 years old, and the oldest 94.8 years (Figure 65).

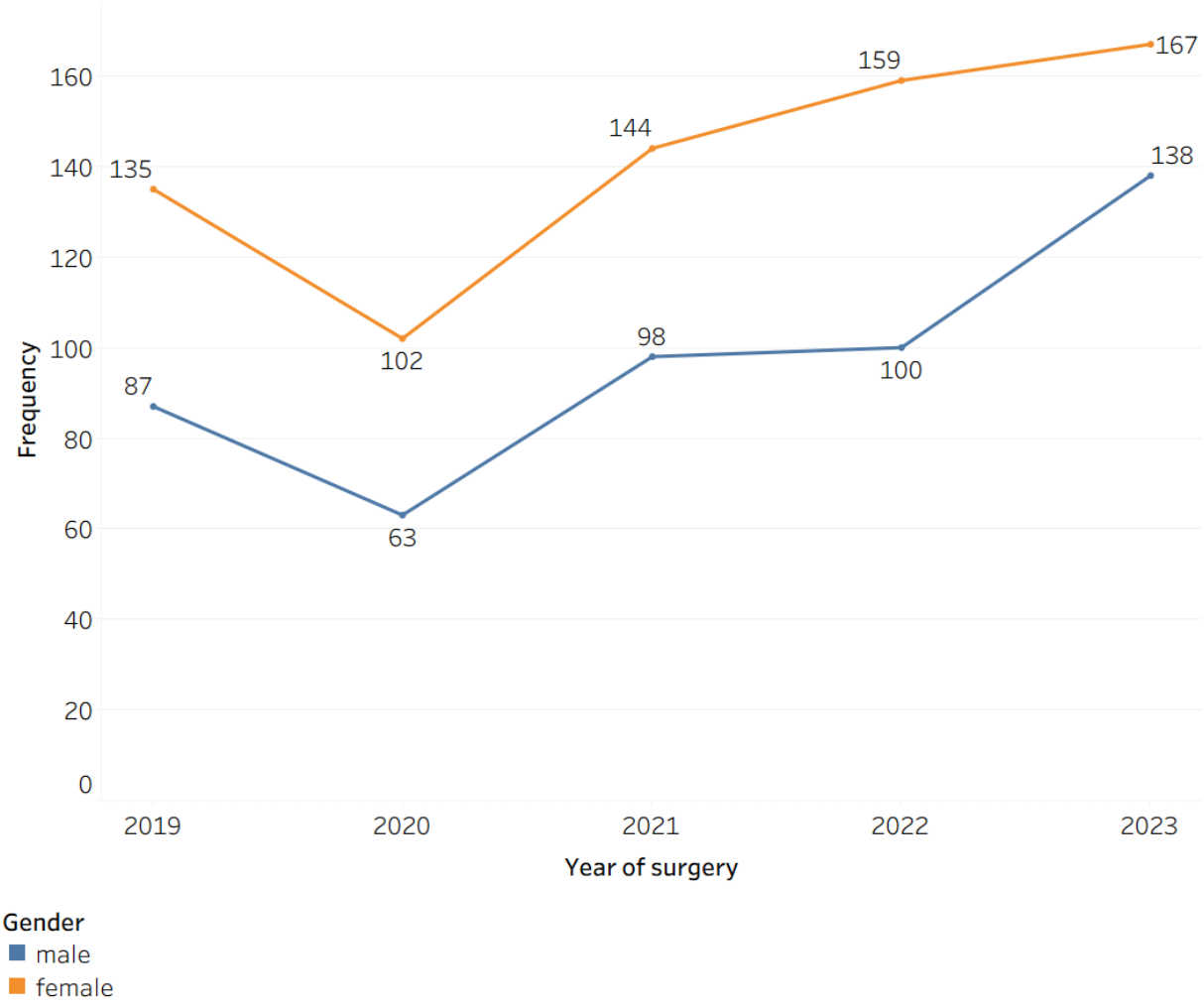


Figure 64: Number of revision knee arthroplasties between 2019 and 2023 by patient gender (Source: RES).

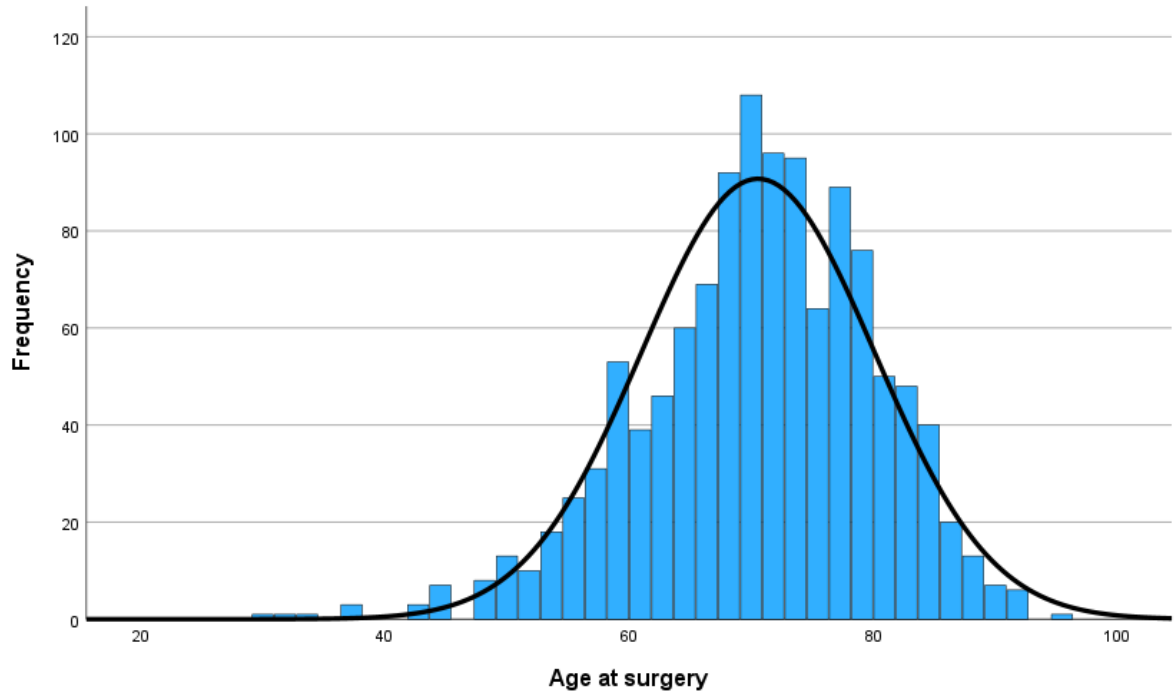


Figure 65: Revision knee arthroplasty between 2019 and 2023 by patient age at surgery (Source: RES).

8.2.3 Characteristics of the surgical procedure in revision arthroplasties

This chapter presents data on the provider performing the surgery, the side of the surgery, the reason for the revision, the extent of the revision, the surgical approach, previous surgeries, the first revision provider, the patient's age at the first revision, and the time from primary arthroplasty to the first revision.

In 2023 (Table 40), the largest number of revision knee arthroplasties, 38.4% (117), were performed in the Valdoltra Orthopaedic Hospital. 14.4% (44) were performed at the Orthopedic Clinic at the University Hospital Ljubljana, 10.5% (32) at the Novo Mesto General Hospital, 8.5% (26) at the Murska Sobota General Hospital, 5.6% (17) at the Celje General Hospital, 4.6% (14) at the Orthopedic Department of the University Hospital Maribor, 4.3% (13) at the Nova Gorica General Hospital, 3.6% (11) at the Bitenc Surgery, 3% (9) at the Slovenj Gradec General Hospital, 1.6% (5) at the Rožna dolina General Hospital, 0.7% (2) at the Brežice General Hospital and 0.3% (1) at the Ptuj General Hospital.

According to RES data (Figure 66), in 2023, 52.1% (159) revision arthroplasties were performed on the left knee and 47.9% (146) on the right knee..

The most common reason for revision in 2023 (Table 41) was deep infection (94 cases - 30.8%). This was followed by loosening (69 cases- 22.6%), instability, imbalance and poor mobility (34 cases - 11.1%), revision after component removal (32 cases - 10.5%), pain (n 22 cases - 7.2%), osteoarthrosis of the contralateral compartment (12 cases - 3.9%), periprosthetic fracture (11 cases - 3.6%) and PE insert dislocation (3 - cases 1%). In 28 (9.2%) cases, other reasons were stated.

In 2023, endoprosthesis replacement was performed in 210 cases (72.4%) (Figure 68). A patellar component was added in 14 cases, endoprosthesis was removed in 39 cases, and in 27 cases, the endoprosthesis was reimplanted.

In 2023, the medial parapatellar surgical approach was most often used (300 cases - 98.4%). Other approaches were used very rarely (Figure 69).

In two-thirds of revision knee arthroplasties in 2023 (207 cases, 67.9%), the procedure represented the first revision.

Table 40: Healthcare providers of revision knee arthroplasties between 2019 and 2023 (Source: RES).

Hospital	2019	2020	2021	2022	2023
Kirurgija Bitenc			1	5	11
KS Rožna dolina	2	1	1		5
OB Valdoltra	88	75	94	105	117
SB Brežice			2	2	2
SB Celje	16	7	10	22	17
SB Jesenice	9	5	13	12	14
SB Murska Sobota	10	7	16	18	26
SB Nova Gorica	11	15	19	5	13
SB Novo mesto	10	9	18	22	32
SB Ptuj	2		2		1
SB Slovenj Gradec	14	5	9	14	9
UKC Ljubljana - ortopedija	46	29	39	43	44
UKC Maribor - ortopedija	14	12	18	11	14

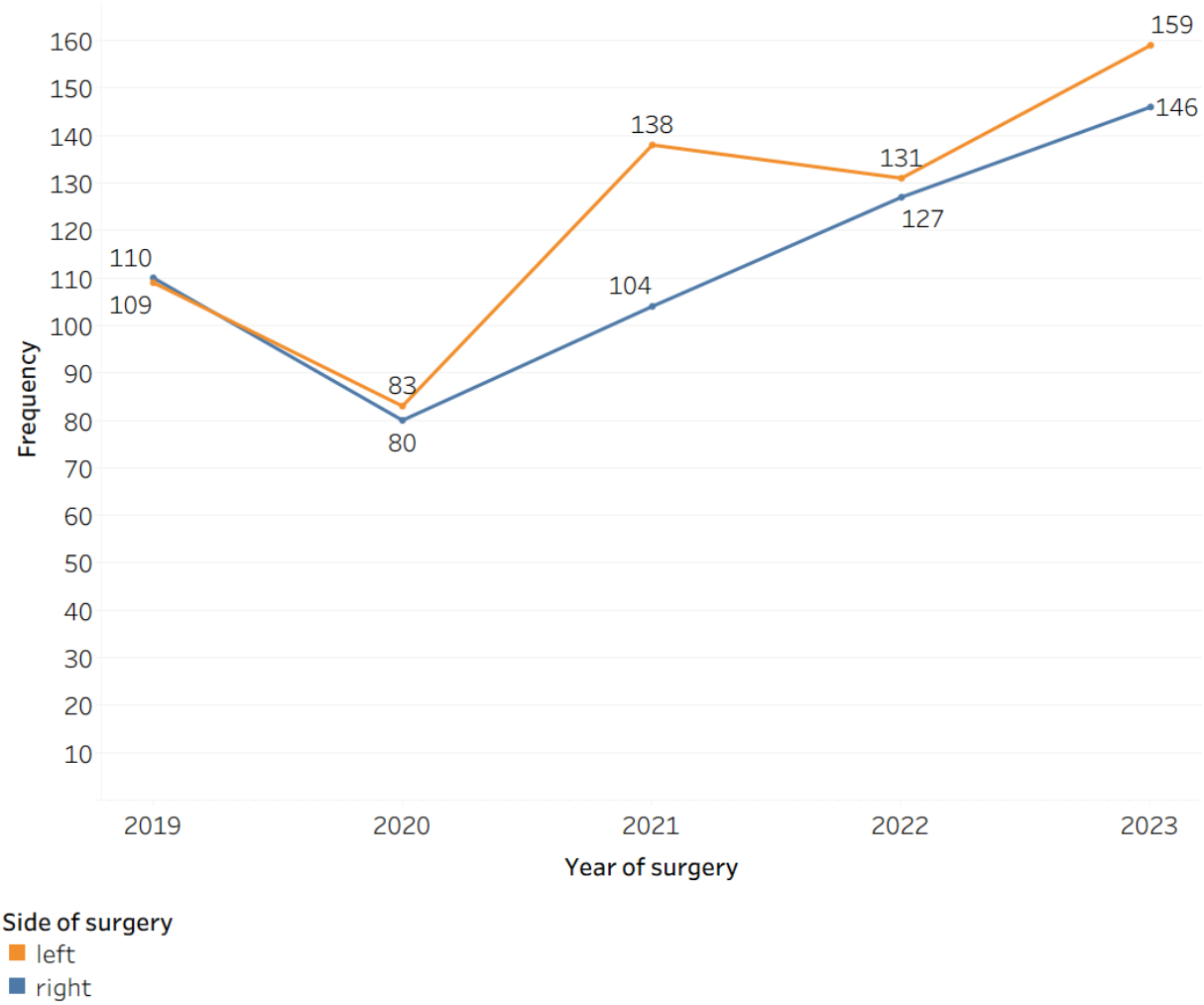


Figure 66:Number of revision arthroplasty surgery between 2019 and 2023 (Source: RES).

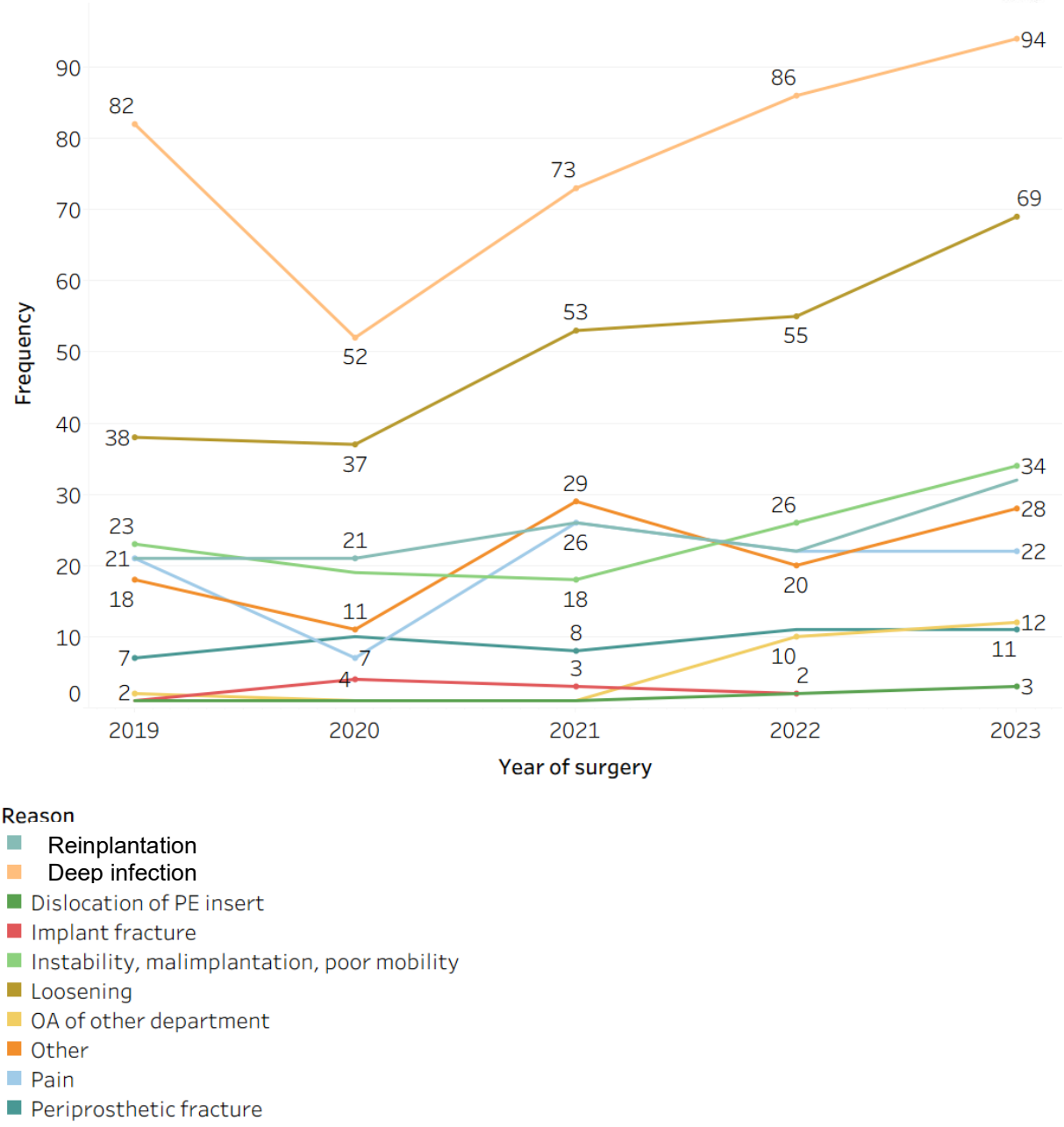


Figure 67: Reasons for revisions from 2019 to 2023 (Source: RES).

Table 41: Knee arthroplasty revisions in 2023 between 2019 and 2023, by reason for revision, by gender and age of patients (Source: RES).

	Years 2019-2022					Year 2023				
	f	f%	Age (Me)	(f_M%)	($f_Ż$%)	f	f%	Age (Me)	(f_M%)	($f_Ż$%)
Deep infection	293	33.0	72.5	50.5	49.5	94	30.8	73.2	56.4	43.6
Aseptic loosening	183	20.6	69.99	34.4	65.6	69	22.6	70.9	42.0	58.0
Reiplantation	90	10.1	72.5	48.9	51.1	32	10.5	70.7	56.3	43.8
Instability, malalignment, poor mobility	86	9.7	68.7	30.2	69.8	34	11.1	71.0	23.5	76.5
Pain	76	8.6	69.4	25.0	75.0	22	7.2	70.4	36.4	63.6
Periprosthetic fracture	36	4.1	76.2	27.8	72.2	11	3.6	78.3	18.2	81.8
Other	124	13.9	NA	30.6	69.4	43	14.2	NA	46.5	53.5

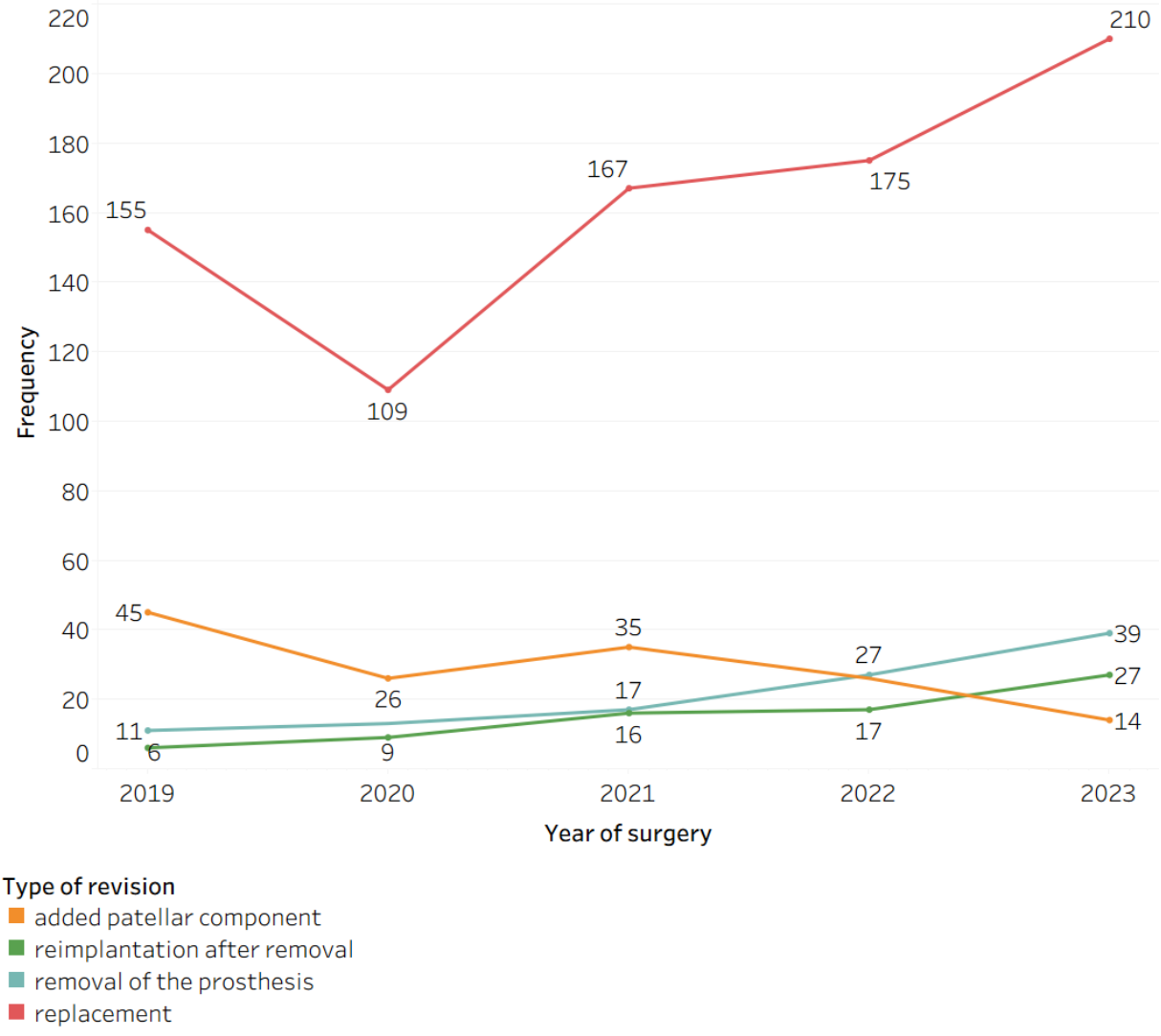


Figure 68: Revisions of knee arthroplasties between 2019 and 2023 by revision volume (Source: RES).

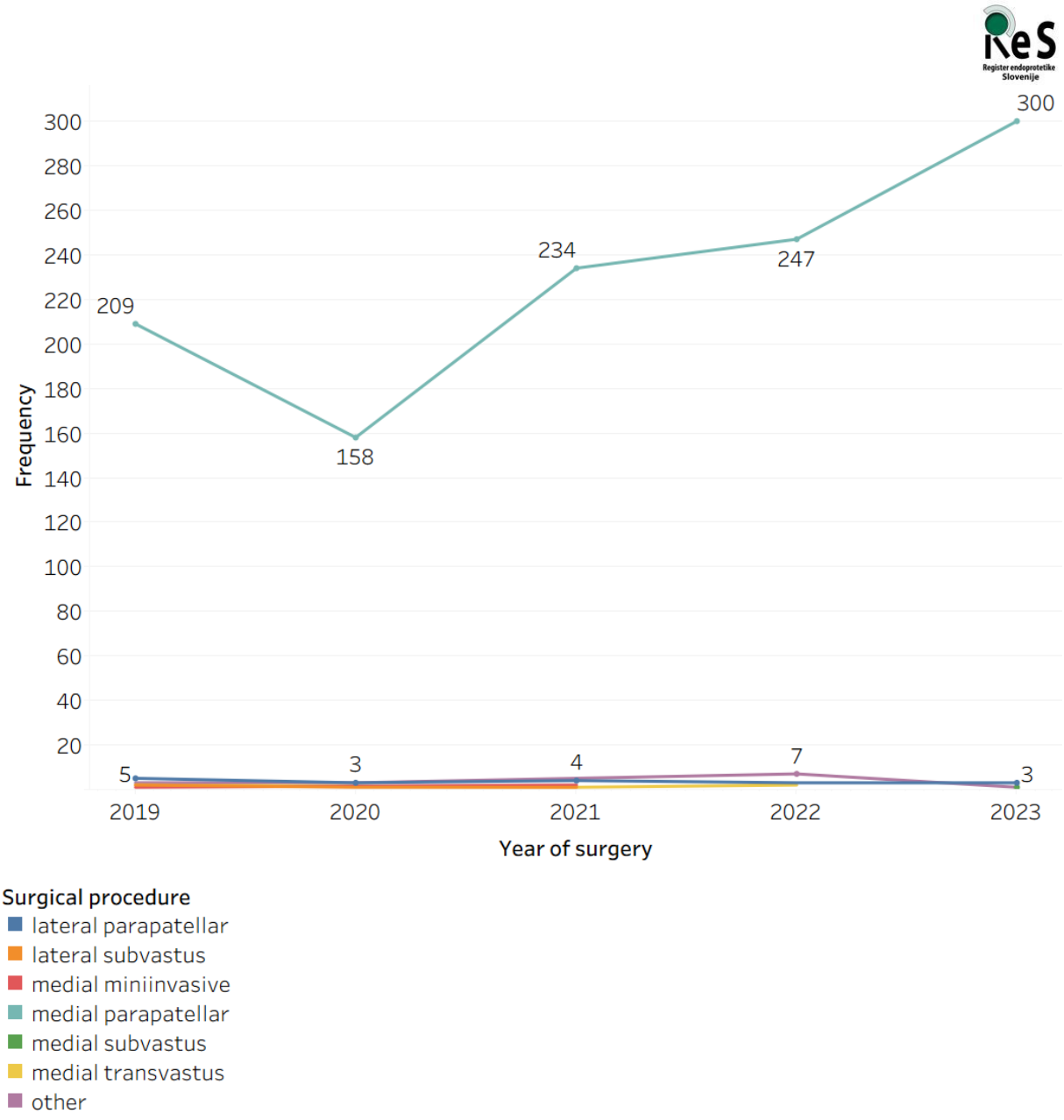


Figure 69: Surgical approach used in revision knee arthroplasties between 2019 and 2023 (Source: RES).

8.2.4 First revision knee arthroplasty

Figure 70 shows that the average time between primary and first revision arthroplasty in 2023 was 2.7 years, slightly less than in 2022 (3.3 years). Between 2021 and 2023, the age at revision arthroplasty did not change significantly.

Between 2019 and 2023, the median time from primary to first revision knee arthroplasty ranged from 2.6 years in 2020 to 3.3 years in 2022 (Figure 71). In 2023, the median difference decreased to 2.7 years.

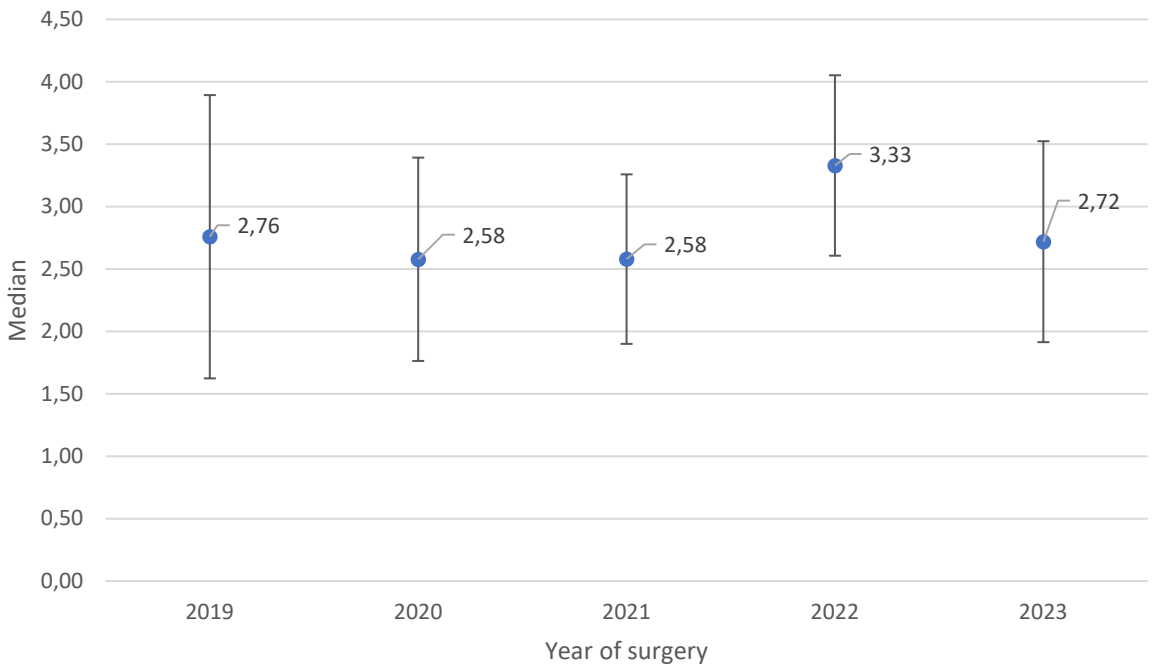


Figure 70: Time from primary knee arthroplasty to first knee revision from 2019 to 2023 (Source: RES).

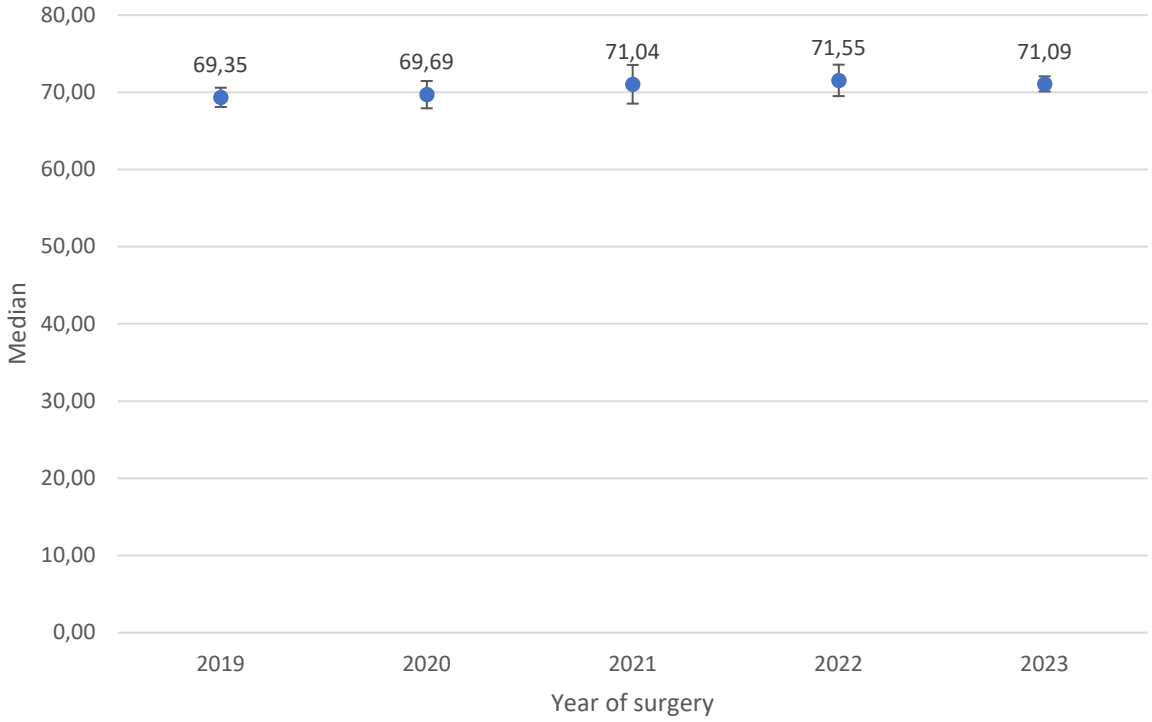


Figure 71: Age at first revision knee arthroplasty from 2019 to 2023 (Source: RES).

8.3 Survival analysis of knee replacements - data until 31. 12. 2023

In this chapter, we present the survival of primary total and partial knee endoprostheses. **The analysis covers implants inserted between January 1, 2019, and December 31, 2023, with at least 100 recorded combinations.**

The time from the primary surgery to the first revision is observed, where the first revision is defined as any reoperation for any reason, regardless of its extent (replacement or removal of all or only part of the endoprosthesis). Implant combinations in patients who died during the observation period or did not have an event at the end of the follow-up (first revision) are considered censored.

The Kaplan-Meier method is used to estimate survival at time t (function S(t)), and the estimates at time t are presented as cumulative revision rates, i.e., 1-S(t), at 1, 2 and 3 years after the primary implantation.

8.3.1 Total knee endoprostheses

Table 42: Number and % of primary total knee endoprosthesis combinations (femur-tibia) by year (Source: RES)

Year	2019-2023		2019		2020		2021		2022		2023	
Femur-tibia (manufacturer)	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
All endoprostheses	**13,917**		**2,834**		**2,185**		**2,299**		**3,068**		**3,531**	
Nexgen LPS Flex - Nexgen tib (Zimmer Biomet)	4,323	31.1	959	33.8	695	31.8	588	25.6	965	31.5	1116	31.6
Sigma CR fem - Sigma tib (DePuy)	1,637	11.8	409	14.4	344	15.7	363	15.8	258	8.4	263	7.4
balanSys PS - balanSys Tibial (Mathys)	1,101	7.9	179	6.3	175	8.0	218	9.5	257	8.4	272	7.7
Score PS cless - Score MB tib (Amplitude)	1,014	7.3	290	10.2	222	10.2	125	5.4	204	6.6	173	4.9
Genus CR - Genus FB tib (Adler Ortho)	704	5.1	217	7.7	112	5.1	129	5.6	132	4.3	114	3.2
Score II cless - Score MB tib (Amplitude)	667	4.8	0	0.0	0	0.0	188	8.2	243	7.9	236	6.7
Sigma PS fem - Sigma tib (DePuy)	439	3.2	113	4.0	110	5.0	91	4.0	89	2.9	36	1.0
Persona CR - Persona tibial (Zimmer Biomet)	372	2.7	0	0.0	3	0.1	85	3.7	103	3.4	181	5.1
Nexgen CR Flex - Nexgen tib (Zimmer Biomet)	350	2.5	62	2.2	76	3.5	58	2.5	71	2.3	83	2.4
Attune CR - Attune FB tib (DePuy)	330	2.4	73	2.6	41	1.9	52	2.3	76	2.5	88	2.5
Sigma CR fem - Sigma PFC tib (DePuy)	253	1.8	40	1.4	43	2.0	17	0.7	94	3.1	59	1.7
Nexgen CR cless - TM Monoblock Tibial (Zimmer Biomet)	239	1.7	94	3.3	80	3.7	65	2.8	0	0.0	0	0.0
Physica KR fem - Physica FB tib (Lima)	238	1.7	3	0.1	0	0.0	17	0.7	53	1.7	165	4.7
Genus PS - Genus FB tib (Adler Ortho)	230	1.7	5	0.2	13	0.6	69	3.0	75	2.4	68	1.9
GMK Sphere fem - GMK Sphere tib (Medacta)	207	1.5	0	0.0	2	0.1	20	0.9	39	1.3	146	4.1
Nexgen CR cless - Nexgen TM FB tib (Zimmer Biomet)	207	1.5	10	0.4	17	0.8	28	1.2	84	2.7	68	1.9
Nexgen LPS Flex cless - Nexgen TM FB tib (Zimmer Biomet)	173	1.2	0	0.0	8	0.4	49	2.1	55	1.8	61	1.7
Persona PS - Persona tibial (Zimmer Biomet)	165	1.2	3	0.1	0	0.0	22	1.0	47	1.5	93	2.6
Nexgen LPS cless - Nexgen TM FB tib (Zimmer Biomet)	150	1.1	109	3.8	41	1.9	0	0.0	0	0.0	0	0.0
Genesis II CR - Genesis II Tibial (S&N)	125	0.9	79	2.8	44	2.0	2	0.1	0	0.0	0	0.0

Anatomic PS - Anatomic FB tib (Amplitude)	117	0.8	0	0.0	3	0.1	37	1.6	36	1.2	41	1.2
Attune PS - Attune FB tib (DePuy)	114	0.8	29	1.0	22	1.0	8	0.3	22	0.7	33	0.9
Physica PS fem - Physica FB tib (Lima)	111	0.8	1	0.0	0	0.0	0	0.0	6	0.2	104	2.9
Genesis II PS - Genesis II Tibial (S&N)	101	0.7	50	1.8	45	2.1	6	0.3	0	0.0	0	0.0

The most frequently inserted combination during the entire period was the Nexgen LPS Flex - Nexgen tib (Zimmer Biomet), with 4,323 cases (31.1%). This was followed by the Sigma CR fem - Sigma tib (DePuy) (11.8%) and balanSys PS - balanSys Tibial (Mathys) (7.9%) (Table 42).

Table 43: One-, two-, and three-year cumulative revision rates of primary total knee arthroplasty combinations (femur-tibia) with 95% confidence interval (CI) (Source: RES)

Femur-tibia (manufacturer)	Number of primaries	Number of first revisions	Age Median (IQR)	% of prostheses in women	Cumulative % of revisions (95% CI)		
					1 Year	2 Years	3 Years
All endoprostheses	**13,917**	**306**	**71 (64-76)**	**62**	**1.31 (1.12 - 1.52)**	**2.24 (1.97 - 2.54)**	**2.87 (2.54 - 3.24)**
Nexgen LPS Flex - Nexgen tib (Zimmer Biomet)	4,323	94	71 (65-76)	61	1.22 (0.92 - 1.62)	2.11 (1.67 - 2.67)	2.79 (2.23 - 3.5)
Sigma CR fem - Sigma tib (DePuy)	1,637	35	70 (64-76)	62	1.1 (0.68 - 1.76)	1.82 (1.24 - 2.66)	2.24 (1.56 - 3.21)
balanSys PS - balanSys Tibial (Mathys)	1,101	22	72 (66-78)	72	0.61 (0.27 - 1.37)	1.71 (1.01 - 2.9)	3.14 (2.02 - 4.86)
Score PS cless - Score MB tib (Amplitude)	1,014	14	72 (66-77)	65	0.85 (0.43 - 1.7)	1.24 (0.69 - 2.24)	1.4 (0.79 - 2.48)
Genus CR - Genus FB tib (Adler Ortho)	704	30	73 (67-79)	65	2.77 (1.75 - 4.36)	4.31 (2.94 - 6.29)	5.13 (3.56 - 7.37)
Score II cless - Score MB tib (Amplitude)	667	4	71 (65-76)	64	0.52 (0.16 - 1.63)	1.03 (0.33 - 3.17)	
Sigma PS fem - Sigma tib (DePuy)	439	8	70 (63-75)	65	1.15 (0.48 - 2.75)	1.15 (0.48 - 2.75)	2.37 (1.16 - 4.84)
Persona CR - Persona tibial (Zimmer Biomet)	372	16	70 (64-75)	60	4.96 (2.94 - 8.3)	6.05 (3.7 - 9.82)	6.05 (3.7 - 9.82)
Nexgen CR Flex - Nexgen tib (Zimmer Biomet)	350	5	72 (66-77)	70	1.28 (0.48 - 3.38)	1.72 (0.71 - 4.13)	1.72 (0.71 - 4.13)
Attune CR - Attune FB tib (DePuy)	330	1	69 (63-75)	62	0.35 (0.05 - 2.46)	0.35 (0.05 - 2.46)	0.35 (0.05 - 2.46)
Sigma CR fem - Sigma PFC tib (DePuy)	253	7	72 (68-77)	58	1.66 (0.63 - 4.38)	2.28 (0.94 - 5.47)	3.37 (1.41 - 7.9)
Nexgen CR cless - TM Monoblock Tibial (Zimmer Biomet)	239	7	64 (58-69)	54	1.26 (0.41 - 3.84)	2.52 (1.14 - 5.53)	2.99 (1.44 - 6.18)
Physica KR fem - Physica FB tib (Lima)	238	1	71 (64-76)	66	0.42 (0.06 - 2.94)	0.42 (0.06 - 2.94)	0.42 (0.06 - 2.94)
Genus PS - Genus FB tib (Adler Ortho)	230	9	72 (68-78)	57	2.48 (1.03 - 5.88)	5.26 (2.53 - 10.77)	7.12 (3.4 - 14.58)
GMK Sphere fem - GMK Sphere tib (Medacta)	207	1	71 (65-75)	63	0.72 (0.1 - 5.03)	0.72 (0.1 - 5.03)	0.72 (0.1 - 5.03)
Nexgen CR cless - Nexgen TM FB tib (Zimmer Biomet)	207	4	66 (61-71)	38	2.29 (0.86 - 6.03)	2.29 (0.86 - 6.03)	2.29 (0.86 - 6.03)
Nexgen LPS Flex cless - Nexgen TM FB tib (Zimmer Biomet)	173	3	66 (60-72)	28	1.3 (0.33 - 5.1)	2.24 (0.71 - 6.92)	2.24 (0.71 - 6.92)
Persona PS - Persona tibial (Zimmer Biomet)	165	1	66 (60-72)	67	0.67 (0.09 - 4.67)	0.67 (0.09 - 4.67)	0.67 (0.09 - 4.67)
Nexgen LPS cless - Nexgen TM FB tib (Zimmer Biomet)	150	5	66 (60-71)	41	0.67 (0.09 - 4.64)	2 (0.65 - 6.07)	2 (0.65 - 6.07)
Genesis II CR - Genesis II Tibial (S&N)	125	2	71 (65-76)	70	0.8 (0.11 - 5.54)	1.63 (0.41 - 6.35)	1.63 (0.41 - 6.35)
Anatomic PS - Anatomic FB tib (Amplitude)	117	2	74 (65-78)	72	1.02 (0.14 - 7.02)	2.7 (0.65 - 10.79)	2.7 (0.65 - 10.79)
Attune PS - Attune FB tib (DePuy)	114	3	73 (67-78)	70	0	1.45 (0.21 - 9.84)	5.24 (1.7 - 15.51)
Physica PS fem - Physica FB tib (Lima)	111	0	72 (67-76)	65	0	0	0
Genesis II PS - Genesis II Tibial (S&N)	101	7	72 (64-78)	57	2.98 (0.97 - 8.96)	5.98 (2.73 - 12.83)	5.98 (2.73 - 12.83)

Table 44: Number of primary total knee endoprosthesis combinations by reason for revision in the period 2019-2023 (Source: RES)

Femur-tibia (manufacturer)	Number of first revisions	Number of primaries	% revisions	Infection	Periprosthetic fracture	Loosening	Dislocation (of PE liner)	Instability, malalignment, poor ROM	Pain	Implant fracture	Other
Total	**281**	**13,367**	**2.1**	**127**	**8**	**29**	**3**	**40**	**35**	**2**	**32**
Nexgen LPS Flex - Nexgen tib (Zimmer Biomet)	94	4,323	2.2	52	0	8	2	15	3	0	11
Sigma CR fem - Sigma tib (DePuy)	35	1,637	2.1	18	0	6	0	4	4	0	3
balanSys PS - balanSys Tibial (Mathys)	22	1,101	2.0	8	2	6	0	4	1	0	1
Score PS cless - Score MB tib (Amplitude)	14	1,014	1.4	8	1	1	0	0	3	0	1
Genus CR - Genus FB tib (Adler Ortho)	30	704	4.3	8	1	1	0	5	9	0	5
Score II cless - Score MB tib (Amplitude)	4	667	0.6	2	0	0	0	1	0	0	1
Sigma PS fem - Sigma tib (DePuy)	8	439	1.8	2	0	0	0	2	2	0	1
Persona CR - Persona tibial (Zimmer Biomet)	16	372	4.3	6	0	1	1	1	1	0	6
Nexgen CR Flex - Nexgen tib (Zimmer Biomet)	5	350	1.4	4	0	1	0	0	0	0	0
Attune CR - Attune FB tib (DePuy)	1	330	0.3	1	0	0	0	0	0	0	0
Sigma CR fem - Sigma PFC tib (DePuy)	7	253	2.8	5	0	1	0	1	0	0	0
Nexgen CR cless - TM Monoblock Tibial (Zimmer Biomet)	7	239	2.9	0	0	0	0	2	5	0	0
Physica KR fem - Physica FB tib (Lima)	1	238	0.4	0	0	0	0	0	0	0	1
Genus PS - Genus FB tib (Adler Ortho)	9	230	3.9	4	0	1	0	2	2	0	0
GMK Sphere fem - GMK Sphere tib (Medacta)	1	207	0.5	0	0	0	0	1	0	0	0
Nexgen CR cless - Nexgen TM FB tib (Zimmer Biomet)	4	207	1.9	3	0	1	0	0	0	0	0
Nexgen LPS Flex cless - Nexgen TM FB tib (Zimmer Biomet)	3	173	1.7	0	3	0	0	0	0	0	0
Persona PS - Persona tibial (Zimmer Biomet)	1	165	0.6	1	0	0	0	0	0	0	0
Nexgen LPS cless - Nexgen TM FB tib (Zimmer Biomet)	5	150	3.3	1	0	2	0	1	0	1	0
Genesis II CR - Genesis II Tibial (S&N)	2	125	1.6	0	0	0	0	0	1	0	1
Anatomic PS - Anatomic FB tib (Amplitude)	2	117	1.7	1	0	0	0	0	1	0	0
Attune PS - Attune FB tib (DePuy)	3	114	2.6	0	1	0	0	0	2	0	0
Physica PS fem - Physica FB tib (Lima)	0	111	0.0	0	0	0	0	0	0	0	0
Genesis II PS - Genesis II Tibial (S&N)	7	101	6.9	3	0	0	0	1	1	1	1

During the entire period, out of a total of 13,917 primary total knee arthroplasties, 306 (2.2%) underwent first revision. The median age of patients at primary was 71 years, and 62% of the prostheses were inserted in female patients. The cumulative revision rate was 1.31% at one year, 2.24% at two years, and 2.87% at three years. Detailed revision rates by individual implant combinations are presented in Table 43.

Table 44 shows the implant combinations by reason for revision. The most common reason for revision was infection (45.2%), followed by instability (14.2%), pain (12.5%), other reasons (11.4%), loosening (10.3%), periprosthetic fracture (2.8%), dislocation (1.1%), and implant fracture (0.7%).

The survival of total knee arthroplasties by fixation is shown in Figure 72.

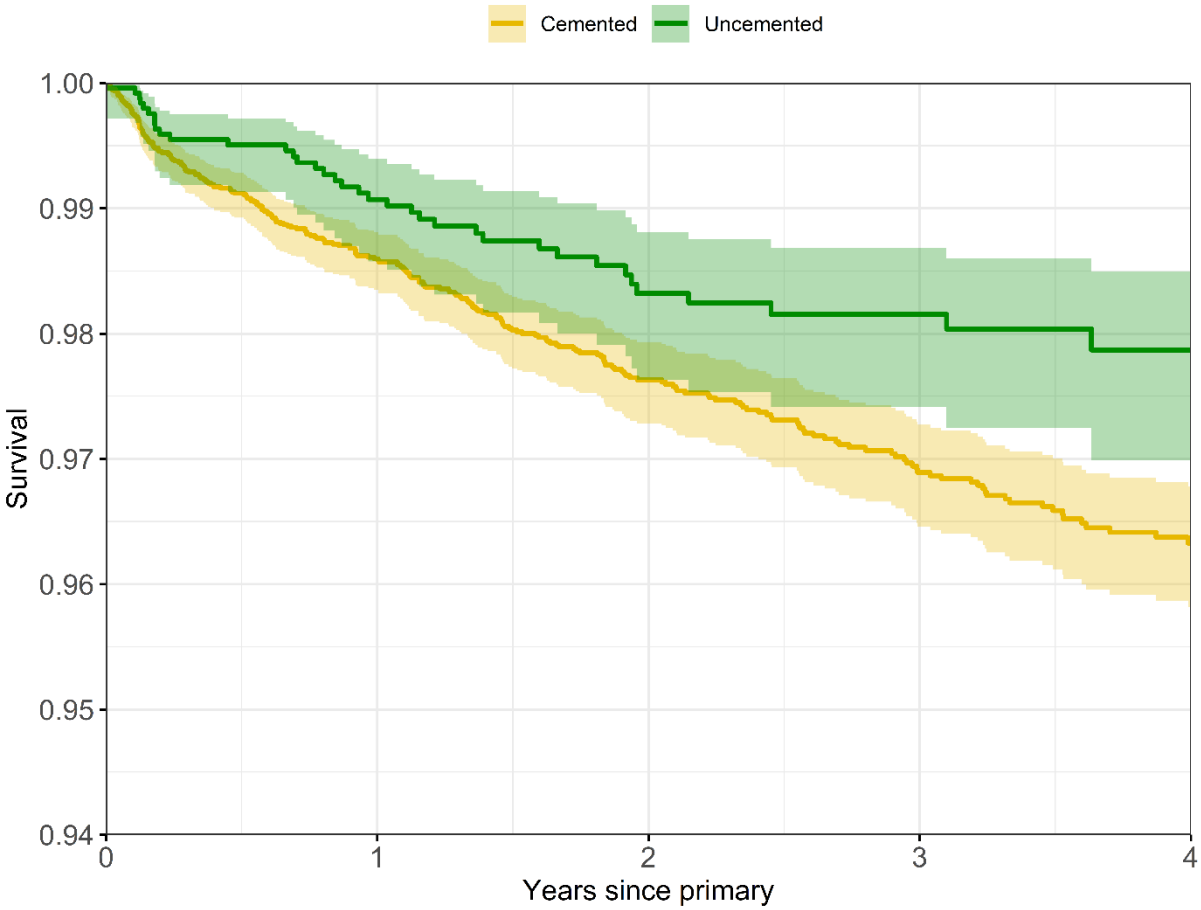


Figure 72: Kaplan-Meier survival curve by type of fixation (shaded area represents 95% confidence interval) (Source: RES)

8.3.2 Partial knee prostheses

Table 45: Number and % of primary partial knee prosthesis combinations (femur-tibia) by year (Source: RES)

Year	2019-2023		2019		2020		2021		2022		2023	
Femur - tibia (manufacturer)	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
All endoprostheses	2,087		346		281		414		495		551	
Physica ZUK - Physica ZUK Tibial (Lima)	1,393	66.8	238	68.8	200	71.2	281	67.9	328	66.3	346	62.8
Persona Partial Knee - Persona Partial tib (Zimmer Biomet)	204	9.8	6	1.7	20	7.1	29	7	66	13.3	83	15.1
Oxford cless fem - Oxford Uncemented Partial Knee Tibial (Zimmer Biomet)	199	9.5	45	13	20	7.1	45	10.9	41	8.3	48	8.7
Uni Score HA - Uni Score FB tib (Amplitude)	174	8.3	4	1.2	20	7.1	51	12.3	59	11.9	40	7.3

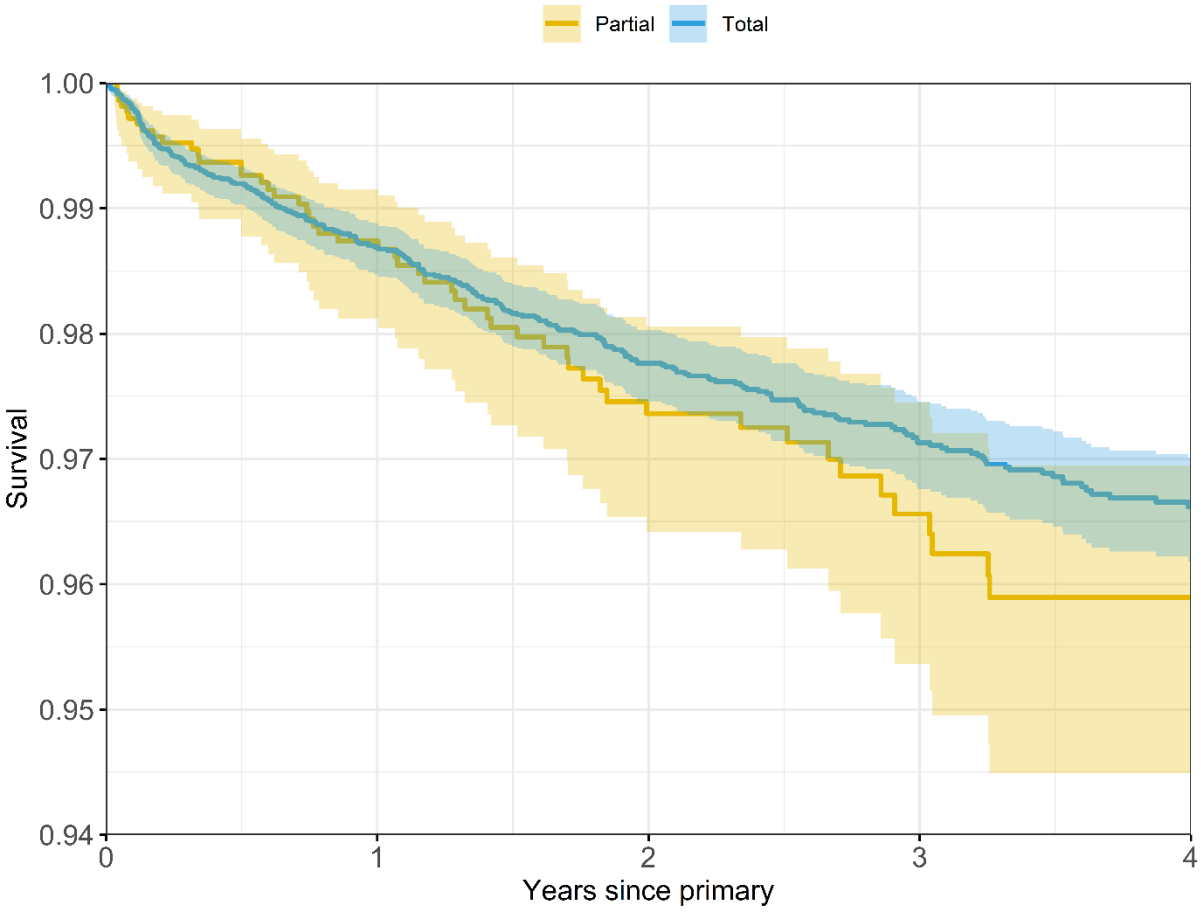


Figure 73: Kaplan-Meier survival curve of primary total versus partial knee replacements (shaded area represents 95% confidence interval) (Source: RES)

Table 46: One-, two-, and three-year cumulative revision rates of primary partial knee implant combinations (femur-tibia) with 95% confidence intervals (CI) (Source: RES)

Femur-tibia (manufacturer)	Number of primaries	Number of first revisions	Age Median (IQR)	% of prostheses in women	Cumulative % of revisions (95% CI)		
					1 Year	2 Years	3 Years
All endoprostheses	**2,087**	**49**	**68 (61-74)**	**55**	**1.25 (0.83 - 1.87)**	**2.52 (1.83 - 3.47)**	**3.35 (2.46 - 4.56)**
Physica ZUK - Physica ZUK Tibial (Lima)	1,393	20	68 (62-74)	53	0.65 (0.32 - 1.29)	1.24 (0.71 - 2.16)	2.22 (1.35 - 3.64)
Persona Partial Knee - Persona Partial tib (Zimmer Biomet)	204	5	67 (58-73)	56	1.67 (0.54 - 5.12)	2.54 (0.94 - 6.8)	2.54 (0.94 - 6.8)
Oxford cless fem - Oxford Uncemented Partial Knee Tibial (Zimmer Biomet)	199	5	67 (61-73)	56	2.26 (0.85 - 5.94)	2.26 (0.85 - 5.94)	2.26 (0.85 - 5.94)
Uni Score HA - Uni Score FB tib (Amplitude)	174	13	69 (61-74)	58	3.89 (1.76 - 8.49)	10.15 (5.75 - 17.58)	12.96 (7.06 - 23.13)

Table 47: Number of primary partial knee implant combinations by reason for revision in the period 2019-2023 (Source: RES)

Femur-tibia (manufacturer)	Number of first revisions	Number of primaries	% of revisions	Infection	Periprosthetic fracture	Loosening	OA of the other compartment	Pain	Other
Total	**43**	**1,970**	**2.2**	**5**	**6**	**19**	**5**	**5**	**3**
Physica ZUK - Physica ZUK Tibial (Lima)	20	1,393	1.4	3	2	7	2	3	3
Persona Partial Knee - Persona Partial tib (Zimmer Biomet)	5	204	2.5	0	2	0	2	1	0
Oxford cless fem - Oxford Uncemented Partial Knee Tibial (Zimmer Biomet)	5	199	2.5	1	2	1	1	0	0
Uni Score HA - Uni Score FB tib (Amplitude)	13	174	7.5	1	0	11	0	1	0

Throughout the entire period and in each year, the most frequently inserted combination was Physica ZUK - Physica ZUK Tibial (Lima) (66.8%). The frequency of the remaining combinations is shown in Table 45.

Table 46 shows the cumulative % of revisions of partial knee prostheses. The cumulative revision rate of all partial prostheses was 1.25% at one year, 2.52% at two years and 3.35% at three years. Table 47 shows the combinations of implants by reason for revision. The most common reason for revision is loosening (44.2%), followed by periprosthetic fracture (14%), in equal proportions infection, osteoarthrosis of the other compartment (11.6%) and other reasons (7%). The survival of partial knee prostheses compared to total prostheses is shown in Figure 73.

8.4 Summary of the RES registry analysis for knee arthroplasties

In 2023, the compliance between the data of the Health Insurance Institute of Slovenia (ZZZS) and the Registry of Endoprostheses of Slovenia (RES) remained very high. The only deviation is recorded in one institution, which initiated the program of inserting total knee prostheses (TP knees) this year.

The incidence of knee endoprostheses insertions (total and partial) is 193 per 100,000 inhabitants, bringing us closer to the levels achieved by Western European countries. The youngest patients receiving knee endoprostheses are often those with a history of anterior cruciate ligament surgery. This confirms the link between sports injuries and the subsequent need for endoprosthesis.

With regard to implant type, slightly fewer uncemented knee prostheses were implanted in 2023 (15.5%) compared with the period 2019–2022 (18.9%). The medial parapatellar approach remains by far the most common surgical approach, used in 89.8% of cases. Partial knee arthroplasty (PKA) accounted for 13.4% of all insertions, a slight increase compared with 2019–2022 (12.8%).

Mortality after knee surgery remains extremely low at 0.19%, which is 2.5 times less than after total hip arthroplasty. The largest improvement in the Oxford Knee Score (OKS) 12 months after surgery was recorded in patients aged between 55 and 65 years, with a mean increase of 19 points. Interestingly, more revisions were performed on the left knee, although the right knee was more frequently replaced. Infection is the most common reason for revisions of knee endoprostheses in all years of follow-up. In 2023, it accounted for 30.8% of all revision procedures.

For total knee prostheses inserted between 2019 and 2023, infection is an even more prominent factor, responsible for 45.2% of all revisions. For partial prostheses in the same period, the main reason for revision is loosening, which was present in 44.2% of cases. The three-year cumulative revision rate for primary total knee prosthesis combinations is 2.87%, consistent with international reference values. However, two combinations had more than double the risk of revision: Persona CR – Persona tibial (Zimmer Biomet): 6.05% (95% CI: 3.7 – 9.82) and Genus PS – Genus FB tib (Adler Ortho): 7.12% (95% CI: 3.4 – 14.58). A more detailed analysis of these combinations showed that these two combinations were used mainly in individual institutions, which could have influenced the results. The third combination, which had worse long-term results, is no longer in use.

Partial knee prostheses had a higher average three-year revision probability than total knee prostheses, 3.35% (95% CI: 2.46 – 4.56). Four different unicondylar (partial) prostheses were in use. Three of them achieve comparable results, while one deviated significantly in a negative direction; Score HA – Uni Score FB tib (Amplitude): three-year probability of revision is 12.96% (95% CI: 7.06 – 23.13).

9 References

9.1 Registries' reports

The National Arthroplasty Registry of Slovenia (RES) https://www.res-nars.si/en

Valdoltra Arthroplasty Registry https://www.ob-valdoltra.si/sl/international

The National Joint Registry (NJR) https://reports.njrcentre.org.uk/

Das Endoprothesenregister Deutschland (EPRD) https://www.eprd.de/de/

AOA National Joint Replacement Registry https://aoanjrr.sahmri.com/home

NZOA Joint Registry https://www.nzoa.org.nz/nzoa-joint-registry

The Swedish Arthroplasty Register https://sar.registercentrum.se/

9.2 Literature

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