ICRS
International Cartilage Regeneration & Joint Preservation Society

ICRS PATIENT REGISTRY

Annual Report 2022

AUTHORS

Gwenllian Tawy
Mike McNicholas

EDITORS

Angie Botto-van Bemden
James Carey
Pieter Emans
Theodorakys Marin Fermin
Laurie Goodrich
Reza Ojaghi
Martyn Snow
Nienke van Egmond

Table of Contents

Letter from Chair

As the Registry matures and the validated dataset grows, we have reached some interesting conclusions about our patients' demographics and the characteristics of the lesions we are treating. New trends are being reported in injectable treatments in particular.

We are grateful to the ICRS Executive Board for their ongoing support and encouragement and are indebted to those members of the ICRS and other users who have so generously entered their patient data to enable us to produce this report. We look forward to the dataset growing and the increasingly granular conclusions that we will be able to draw from our combined efforts.

We hope you find the report to be an interesting and informative resource. If you would like to dive deeper into the dataset, we encourage you to submit a proposed title to the ICRS Patient Registry Steering Committee via this online form by 30th June 2023: https://icrs.wufoo.com/forms/s1ld01ot1ingwa2/

The Steering Committee will assess the merits of all entries according to the FINER criteria (Feasibility, Interest, Novelty, Ethics, and Relevance) ahead of the 17th ICRS World Congress in September 2023. The first set of approved proposals will be announced at the meeting.

Finally, none of this would be possible without the generous financial support of our sponsors and the ICRS. Thank you to you all for your ongoing contributions to the Registry, enabling us to fulfil its mission statement's aims and objectives.

Keep up the good work!

Mr Mike McNicholas

Committees 2021-2022

ICRS Patient Registry Steering Committee
Chair – Mr Mike McNicholas, MD
Member – Angie Botto-van Bemden, PhD
Member - James Carey, MD
Member - Pieter Emans, MD
Member - Theodorakys Marin Fermin, MD
Member - Laurie Goodrich, PhD
Member - Guilherme Gracitelli, MD
Member - Marcel Karperien, PhD
Member - Robin Martin, MD
Member - Reza Ojaghi, MD
Member - Liu Qiang, MD
Member – Martyn Snow, MD
Member - Ryszard Tomaszewski, MD
Member - Nienke van Egmond, MD
Registry Manager— Gwenllian Tawy, PhD

Registry Advisory Committee
Chair – Christoph Erggelet, MD
Member – Daniel Saris, MD
Member – Peter Bak
Member – Jennifer Sisler, BSN, RN
Member – Marco Greber
Member – Leela Biant

Annual Report Prepared by
Gwenllian Tawy, PhD
Mike McNicholas, MD

Sponsors

ICRS Patient Registry Information

The ICRS Patient Registry is the first global multilanguage database for the clinical outcomes of cartilage repair and joint preservation treatments. We aim to be the primary source of information for our patients, and ourselves as scientists and clinicians working to help those living with pain and disability associated with articular cartilage lesions. The Registry is currently live in eleven languages, and we are in the process of translating it into its twelfth language. The Arabic translation will be launched at the 6th ICRS Surgical Skills Course in Doha in January 2023.

The Registry was established in 2016 at the ICRS Meeting in Sorrento. It is guided by a Steering Committee comprised of orthopaedic surgeons, equine surgeons, clinician scientists, and research scientists. The Registry can monitor the progress of patients who have been diagnosed with pathologies of the articular cartilage. It can allow a study of the natural history of such lesions, whether the cartilage damage itself is treated surgically or conservatively. The response of patients to cartilage damage and treatments can be variable. Treatments can also be at the forefront of medical advances, and as such may be expensive. It is thus vital that patient progress is monitored.

Clinicians may monitor their own patients' progress through the Registry, as all users have direct access to their own data and can export their data at any time. To monitor the progress of all patients in the Registry, the ICRS pool together large numbers of anonymized patient results and analyse these. This gives us the most accurate picture of which techniques are working best for which patients. Ultimately, this will help future patients with similar injuries or cartilage problems, and rapidly identify treatments that are showing great benefit, or those that may not be performing as well as hoped. Including the EQ-5D score in the Registry will also enable cost effectiveness and health economic analysis of the data. Irrespective of the health care location in which you practice, recording this data is increasingly required for continued service provision.

Registry Mission

The ICRS Patient Registry mission is to create a global source of unbiased outcomes data for treatments of articular cartilage lesions. This is paramount for the improvement of existing and discovery of new cartilage repair strategies, which has the potential to be beneficial for millions of patients worldwide.

Annual Report Disclaimer

Please note that the data presented in this Annual Report have been manually input by clinicians and patients. As such, all data rely on patient and clinician motivation and reliability. These confounders and biases should be considered when interpreting the data presented in this Report.

1. ICRS Patient Registry

1.1 Registry Updates

Many changes to the Registry have been implemented since the publication of the last Annual Report in 2021. Most notably, Registry users can now benefit from a new Conservative Treatments tab in the portal. This tab can be used to report 18 discreet conservative treatments for articular cartilage injuries. We have also published a new series of tutorials on the ICRS website to help new and current users learn how to use the Registry most efficiently. Each short tutorial focuses on a specific aspect of the Registry's online portal and is designed to address your questions about using the Registry.

In addition to adding a new treatment tab, other areas of the clinical portal have also been updated. In a response to user feedback, some previously mandatory items have now been made optional to improve the efficiency and accuracy of data entry.

1.2 Language Translations

The Registry is now live in English, Dutch, Chinese, German, Greek, Italian, Japanese, Polish, Portuguese, Spanish, and Swedish.

The Arabic translation is due to be launched to users in January 2023.

1.3 Registry Profile

1.3.1 User Locations

The Registry is comprised of clinician users and delegate users from 48 countries across the globe. The map below illustrates the truly international reach of the Registry. Each node on the map denotes an institution or hospital that is known to be using the Registry (Figure 1).

The Registry is in use across the world. The largest data entry in the Registry is from our members from the United States (Figure 2). Our other main contributors are Japan, the United Kingdom, the Netherlands, and Italy. We will target other countries to help increase our data capture from our members there.

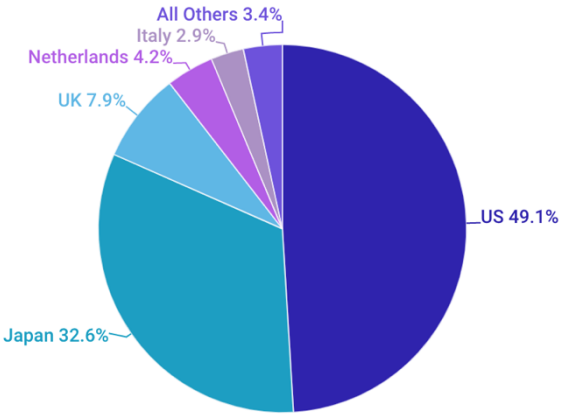

Figure 2: Graphical illustration of percentage contribution per country to the ICRS Patient Registry between 2017 and the end of 2021.

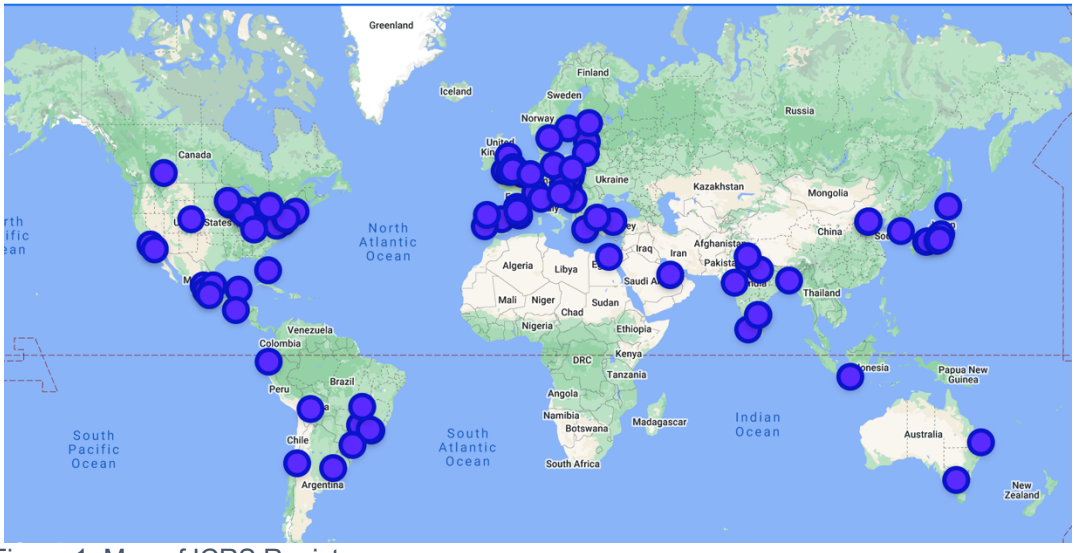

Figure 1: Map of ICRS Registry users.

1.4 Pathway Volume

At the end of 2021 a total of 1,798 patient care pathways had been created in the ICRS Patient Registry: an increase of 98.4% since 2020. These figures have been corrected since the publication of the 2021 Annual Report, after we carried out an exhaustive data cleaning exercise and unified–duplicate pathways for the same patients. It is possible for patients to have more than one care pathway if they have undergone multiple procedures; however, erroneous and duplicate entries of the same pathway must be removed when analysing the data. Such recalibration is commonly required in registries that are early in their evolution.

Figure 3 also shows that while 97.1% of patients enrolled in the Registry had been allocated a treatment pathway, 54 patients who were enrolled between 2017 and the end of 2021 did not have an allocated pathway. Data from patients who are not allocated to a pathway are not included in the Registry. Could users of the Registry please check their data entries and remove those rare patients who change plans for whatever reason and do not set out on their planned treatment pathway, to help us minimise the need for such interventions in future.

It is no surprise that few patient pathways were added to the Registry in 2020, given the onset of the COVID-19 pandemic. The sharp increase in Registry pathways in 2021 may be explained by the addition of historic data into the Registry during the pandemic. For example, a significant number of pathways were added in January 2021, as can be seen by comparing the final figure in 2020 (Figure 3) to the total in January 2021 (Figure 4). After January 2021, a steady monthly increase was observed. In 2021, ongoing COVID-19 restrictions prevented clinicians in many countries from performing elective orthopaedic procedures. This may explain why only a small number of pathways were added to the Registry in 2021. We anticipate the number of pathways and patients in the Registry to increase from 2022 onwards and are most grateful for those active members who kindly contribute their cases.

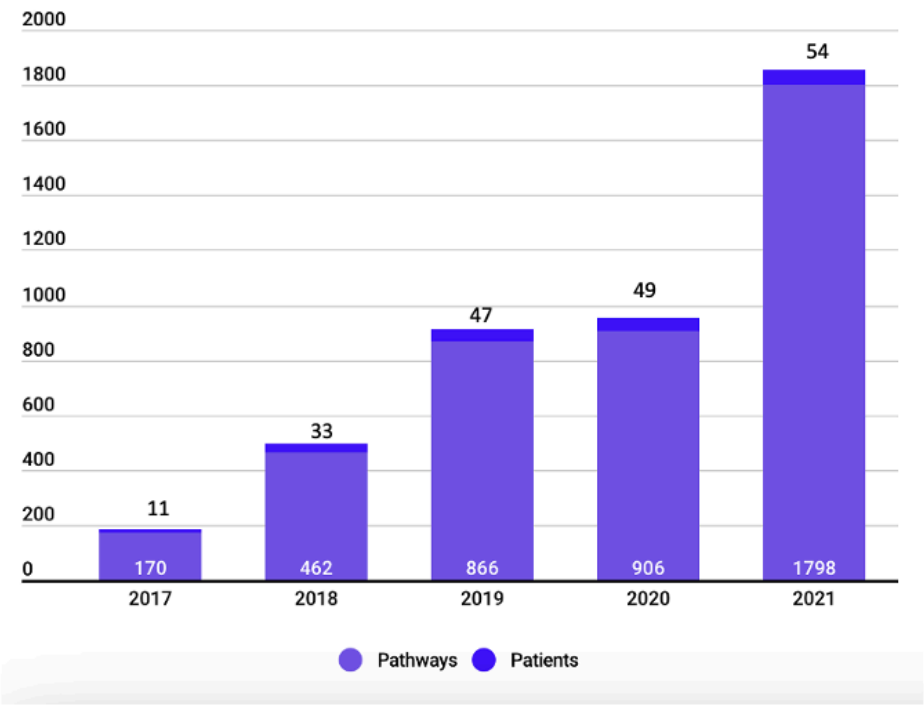

Figure 3: The annual growth of patients and pathways in the ICRS Patient Registry between 2017 and the end of 2021.

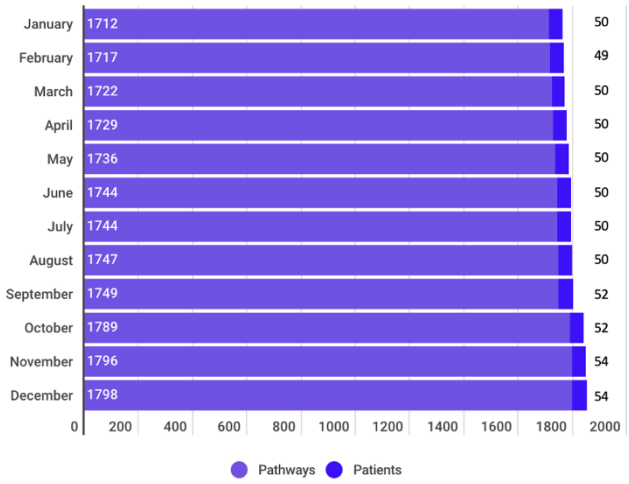

Figure 4: The monthly growth of the patients and pathways in the ICRS Patient Registry in 2021.

2. Registry Patients

2.1 Patient Demographics

The Registry captures data on sex, age, body mass index (BMI), affected limb and smoking status of enrolled patients. Although 1,798 pathways had been created in the Registry between its inception and the end of 2021, an additional 21 pathways were retrospectively added by clinicians in 2022, dated 31st December 2021 or earlier. As the procedures linked to these pathways were carried out before the end of 2021, these additional pathways have been included in this Annual Report. The total number of pathways eligible for analysis was therefore 1,819.

A summary of the demographics is shown here, with further detail provided in the subsections.

- 53% of all pathways were male
- Males were taller and heavier than females, as anticipated
- There were no differences in the laterality of the limbs
- The average age at intervention was 43±18 years old
- Patients treated with an injection were almost twice as old as patients who were treated surgically (64.3±14.2 years compared to 33.8±12.1 years)
- Analyses of age categories showed females were older than males at time of treatment

2.1.1 Sex

Sex was reported in 99.8% of patient pathways. 53.0% of patients were Male, 46.8% were Female, 0.2% (n = 3) had their sex listed as 'unknown' and 0.05% (n = 1) were listed as Intersex.

2.1.2 Age

The age range on the day of intervention ranged from 11 years old to 92. On average, patients were 43±18 years old (median age of 40 years). Data on age was available for 99.6% of patient pathways.

Patients treated with an injection were older than patients surgically treated, as depicted in Figure 5.

The distribution of age is represented as a burst with larger age frequencies covering a larger surface area. The average age of patients who had an injection was 64.3±14.2 years, whereas the average patient undergoing primary surgery was half the age at 33.8±12.1 years. Patients undergoing a revision surgery were slightly older at 38.8±11.8 years old.

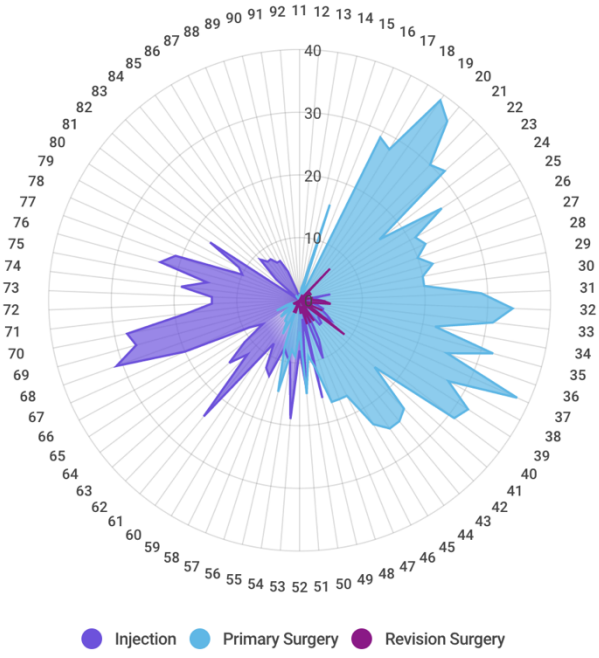

Figure 5: Radar chart of the ages at which patients received an injection or underwent primary or revision surgery. The age is depicted on the circumference of the chart, whilst the frequency is depicted within the chart.

When the data for males and females were analysed individually it was found that females were on average 8 years older than males at the time of intervention (Table 1).

Table 1: Independent ages of different sexes at the date of intervention.

Sex	Number of Patients	Mean±SD* Age at Intervention (years)	Range (years)
Male	961	40±16	13-97
Female	849	48±19	11-94
Intersex	1	51	-
Unknown	2	76±8	70-81

SD – Standard Deviation

Interestingly, when the data for males and females were further subdivided by age at intervention, it was found that the number of procedures in males consistently decreased from the age of 40 (Figure 6). Conversely, interventions in females were shown to be relatively steady until the age of 65. It is therefore plausible to infer from this data that males generally undergo intervention for cartilage regeneration or joint preservation between early adulthood and middle-age, whereas females tend to start and end treatments later in life.

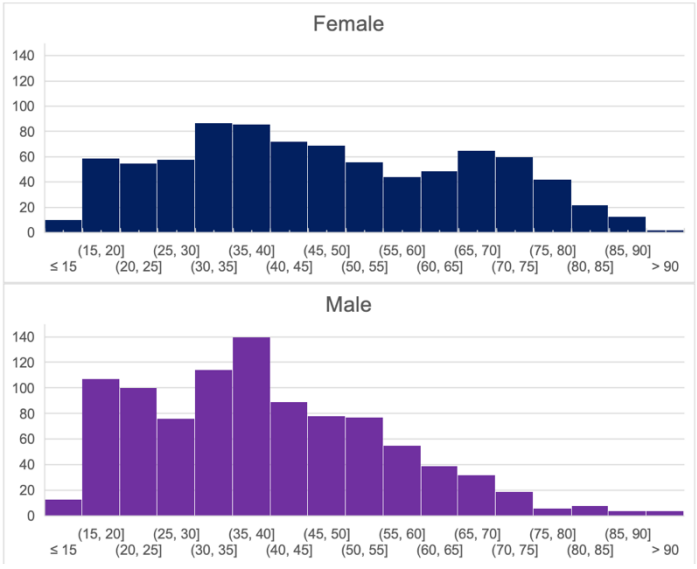

Figure 6: Histograms showing the distribution of Female (above) and Male (below) ages at intervention.

2.1.3 BMI

Users of the Registry and patients may input mass in kilograms, stones, or pounds. Thus, to calculate average mass, all entries were converted to kilograms. The average patient weighed 82.3±19.4kg, with males being heavier than females (Table 2). Data were available for 960 patients (52.8%).

Table 2: Independent masses of different sexes at the date of intervention.

Sex	Number of Patients	Mean±SD Mass at Intervention (kg)
Male	573	93.6±16.2
Female	387	73.5±17.0

Like mass, height can be input into the Registry in centimetres or feet and inches. Thus, all entries were converted to centimetres to calculate the average height. The average patient was 175.1±10.7cm, with males being taller than females (Table 3). Data was available for 962 patients (52.9%).

Table 3: Independent heights of different sexes at the date of intervention.

Sex	Number of Patients	Mean±SD Height at Intervention (cm)
Male	574	180.6±8.9
Female	388	167.1±7.6

The available data on patients' masses and heights were used to calculate the average BMI. The mass and height of an individual were reported for 952 patients (52.3%). The average BMI across all patients was 26.0±5.2kg/m^2. The BMI was lower in females than in males (Table 4). As with the mass and height, the difference in BMI between sexes was statistically significant ($p < 0.001$, two-sample t-test).

Table 4: Independent body mass indices of different sexes at the date of intervention.

Sex	Number of Patients	Mean±SD BMI at Intervention (kg/m^2)
Male	567	26.9±5.1
Female	385	24.7±5.0

2.1.4 Affected Limb

The limb affected was reported in 762 patients in the pre-treatment form (41.9%). In the remaining pathways, the injured side was not identified. Of the 762 patients whose data was available at this stage, 377 (had a procedure on their right knee 49.5%), and the remaining 385 had a procedure on the left knee (50.5%). Thus, the split between limbs was even.

2.1.5 Smoking Status

Data on smoking status was available for 285 patients (15.7%). Most patients were non-smokers, and smokers were more likely to be male (Table 5).

Table 5: Smoking status of patients in the ICRS Registry.

Sex	Number of Patients	Smoker (%)	Ex-smoker (%)	Non-smoker (%)
All	285	29 (10.2)	35 (12.3)	221 (77.5)
Male	145	18 (12.4)	18 (12.4)	109 (75.1)
Female	140	11 (7.8)	17 (12.1)	112 (80.0)

3. Patient History

3.1 Baseline Patient Data

When enrolling with the Registry, patients, clinicians, and their delegates are asked to complete a questionnaire on the patients' condition at baseline. This questionnaire has been partly or fully completed for 1,024 patients (56.3%). This seemingly low completion rate is likely because some pathways have been added to the Registry retrospectively. The data required for this questionnaire may therefore not have been available to the clinician or delegate when entering the data into the Registry. As we proceed with prospective data collection, this effect will decrease over time.

Of the data available, 76.2% of entries were made by patients (Figure 7). As this questionnaire forms part of the enrolment process, we would recommend that all users to encourage their patients to enrol in the Registry. This reduces the workload on the clinician or delegate and is therefore the most efficient way to collect this data. We are all very busy in our working lives, and the Registry was purposely designed to minimise our input levels.

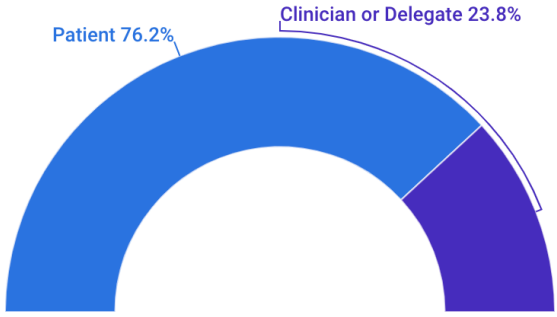

Figure 7: Percentage of patients and clinicians or delegates who have completed the baseline patient data questionnaire.

The completion rate for the questionnaire was high for both patients and clinicians (Table 6).

Table 6: Completion rate of baseline patient questionnaire.

User	Number of Individuals	Complete (%)	Incomplete (%)
All	1023	1006 (98.3)	17 (1.7)
Patients	780	764 (97.9)	16 (2.1)
Clinicians	243	242 (99.6)	1 (0.4)

3.1.1 Previous History of Injections and/or Surgery

As part of the baseline assessments, users are asked a series of mandatory and optional questions.

One of the questions asks whether the patient has undergone previous injections to their knee. An answer was provided for 254 pathways (24.8%). Almost three-quarters of these patients (n = 185) had not previously had an injection in knee (Figure 8) remaining quarter reported previous injections to the knee.

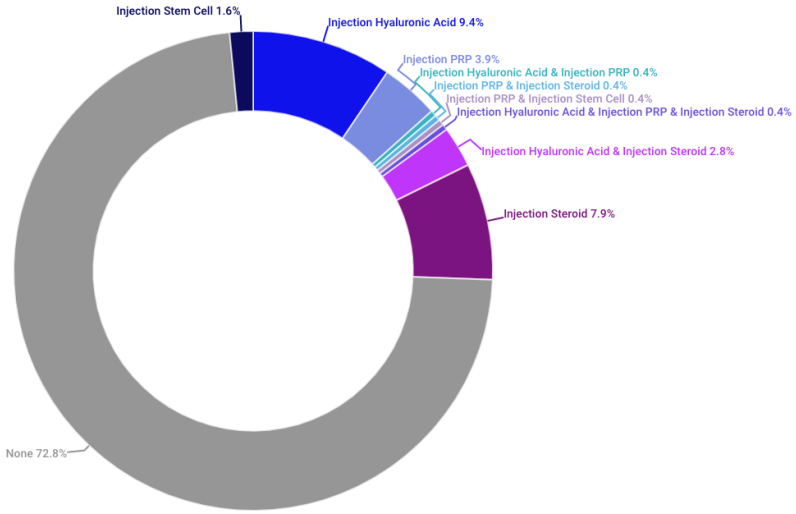

Figure 8: Previous history of injections in treated knee.

When asked whether previous surgery had been carried out on the knee, an answer was provided for 774 patient pathways (75.5%). Thus, at least three-quarters of patients in the Registry had undergone previous knee surgery before their involvement in the Registry.

Of the 774 patients who had data available on this variable, 52 previously had an injection to their knee (6.7%).

Table 7 outlines the relationship between previous histories of injections and surgery, where the data is available in the Registry. The results suggest that a previous history of injections was more common in patients who also had previous surgery. PRP was the only injection that was more commonly prescribed for patients with no known history of knee surgery (Table 7).

Table 7: Numbers and percentages of patients who have reported previous injections and/or surgery in their knee.

Type of Injection	History of injections and surgery (%)	History of injections but no surgery (%)
None	129 (71.3)	46 (73.0)
Hyaluronic Acid	19 (10.5)	5 (7.9)
Steroid	16 (8.8)	4 (6.3)
Hyaluronic Acid & Steroid	6 (3.3)	1 (1.6)
PRP	4 (2.2)	6 (9.5)
Stem Cell	3 (1.6)	1 (1.6)
Hyaluronic Acid & PRP	1 (0.5)	0 (0.0)
Hyaluronic Acid & PRP & Steroid	1 (0.5)	0 (0.0)
PRP & Steroid	1 (0.5)	0 (0.0)
PRP & Stem Cell	1 (0.5)	0 (0.0)
Total (number)	181 (100.0)	63 (100.0)

Of the 774 patients with data on their history of knee surgery, the total number of procedures each patient had undergone was known for 71 patients (9.2%). Over half of these patients (58.3%) had undergone more than one surgical procedure (Figure 9). However, it was most common for patients to have undergone one or two procedures previously.

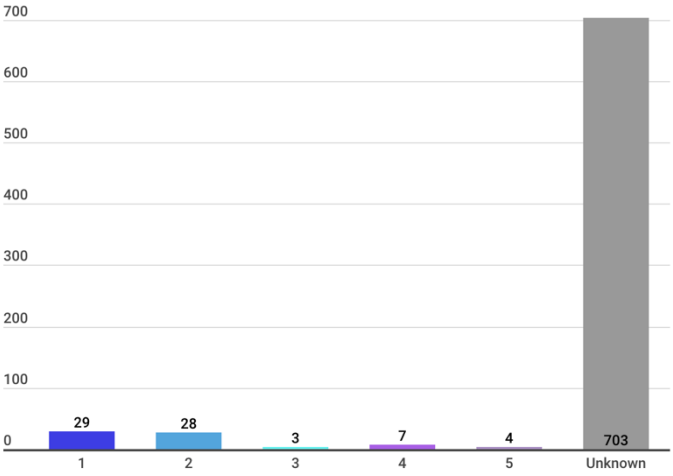

Figure 9: Number of previous surgeries per patient when enrolled with the ICRS Patient Registry.

Patients reported having previously undergone various procedures in numerous combinations (Table A, Appendix A). The most commonly reported previous surgery was a debridement of the cartilage injury (36.2%), while subchondral marrow stimulation with a debridement was the second most common procedure (21.2%). 11.5% of patients had not previously had a cartilage procedure carried out on their knee. All other combinations of cartilage treatment were less common (<10%).

Near half of all patients in the Registry are also known to have undergone other knee surgery that was not specific to the knee's cartilage prior to their enrolment in the Registry (43.4%). The most common non-cartilage procedure was loose body removal (Table B, Appendix A). As for the cartilage-specific procedures, most treatments and their combinations were uncommon (<10%).

While it was not possible to include the data on how many previous procedures 703 patients had on their knees, text data on all 774 patients was available for analysis. The types of previous interventions reported are given in Table A, Appendix A.

The Registry data also shows that 87 patients underwent 'Other' procedures that were not listed in the Registry (Table B, Appendix A). Free text answers for each patient were available. Most procedures were unique to each patient. However, the following were carried out in more than one patient: arthroscopy, drilling, incision and drainage, irrigation, lateral release, manipulation, patellectomy, refixation, and synovectomy. The repeated use of these procedures suggests they should be included in the Registry as independent options.

The sheer variety of previous treatments patients have had for their knee evidences the importance of the importance of tailoring treatments to patients' needs.
Users of the Registry can add more detail on previous surgery their patients have had on the knee before their enrolment in the Registry. The following information summarises the data currently available on the previous surgeries.

While the initial data (Table B, Appendix A) suggests that 34 patients had a previous history of meniscal surgery in their knee, elsewhere in the Registry were 262 entries for previous meniscal surgery. This discrepancy is because the option 'Other' had been selected for 27 patients instead of 'Meniscal Surgery', while no option had been chosen for the remaining 202 datasets when originally asked about the previous history of surgery in the knee. Thus, 25.6% of patients enrolled in the Registry are known to have a previous history of meniscal surgery. Most of these patients had previous surgery on their medial meniscus (n = 144; 55.0%). 31.7% had surgery on the lateral meniscus (n = 83), while the remaining 13.3% had previous surgery on both menisci (n = 35). Table C in Appendix A outlines further details on the previous meniscal surgery carried out on these patients. Partial

meniscectomies were generally the most common meniscal procedure.

In a similar nature to meniscal surgery, the Registry data suggests that 19 patients had previously undergone surgery on one of the ligaments in their knee (Table B, Appendix A). However, data on 62 previous ligament surgeries were identified. Again, this is likely due to some ligament surgeries being labelled as 'Other' earlier in the Registry form. Figure 10 outlines the kinds of ligamentous surgery patients had undergone before enrolling in the Registry.

Figure 10: Types of ligamentous surgery patients are known to have undergone prior to their enrolment in the ICRS Patient Registry.

Most previous ligamentous surgeries were ACL reconstructions (66.1%) alone or in combination with another procedure (Figure 10).

Additional information on previous extensor mechanism surgery was available for 10 patients, despite it being reported in 76 patients (Table B, Appendix A). The mechanisms used varied, but MPFL reconstruction was the most common (40.0%).

All eight patients who had previously undergone patellofemoral surgery were reported having a soft tissue extensor mechanism realignment (Table B, Appendix A). An additional 2 patients were also found to have undergone a previous a soft tissue extensor mechanism realignment on their patellofemoral joint, bringing the total number of patients to 10 (1.0% of all patient pathways).

Very little additional information was available for the previous osteotomies performed on patients. Two patients underwent a high tibial osteotomy (3.6%), one underwent a distal femoral osteotomy (1.8%), and one underwent an anterior closing wedge osteotomy (1.8%). The remaining 52 patients had no further information (92.8%). Given the rates of osteotomy reported in the articular cartilage restoration literature, we would expect these levels to increase as time goes on and we return to pre pandemic operating levels.

3.1.2 Associated Injuries

When asked whether the patient suffered any associated injury at the same time as their cartilage injury 247 answers were given (24.1%). One fifth of entries had a known associated injury (Figure 11). The most commonly reported associated injuries were osteochondritis dissecans and injury to the medial meniscus.

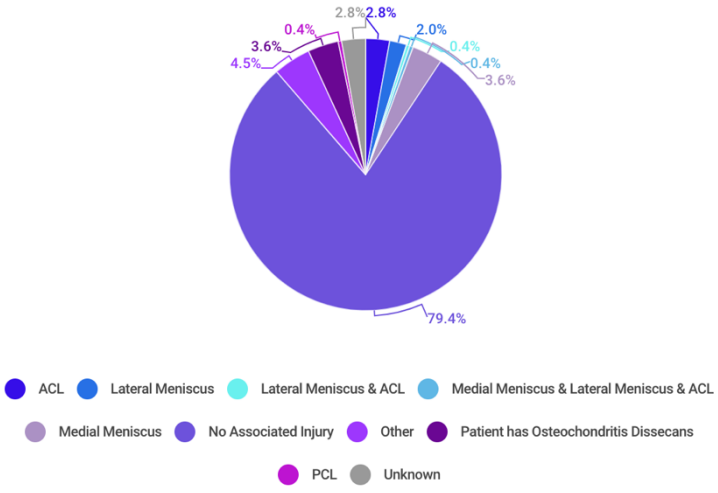

Figure 11: Available information on the associated injuries incurred at the same time as the cartilage injury.

Eleven of the associated injuries were labelled as 'Other'. These were later disclosed to be one failed ACL reconstruction, one MPFL tear, two MPFL ruptures, one ACL rupture, one patellar tendon injury, two patella dislocations, one metal fragment in knee, and two were unknown.

3.1.3 Pre-Treatment Knee Alignment

Users of the Registry may also report the injured knee's alignment before treatment. This data was available for 23.7% of patients. The vast majority (88.5%) had a normal alignment (< 5º Valgus or Varus). 8.2% were reported to have excess varus alignment (>5 º Varus), and the remaining 3.3% had an excess valgus alignment (>5 º Valgus).

3.1.4 Underlying Cause of Defect

The underlying cause of the cartilage defects in patients enrolled in the Registry was available for 676 pathways (66.0%).

Table 8 outlines the causes of these pathways. Osteochondritis dissecans was the most reported cause, followed by a damaged chondral lesion.

Table 8: The underlying causes of cartilage defects reported in the ICRS Patient Registry.

Underlying Cause	Number	Percentage (%)
Osteochondritis Dissecans / OCD	215	31.8
Damaged Chondral Lesion (DCL)	158	23.4
Osteoarthritis	80	11.8
TCI	75	11.1
Osteonecrosis / AVN	57	8.4
Failed Osteochondral Allograft	27	4.0
Osteochondral Fracture	23	3.4
Tibial Plateau Fracture	23	3.4
Other	7	1.0
DCL & Failed Osteochondral Allograft	2	0.3
Osteochondritis Dissecans / OCD & DCL	2	0.3
DCL & Traumatic Cartilage Injury (TCI)	1	0.1
Malpositioned ACL Reconstruction	1	0.1
Osteochondral Fracture & Osteoarthritis	1	0.1
Osteochondral Fracture & Other	1	0.1

3.1.5 Pre-Injury Status

To better understand how the patients' injuries have impacted their daily activities, patients are asked to describe their activity and functional status before their injury compared to before treatment.

Data on the level of activity was available for 572 (55.8%) pathways pre-injury and 616 (60.1%) pathways post-injury. Figure 12 shows how the level of activity changed over time. Most individuals were engaged in sports to some degree prior to their injury. Excluding highly competitive athletes, there was a positive trend between frequency and sporting level pre-injury. Post-injury there was a clear negative trend between frequency and sporting level, with the majority of patients claiming they were no longer participating in sports. The percentage of individuals claiming to be highly competitive athletes had also dramatically reduced from 34.1% to 3.1%. These results highlight the impact cartilage injuries can have on an individual's activity level prior to treatment. As our data increases, it will be interesting to see how this varies by age cohort.

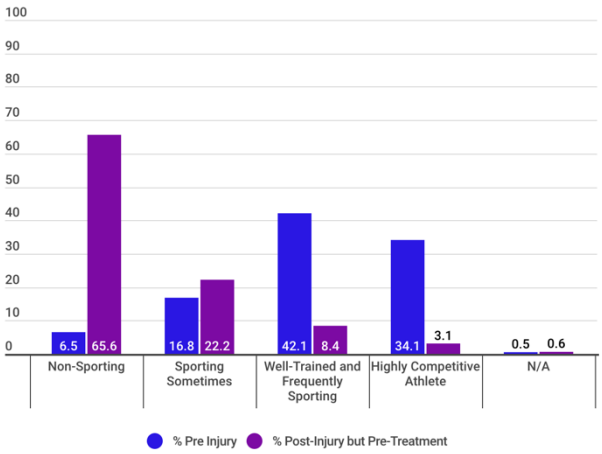

Figure 12: Level of activity of patients before injury and after injury (but prior to treatment).

A similar amount of data was available for the level of function patients felt they had in their knees. Pre-injury, there was data on 583 pathways (56.9%); after injury there was data for 608 patients (59.4%).

Three-quarters of patients reported no functional limitations in their knee prior to their injury (Figure 13). However, following injury, only 2.3% of patients reported they could do everything they wanted with their knee. Most people could only do some things they wanted (56.1%).

4. Treatments

4.1 Procedure and Treatment Data

Of all 1,819 pathways in the Registry, data on the limb treated was available for 1,647 (90.5%). 51.3% of procedures were on the left knee (n = 845) and the remaining 49.7% were on the right (n = 802).

Data on the state of the opposite knee was available for 1,320 pathways (72.6%). Most patients whose data was reported had a normal contralateral knee (Figure 14).

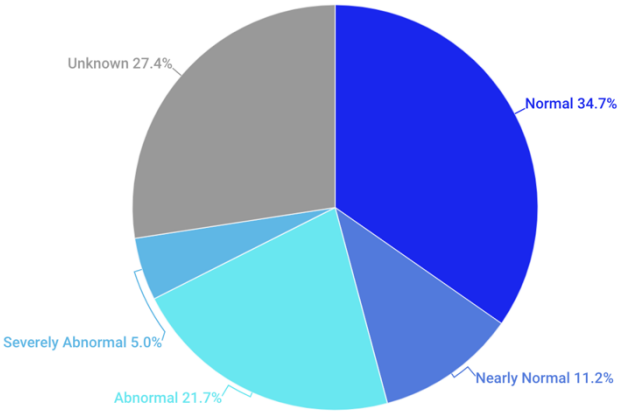

Figure 14: State of the contralateral knee.

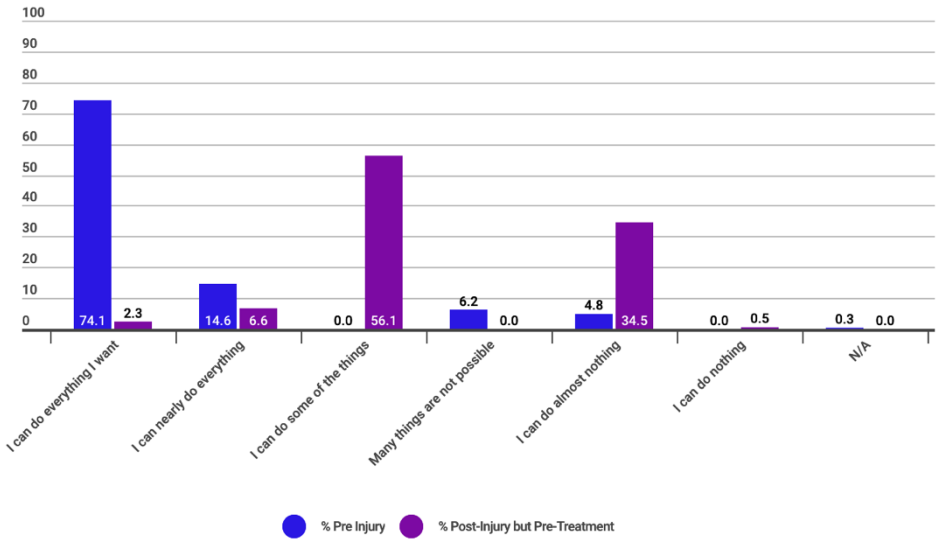

Figure 13: Patient-reported knee function before and after injury (but prior to treatment).

When asked whether the procedure in question was a primary or revision, data was available for 48.8% of all pathways. Most procedures with a known classification were primary (Figure 15).

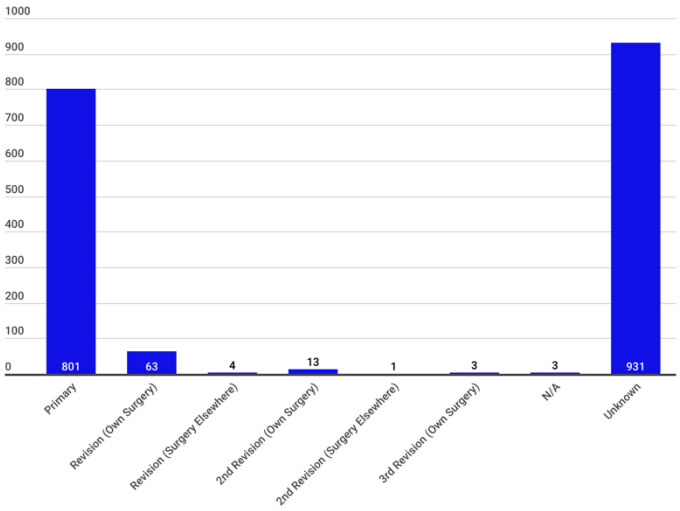

Figure 15: Type of procedure carried out on patients in Registry.

The approach used was reported in 46.2% of cases. Injections were reported more frequently than surgeries (Figure 16). Of the surgeries, open surgery was more common as an approach than arthroscopy or subchondroplasty.

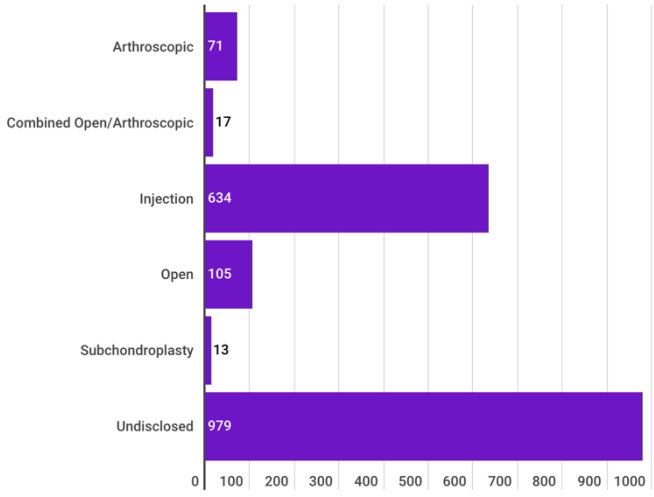

Figure 16: Data on the approaches reported in the Registry

Of the arthroscopic procedures, fifteen procedures are known to have approached the joint both medially and laterally. Three used anteromedial and standard anterolateral portals, while only one case of anteromedial as the only portal was reported. Three additional cases used a combination of three various portals.

Patients who underwent a combined open and arthroscopic procedure generally had standard anterolateral and anteromedial portals (10/17 – 58.8%). One had an additional medial portal, while one had standard anterolateral and medial portals. A central patella tendon portal was used for one patient, while medial and lateral portals were used for two. Data on portals was not available for 2 of the patients. The open part of the procedure generally involved only one incision (58.8%). Three patients had two incisions, while one had three. The locations of the incisions varied: Lateral (4 – 23.5%), Lateral at distal femur (1 – 5.9%), Medial Paramedial (5 – 29.4%), Medial to tibial tuberosity (1 – 5.9%), Medial and lateral (1 – 5.9%), Midline (2 – 11.8%).

Further information on incisions was available for 98 patients who underwent an open procedure alone (93.3%). A single incision was performed in all cases. The location was typically in the midline – from the patella to the tibial tuberosity (66.3%). 17.3% of incisions were performed medial paramedial, while 3.1% were midline or medial curved longitudinal, and 2.0% were medial to tibial tuberosity. The remaining incision locations were unknown.

4.1.1 State of Joint Fluid

The presence or absence of fluid in the joint during the procedure was reported for 139 patients. Generally, half were reported to have no fluid, while the remaining half had clear joint effusion (Figure 17).

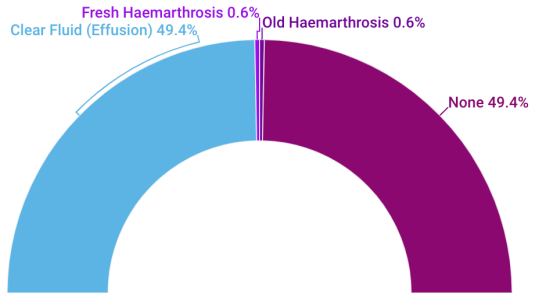

Figure 17: Reported fluid presence within the knees of patients in the Registry.

The volume of fluid present in the joint was estimated to be 10-50ml in 58 cases (41.7%), 50-100ml in 22 cases (15.8%), and 100-200ml in 3 cases (2.1%).

4.1.2 State of Synovium

The state of the joint's synovium intra-operatively was also reported for 139 patients (Table 9). Roughly half of all patients had normal synovium, while half had mild proliferation. More severe proliferation was rarely reported.

Table 9: The reported state of proliferation of the synovium.

State of Synovium	Number (N)	Percentage (%)
Normal	67	48.2
Mild Proliferation	64	46.0
Moderate Proliferation	7	5.0
Severe Proliferation	1	0.7

The location of proliferation and type of synovitis was available for 70 of the reported cases (97.2%). The proliferation was throughout the synovium in 58 cases (82.9%), in the suprapatellar pouch in 8 cases (11.4%), and in the medial gutter in the remaining 4 cases (5.7%). All but two cases were reactionary (97.1%). The two cases that were not reactionary were inflammatory.

4.1.3 State of Cartilage

The locations of cartilage damage were reported for 476 pathways (26.2%), and the total size of the defect(s) per patient was available for 343 pathways (18.8%). The average total area of all defects in a patient across all pathways was 9.50±8.40cm^2. This figure is seemingly high as it includes patients who had multiple lesions in numerous locations. However, most pathways (66.4%) involved a single area of cartilage damage (Figure 18).

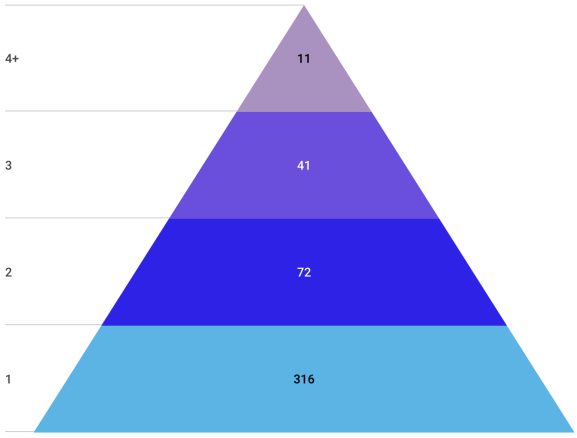

Figure 18: Number of areas reported to have cartilage damage per patient.

The patella was most the commonly reported location of cartilage damage (20.6%). Of the isolated regions, damage to the medial compartment was more likely than the lateral compartment (Figure 19).

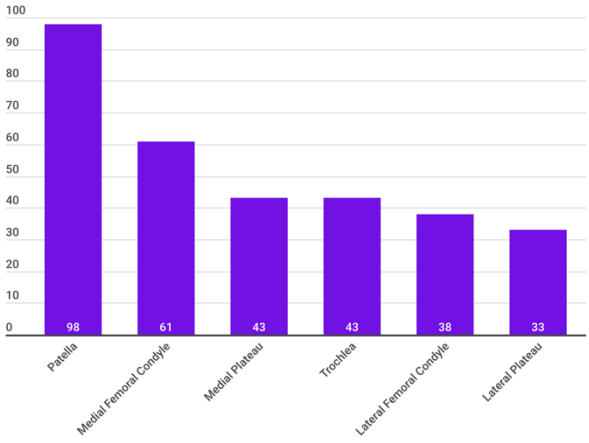

Figure 19: Number of pathways per location with isolated cartilage damage.

The reported cartilage damage in knees with one single injured area was greatest in the trochlea, followed by the lateral femoral condyle and medial tibial plateau. The area with the smallest lesions was the lateral tibial plateau (Table 10).

Table 10: The average area of cartilage damage reported in patients with one involved area.

Location (Isolated)	Average Area (cm^2)	SD (cm^2)
Trochlea	10.18	8.23
Lateral Femoral Condyle	9.05	7.02
Medial Plateau	8.52	4.67
Patella	7.86	4.89
Medial Femoral Condyle	7.84	6.02
Lateral Plateau	7.19	5.59

All isolated areas of cartilage damage were more common than pathways with multiple locations of damage (Figure 20). Of the pathways with two areas of cartilage damage, trochlear damage combined with patellar damage was most common (6.7% of all pathways).

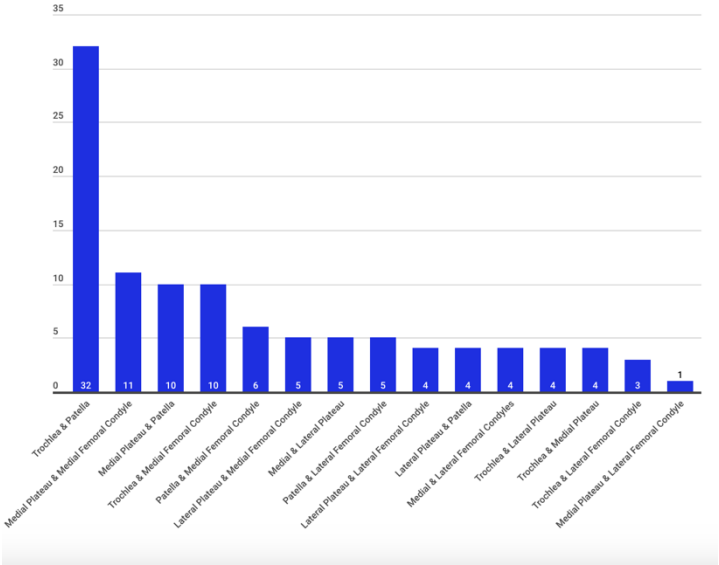

Figure 20: Number of pathways with two locations of cartilage damage.

The area of cartilage damage was reportedly greatest in the lateral tibial plateau and lateral femoral condyle (Table 11).

Table 11: The average area of cartilage damage reported in patients with two involved areas.

Locations	Average Area (mm^2)	SD (mm^2)
Lateral Plateau Lateral Femoral Condyle	23.78	30.85
Trochlea Medial Plateau	18.00	N/A
Medial Plateau Medial Femoral Condyle	13.88	16.46
Medial Plateau Patella	12.81	7.22
Medial Plateau Lateral Femoral Condyle	11.88	N/A
Trochlea Patella	10.31	6.84
Trochlea Lateral Femoral Condyle	9.75	5.25
Trochlea Lateral Plateau	8.67	5.03
Lateral Plateau Medial Femoral Condyle	7.80	4.10
Medial Plateau Lateral Plateau	7.75	4.77
Patella Lateral Femoral Condyle	7.21	5.49
Trochlea Medial Femoral Condyle	7.09	4.12
Patella Medial Femoral Condyle	6.35	4.29
Lateral Plateau Patella	5.27	3.61
Medial Femoral Condyle Lateral Femoral Condyle	No Data	No Data

Patients with three or more locations of cartilage damage were reported less frequently (Appendix B).

4.2 Patellar Defects

Further information was available for a subset of all cartilage damage reported in the patella (total n = 194). The type of lesion was reported for 71 (36.6%). 26 were chondral lesions (36.6%), and 45 were osteochondral lesions (63.4%).

Roughly one-fifth of chondral and osteochondral lesions were not contained and shouldered. The majority were contained and unshouldered (Table 12). Osteophytes were more prevalent in osteochondral lesions. Most chondral lesions had no osteophytes (Table 12).

Chondral lesions were on average 18.7±7.7mm wide (range: 10-40mm), 16.9±5.2mm long (range: 10-25mm), and 4.6±1.9mm deep (range: 2-8mm).

Osteochondral lesions were slightly larger at 22.7±6.6mm wide (range 8-40mm), 19.8±6.0mm long (range: 7-30mm), and 4.5mm deep (range: 2-11mm).
These values are smaller than the average total size reported in Table 10, because they are calculated from only 36.6% of all reported patellar lesions. They are also based on data from all patients with a patellar lesion and not only those whose cartilage damage is restricted to their patella.

The ICRS Grade of cartilage damage was more severe in the osteochondral lesions. Generally, the chondral lesions were described as being at least 50% greater than the cartilage depth, whereas the osteochondral lesions were described as extending through the subchondral bone plate, or worse (Figure 21).

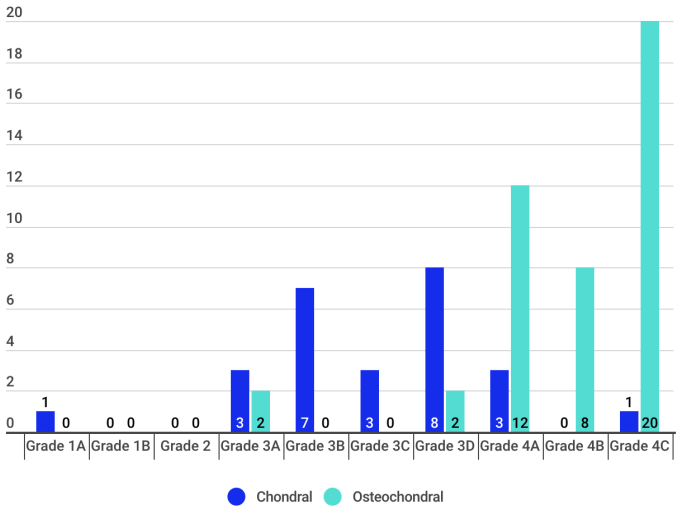

Figure 21: ICRS Grade of cartilage damage in chondral and osteochondral lesions of the patella.

Table 12: Detailed information on the patella defects reported in the Registry.

Variable	Subtype	Chondral Lesion		Osteochondral Lesion	
		N	%	N	%
Containment	Contained	21	80.8	37	84.1
	Not Contained	5	19.2	7	15.9
Shouldered	Shouldered	23	88.5	39	88.6
	Unshouldered	3	11.5	5	11.4
Osteophytes	No Osteophytes	17	73.9	10	22.7
	Early Osteophytes	6	26.1	31	70.5
	Well Established Osteophytes	0	0.0	3	6.8

4.3 Trochlear Defects

A trochlear defect was reported in 137 patients in the Registry. Additional information was available for 38 of these patients (27.7%). Twenty of these patients had a chondral defect, while the remaining 18 had an osteochondral defect.

Chondral lesions were less likely to be contained and shouldered than osteochondral lesions of the trochlea, but most people in both groups had contained and shouldered lesions (Table 13). 70-75% of patients with trochlear lesions had no osteophytes. Well-established osteophytes were more commonly reported in patients with chondral lesions.

On average, chondral lesions of the trochlea were 17.1±7.2mm wide (range: 2-30mm), 15.3±7.4mm long (range: 3-36mm) and 3.4±1.9mm deep (range: 1-6mm). These dimensions were similar to the osteochondral lesions, which were 15.3±6.4mm wide (range: 4-25mm), 18.5±6.3mm long (range 6-30mm), and 2.8±1.6mm deep (range: 0.6-6.2mm).

These values are smaller than the average total size reported in Table 10, because they are calculated from only 27.7% of all reported trochlear lesions. They are also based on data from all patients with a trochlear lesion and not only those whose cartilage damage is restricted to their trochlea.

As expected, the ICRS grade of cartilage damage was worse for the osteochondral lesions (Figure 22).

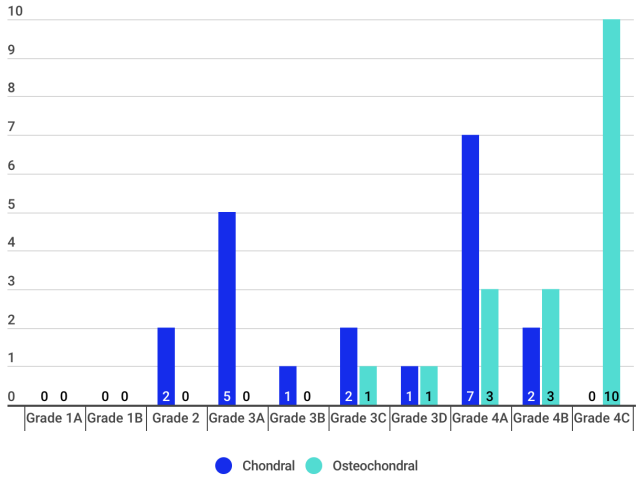

Figure 22: ICRS Grade of cartilage damage in chondral and osteochondral lesions of the trochlea.

Table 13: Detailed information on the trochlear defects reported in the Registry.

Variable	Subtype	Chondral Lesion		Osteochondral Lesion	
		N	%	N	%
Containment	Contained	14	70.0	18	100.0
	Not Contained	6	30.0	0	0.0
Shouldered	Shouldered	17	85.0	17	94.4
	Unshouldered	3	15.0	1	5.5
Osteophytes	No Osteophytes	14	70.0	13	72.2
	Early Osteophytes	1	5.0	3	16.7
	Well Established Osteophytes	5	25.0	2	11.1

4.4 Medial Femoral Condyle

A defect of the medial femoral condyle was reported in 125 patients within the Registry. Additional information was available for 49 of these patients (39.2%). Twenty-seven (55.1%) were found to have a chondral defect, whereas the remaining 22 had an osteochondral defect (44.9%).

As with other areas of cartilage defect, chondral lesions were far less likely to be contained than osteochondral lesions (Table 14). The frequency of shouldered and unshouldered defects was similar in both lesions, with shouldered lesions being present in at least 4/5th of patients. Patients with lesions of the medial femoral condyle were also more likely to have no osteophytes than early or well-established osteophytes (Table 14).

Chondral lesions on the medial femoral condyle were 16.6±5.5mm wide (range: 6-25mm), 16.9±7.4mm long (range: 8-40mm), and 2.5±0.6mm deep (range: 2-3mm). Osteochondral lesions were 18.1±5.3mm wide (range: 8-30mm), 19.9±9.2mm long (range 8-40mm), and 6.6±3.2mm deep (range: 2-10mm).

Like other regions of cartilage damage within the knee, the ICRS grade of cartilage damage was more severe in patients with osteochondral defects to the medial femoral condyle (Figure 23).

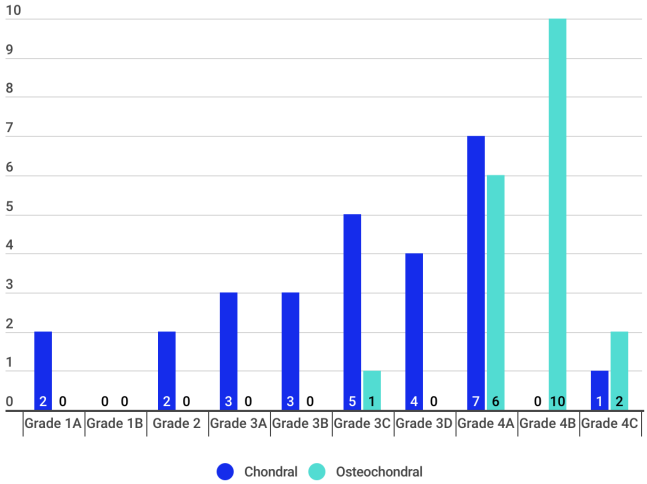

Figure 23: ICRS Grade of cartilage damage in chondral and osteochondral lesions of the medial femoral condyle.

Table 14: Detailed information on the medial femoral condyle defects reported in the Registry.

Variable	Subtype	Chondral Lesion		Osteochondral Lesion	
		N	%	N	%
Containment	Contained	1	3.7	14	70.0
	Not Contained	26	96.3	6	30.0
Shouldered	Shouldered	24	88.9	16	80.0
	Unshouldered	3	11.1	4	20.0
Osteophytes	No Osteophytes	23	85.2	16	80.0
	Early Osteophytes	3	11.1	4	20.0
	Well Established Osteophytes	1	3.7	0	0.0

4.5 Medial Plateau

Despite 99 reports of patients with a cartilage lesion of the medial plateau, no further information was available on the type, subtype, size, or grade of the lesion. This is because the option to input this data is currently unavailable in the Registry. We will address the absence by introducing these questions to the Registry soon.

4.6 Lateral Femoral Condyle

There were 75 reports of a cartilage lesion in the lateral femoral condyle. Further information was available on 33 of these (44.0%). The majority were chondral lesions (23 chondral vs 10 osteochondral). All but one of the chondral lesions were contained (95.6%), while all osteochondral lesions were contained. Lesions were more likely to be shouldered than unshouldered in both chondral and osteochondral lesions (Table 15). Generally, patients with lesions of the lateral femoral condyle presented with no osteophytes (Table 15).

On average, the chondral lesions were 13.7±4.5mm wide, 16.4±6.5mm long, and 2.7±0.8mm deep. Osteochondral lesions were similarly sized at 14.6±4.9mm wide, 12.3±4.6mm long, and 3.8±2.2mm deep. As expected, the ICRS grade of cartilage damage was more severe in the osteochondral defects (Figure 24).

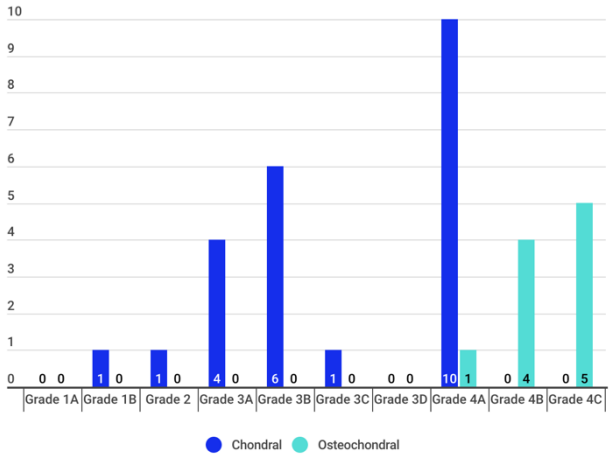

Figure 24: ICRS Grade of cartilage damage in chondral and osteochondral lesions of the medial femoral condyle.

4.7 Tibial Plateau

Despite 72 reports of patients with a cartilage lesion of the tibial plateau, no further information was available on the type, subtype, size, or grade of the lesion. As with the medial plateau, this is because the option to input this data is currently unavailable in the Registry. We will address the absence by introducing these questions to the Registry soon.

Table 15: Detailed information on the lateral femoral condyle defects reported in the Registry.

Variable	Subtype	Chondral Lesion		Osteochondral Lesion	
		N	%	N	%
Containment	Contained	22	95.6	10	100.0
	Not Contained	1	4.4	0	0.0
Shouldered	Shouldered	20	87.0	9	90.0
	Unshouldered	3	13.0	1	10.0
Osteophytes	No Osteophytes	22	95.6	8	80.0
	Early Osteophytes	1	4.4	2	20.0
	Well Established Osteophytes	0	0.0	0	0.0

4.8 State of Menisci

Data on the state of the menisci of patients with chondral or osteochondral defects that required surgical intervention was available for 149 patients (8.2% of all pathways). In most cases, the menisci were normal (n = 132, Figure 25).

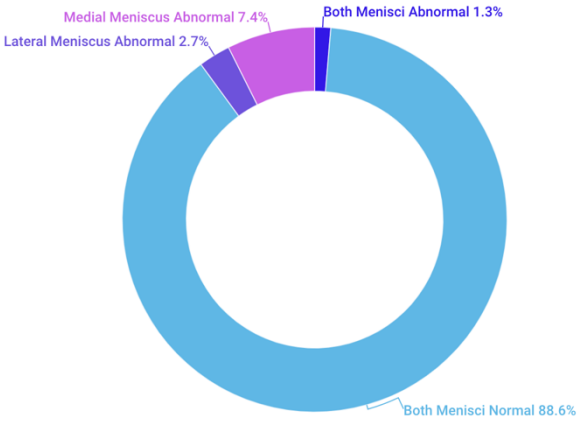

Figure 25: State of menisci in patients treated surgically for a chondral or osteochondral lesion.

4.9 State of Ligaments

Data on the state of the ligaments in the knee was available for 817 patients (44.9%). 135 were all normal (13.6%), whereas the vast majority had an abnormal ACL (681, 83.3%). One patient was described as having abnormalities in all ligaments (0.1%).

One of the patients with an abnormal ACL had a complete rupture, and two had been previously reconstructed. The competency of the ligament was available for 678 patients with an abnormal ACL (99.5%); 632 were competent and 46 were incompetent (93.2% vs 6.8%).

5. Surgical Treatment

5.1 Primary Treatments for Defects

943 patients in the Registry underwent a surgical procedure (51.8% of all pathways). Demographic data on the patients who underwent surgery is given in Table 16. On average, patients who underwent surgery were younger than the general population of the Registry by 10 years. Patients who underwent surgery were also 2kg lighter than the general population, but there was little difference in height or BMI. The data also showed that more males than females underwent surgery on the knee (57.2% vs 42.8%). This trend is also seen in the general population of Registry patients.

Table 16: Demographics of patients who underwent a surgical procedure.

	Average	SD	Data Available (n)	Data Available (%)
Age (years)	33.6	11.7	937	99.0
Height (m)	175.6	10.4	762	80.8
Weight (kg)	80.1	18.5	765	81.1
BMI (kg/m^2)	25.9	4.9	744	78.9
Side (L/R)	79L 59R	-	138	14.6
Sex (M/F)	374F 569M	-	943	100.0

The data also showed that females and males undergoing surgery were of similar age and that males were generally taller and heavier (Table 17).

Table 17: Comparison of male and female demographics for patients who underwent a surgical procedure.

	Average		SD	
	Males	Females	Males	Females
Age (years)	32.8	34.9	11.3	12.3
Height (m)	180.8	167.1	8.5	7.3
Weight (kg)	87.3	68.4	17.4	13.6
BMI (kg/m^2)	26.7	25.5	4.9	4.7

Detailed information on which areas of the knee were primarily treated by surgical intervention was available for 864 patients (91.6% of all surgical pathways). The most common sites to be treated were the medial condyle (43.6%) and the lateral condyle (25.3%), even though isolated lesions were more likely to be reported in the patella (Figure 19). The medial plateau was the site least likely to be treated (2.0%). Generally, one area was treated per site, but multiple defects were treated per site in some patients (Table 18).

Table 18: Number of areas treated by anatomical site as a primary treatment.

	Lateral Condyle		Lateral Plateau		Medial Condyle		Medial Plateau		Patella		Trochlea	
	N	%	N	%	N	%	N	%	N	%	N	%
Number of Patients	219	100.0	42	100.0	377	100.0	17	100.0	119	100.0	90	100.0
1 area treated	155	70.8	36	85.7	211	56.0	8	47.0	83	69.7	40	44.4
2 areas treated	52	23.7	6	14.3	127	33.7	6	35.3	29	24.4	33	36.7
3 areas treated	10	4.6	0	0.0	26	6.9	3	17.6	5	4.2	12	13.3
4 areas treated	2	0.9	0	0.0	11	2.9	0	0.0	2	1.7	4	4.4
5 areas treated	0	0.0	0	0.0	1	0.3	0	0.0	0	0.0	0	0.0
6 areas treated	0	0.0	0	0.0	1	0.3	0	0.0	0	0.0	1	1.1

The type of surgical procedure used to treat the areas was available for 138 of the 864 patients (16.0%). Half of these patients underwent an osteochondral repair (Table 19). The second most common procedure was cell therapy cartilage reconstruction (23.1%).

Table 19: Type of intervention carried out on a subset of patients in the Registry.

Type of Intervention	N	%
Cell Therapy Cartilage Reconstruction	32	23.1
Cell Therapy/Scaffold on Top of Bone Graft Cartilage Reconstruction	1	0.7
Conservative Treatment of Cartilage Defect	6	4.3
Debridement or Chondroplasty Only	8	5.8
Debridement or Chondroplasty Only & Microfracture	3	2.2
Microfracture	9	6.5
Microfracture + Scaffold Cartilage Reconstruction	4	2.9
Osteochondral Repair	73	52.9
Scaffold/Carrier Cartilage Reconstruction	2	1.4

Six different cell therapy products were listed in the Registry, and three different scaffold carriers were mentioned, suggesting that multiple variables need to be considered when interpreting the outcomes of these procedures.

Of the 73 reported cases of osteochondral repair as a primary treatment, 7 were allograft (9.6%), 63 were autograft (86.3%), and the remaining 3 were defined as 'other' (4.1%). The number of plugs used for the osteochondral autograft procedures is given in Table 20.

Table 20: Number of plugs used for osteochondral autograft procedures.

Number of Plugs	Number of Patients	% Patients
1	4	5.5
2	5	6.8
3	12	16.4
4	7	9.6
5	14	19.2
6	16	21.9
7	3	4.1
8	2	2.7
Unknown	10	13.7

The use of five or six plugs was most commonly reported. The diameter of the plugs ranged from 4.5-10mm. 6mm diameter plugs were the most common (Figure 26).

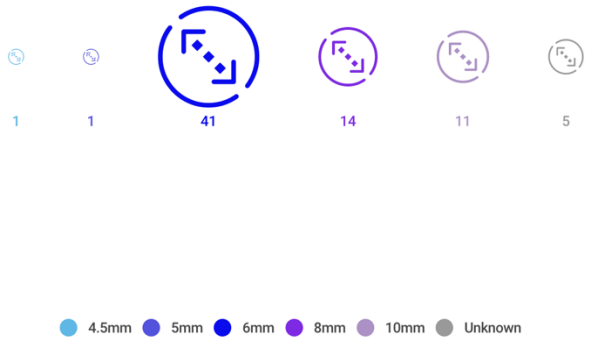

Figure 26: Varying diameters of osteochondral autograft plugs reported in the Registry.

While osteochondral allograft repair was only assigned to 7 patient pathways in the Registry as a primary treatment, 508 patients were known to have had a plug implanted during an allograft procedure, and an additional 278 patients were implanted with a shell graft. This data suggests that many more patients enrolled in the Registry underwent osteochondral allograft repair than the initial data suggests. This may be because the treatment type had not been identified appropriately for all patients by the users. It also reflects that many of our retrospective data imports were kindly donated by users of osteochondral allografts, and until we reach a steady state of prospective data input, this data should be viewed cautiously. We will then be able to comment further on the prevalence of various treatments.

Data on the diameter of allograft plugs were available for all 508 patients implanted with an allograft plug. The most common diameter plug was 20mm, and 6mm was the most common reported depth. However, the average dimensions across all entries were 22.3±4.1mm in diameter and 6.3±2.2mm deep (Table 21). The average total area covered was 5.1±1.8cm^2.

Table 21: The dimensions of the osteochondral allograft plugs reported in the Registry.

Diameter		Depth		Total Area	
mm	N	mm	N	mm	N
0.0-5.9	2	0.0-5.9	93	0.0-5.9	327
6.0-10.9	0	6.0-10.9	376	6.0-10.9	171
11.0-15.9	26	11.0-15.9	20	11.0-15.9	3
16.0-20.9	196	16.0-20.9	1	16.0-20.9	0
21.0-25.9	217	21.0-25.9	0	21.0-25.9	0
26.0-30.9	64	26.0-30.9	0	26.0-30.9	0
31.0-35.9	1	31.0-35.9	0	31.0-35.9	0
36.0-40.9	2	36.0-40.9	0	36.0-40.9	0
Unknown	0	Unknown	18	Unknown	7

There was no data available for the diameter of the shells. However, the average depth was 7.4±5.9mm, and the average area was 9.0±5.8cm^2. As expected, the shells tended to be larger than the plugs (Table 22; Figure 27).

Table 22: The dimensions of the osteochondral allograft shells reported in the Registry.

Depth		Total Area	
mm	N	mm	N
0.0-5.9	64	0.0-5.9	80
6.0-10.9	102	6.0-10.9	55
11.0-15.9	65	11.0-15.9	55
16.0-20.9	12	16.0-20.9	4
21.0-25.9	6	21.0-25.9	1
26.0-30.9	2	26.0-30.9	0
31.0-35.9	0	31.0-35.9	0
36.0-40.9	0	36.0-40.9	0
41.0>	1	41.0>	1
Unknown	26	Unknown	82

The allograft fixation used varied, but pins were generally more common for both plugs and shells (Figure 27).

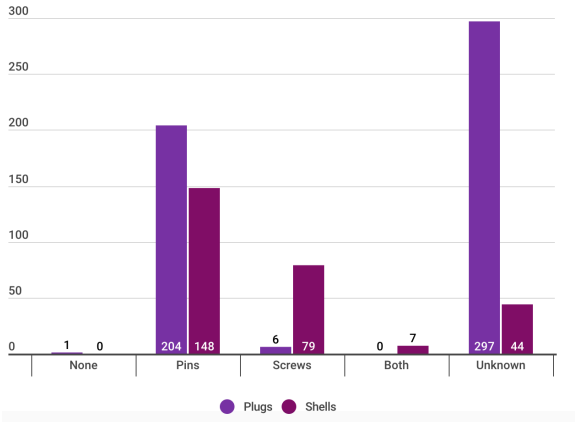

Figure 27: Allograft fixation used with the plugs and shells for the primary treatment.

Where additional bone grafts were necessary, autografts appeared to be more common than allografts for the patients who had undergone both plug and shell allografts (Figure 28).

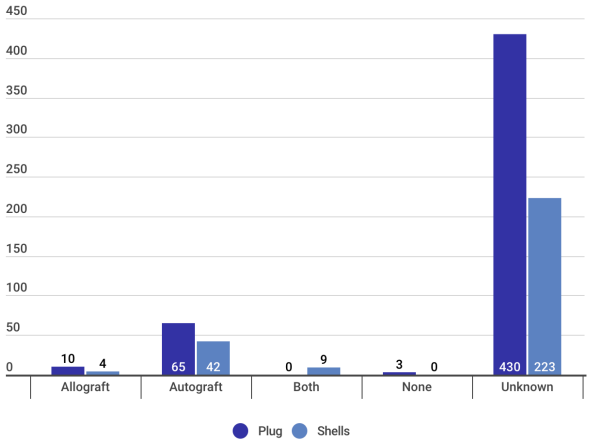

Figure 28: Number of patients reported to require additional bone grafts at the time of primary treatment.

Table 23: Number of locations treated by anatomical site as a secondary treatment.

	Lateral Condyle		Lateral Plateau		Medial Condyle		Medial Plateau		Patella		Trochlea	
	N	%	N	%	N	%	N	%	N	%	N	%
Number of Patients	42	12.7	23	6.9	134	40.4	13	3.9	57	17.2	63	19.0

5.2 Secondary Treatment Site for Defects

As has previously been established, some patients had numerous defects in different areas of their knee that required treatment. A secondary treatment site was reported for 332 patients in the Registry. As with the primary treatment location, the most common secondary location for treatment was the medial condyle (Table 23).

Most patients underwent osteochondral allograft repair (303, 91.2%). 214 patients were implanted with a plug graft (70.6%), while the remaining 89 had a shell graft (29.4%). The plugs had a mean diameter of 15.6±4.1mm and a depth of 6.3±2.1mm. The average area was 3.7±1.5cm^2. Therefore, the secondary treatment site was generally smaller in size than the primary site.

The shells had a mean depth of 7.9±4.8mm and an average area of 9.2±5.7cm^2; similar to the primary treatment site.

Pins were most used to fix both plugs and shells (Figure 29). Very little information was available for additional bone grafts. However, autografts appeared to be more common when reported (Figure 30).

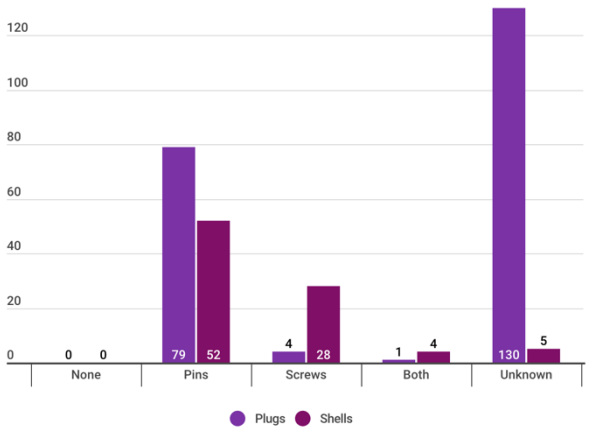

Figure 29: Allograft fixation used with the plugs and shells for the secondary treatment.

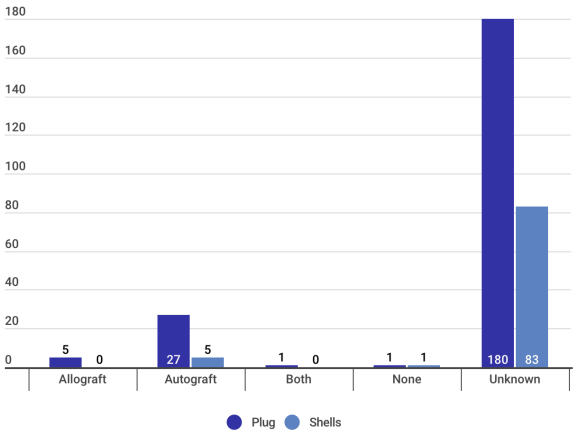

Figure 30: Number of patients reported to require additional bone grafts at time of secondary treatment.

5.3 Total Area of Graft

The combined total area grafted across all treated locations was reported for 784 patients (83.1% of all surgical pathways). On average, the graft area was 9.2±7.1cm^2.

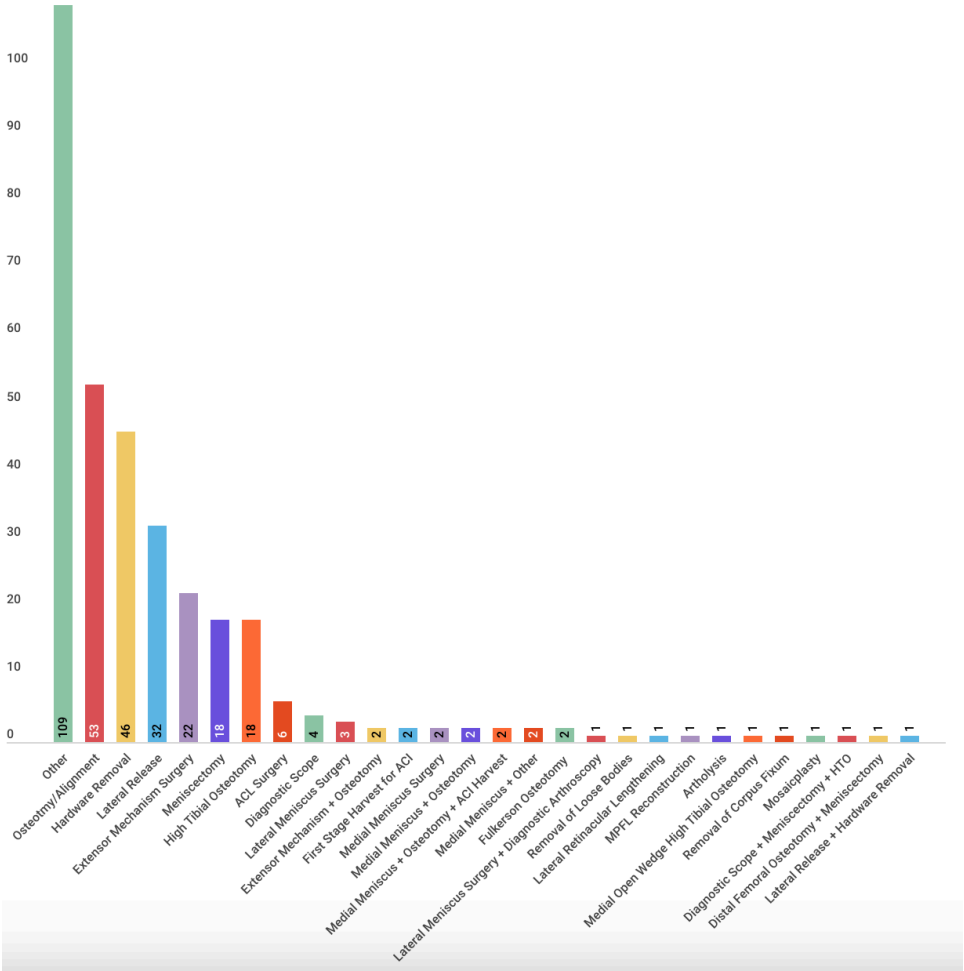

Figure 31: Additional procedures carried out on Registry patients

5.4 Other Procedures

Additional procedures were reported for 336 pathways (18.5% of all pathways). Unfortunately, little information was available for most pathways as one third were labelled as 'other' in the Registry (Figure 31). This is presumably because the procedure was not listed as an option in the database (in the cases of BMAC injections and quadricepsplasty), and the users did not use the text box to elaborate further. Of the available answers, osteotomies were the most common additional procedure (Figure 31). Additional procedures that were performed in combination with other procedures were less common. This is likely due to the personalised nature of these complex procedures.

Twenty-five patients were found to have undergone an additional extensor mechanism surgery. One was performed by tibial tubercle distalisation (4.0%), one was by patellar facetectomy (4.0%), two were by retinacular release (8.0%), and the remaining 21 were by tibial tubercle transfer (84.0%).

Additional information regarding medial meniscal surgery was available for 28 patients. This exceeded the number of pathways assigned to medial meniscal surgery, suggesting that some users preferred to use the text box to describe the surgery performed rather than choose the option in the portal. Two cases were reported to be meniscal repairs (7.1%), two were meniscectomies (7.1%), and the remaining cases were allograft transplants (85.8%).

There was no further information on any of the other additional procedures.

5.5 Intra-Operative Complications

Data on intra-operative complications were reported for 162 procedures (18.7% of all surgical procedures). Only one complication was reported (0.6%), but further details about the complication were not available. This is a common feature of registry data.

6. Knee Injections

Knee injections were commonly reported in the Registry. 631 patients underwent an injection of some kind (34.7% of all pathways). When compared to the patient cohort that underwent surgery, it was clear that the patients who had an injection were older. While weight, height and BMI also appeared similar, very little data was available for patients who had an injection (Table 24). This may be because these data are less routinely collected before an injection. Thus, clinicians using the Registry should encourage their patients to enrol themselves (rather than being enrolled by the clinician) so that this information can be captured more frequently.

Table 24: Demographics of patients who underwent an injection.

	Average	SD	Data Available (n)	Data Available (%)
Age (years)	64.9	14.2	630	99.8
Height (m)	1.81	12.6	9	1.4
Weight (kg)	79.8	18.2	9	1.4
BMI (kg/m^2)	24.1	3.4	9	1.4
Side (L/R)	260L 296R	-	556	88.1
Sex (M/F)	224M 403R	-	627	99.4

When the demographics of males and females were separated, it was found that females were generally ten years older than males at the time of injection. Females were also shorter and weighed less (Table 25).

Table 25: Comparison of male and female demographics for patients who had an injection.

	Average		SD	
	Males	Females	Males	Females
Age (years)	58.6	68.3	16.3	12.0
Height (m)	1.83	1.62	11.2	-
Weight (kg)	81.0	69.9	19.1	-
BMI (kg/m^2)	23.8	26.4	3.5	-

Compared to the kinds of injections patients in the Registry had previously had prior to their enrolment, the Registry data shows how trends have changed. Where hyaluronic acid was previously the most common injection (Figure 8), most patients now underwent a stem cell injection when enrolled in the Registry (Figure 32). All stem cell injections were reported to be adipose-based. Please note that the terminology for stem cell injections has now changed, but the terms used in the Registry are yet to be updated to reflect this. The second most common injection was PRP. This was also the second-most common injection patients had received prior to their enrolment in the Registry (Figure 8; Figure 32). This is likely to be a reporting bias rather than a reflection of the general population treatment distribution.

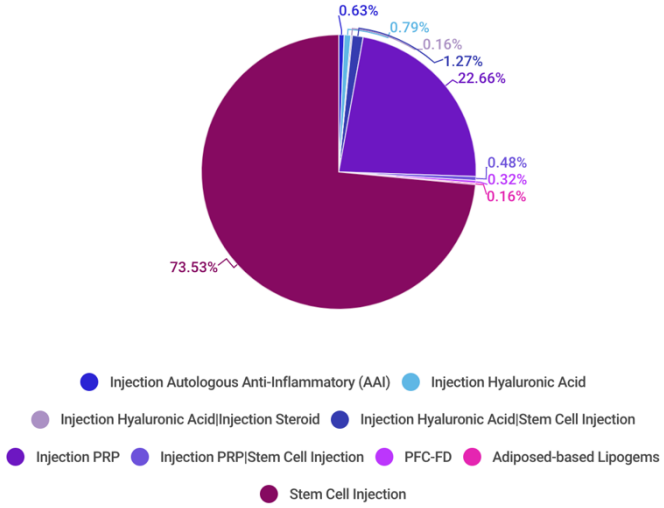

Figure 32: The types of knee injections received by Registry patients for their cartilage injuries.

7. Post-Treatment Recommendations

7.1. Treatments Following Surgery

Additional information for the post-operative treatment prescribed by clinicians was available for 122 patients (14.1% of all patients who underwent surgery).

7.1.1 Bracing

Three-quarters of patients were not prescribed a brace post-operatively (76.2%; Figure 33). The remaining twenty-nine patients (23.8%) were prescribed a brace after their operation. The double-upright double-hinge was most used.

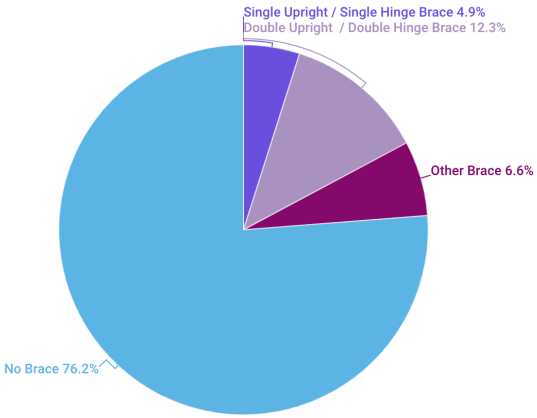

Figure 33: post-operative brace usage.

7.1.2 Weightbearing

21 patients were allowed to fully weight-bear after their operation (17.2%). Most patients were asked to partially weight-bear (n = 89; 73.0%). Of those partially weightbearing, most were advised to do so as tolerated (Table 26). On average, patients were asked to partially weight-bear for 4.1±2.0 weeks. The duration of weightbearing depended on the prescribed type of weightbearing (Table 27).

The remaining 12 patients were not allowed to weight-bear (9.8%). The average duration of non-weight-bearing was 5.6±2.6 weeks, with a minimum duration of 2 weeks and a maximum duration of 12 weeks.

Weightbearing instructions will vary depending on the treated area and the technique employed, so it is not surprising to see the wide variations in reported protocols.

Table 26: Type of partial weight-bearing recommended following surgery.

Type	Number of Patients	Percentage of Patients (%)	Average Duration (weeks)
25%	2	2.2	4.0±2.8
50%	2	2.2	4.0±0.0
75%	1	1.1	3.0±0.0
As Tolerated	61	68.5	3.1±2.5
Toe Touch	22	24.7	6.9±3.0
Unknown	1	1.1	N/A

7.1.3 Physiotherapy

Most patients underwent physiotherapy, but the treatment was generally delayed following surgery by 2.6±1.8 weeks, with a minimum delay of 2 weeks and a maximum delay of 12 weeks. One-hundred-and-one (82.8%) patients underwent closed-chain physiotherapy at an average duration of 7.0±2.7 weeks. Open-chain physiotherapy was prescribed for 17 patients (13.9%) at an average duration of 9.9±3.4 weeks.

Table 27: Type of physiotherapy recommended following surgery.

Physiotherapy	Number	Percentage (%)
Delayed	80	65.6
Immediate	39	32.0
None	2	1.6
Unknown	1	0.8

7.2. Treatments Following Injections

Further data for 189 patients who underwent an injection to the knee was available in the Registry (29.9% of all patients who had an injection).

7.2.1 Bracing

Two patients required a brace following their injection (1.1%). The majority required no brace, however (n = 187, 98.9%).

7.2.2 Weightbearing

Most patients were allowed to weight-bear after their injection (97.3%). One patient was advised to non-weight-bear for 4 weeks, while it was unknown whether the remaining 5 patients could weight-bear after their injection.

7.2.3 Physiotherapy

The majority of patients were not prescribed physiotherapy after their injection (Table 28). Those who required physiotherapy after a delay were recommended to wait an average 1.7±1.2 weeks after their injection (minimum delay of 1 week and a maximum delay of 4 weeks).

Five (31.2%) patients underwent closed-chain physiotherapy at an average duration of 3.6±2.2 weeks. Open-chain physiotherapy was prescribed for 4 patients (25.0%) at an average duration of 3.8±2.6 weeks. Six patients (37.5%) underwent a combination of closed-chain and open-chain physiotherapy for 3.7±4.5 weeks.

As the timing and type of physiotherapy prescribed is dependent on the type of treatment received, it should be noted that the data presented here may not be generalisable to all patients.

Table 28: Type of physiotherapy recommended following a knee injection.

Physiotherapy	Number	Percentage (%)
Delayed	6	3.2
Immediate	10	5.3
None	168	88.9
Unknown	5	2.6

7.3. Treatments Following Both Interventions

324 patients underwent an injection as well as a surgical intervention. Further information on the follow-on treatment recommended by the clinician was available for 15 of these patients (4.6%).

7.3.1 Bracing

Patients were split evenly into those requiring a brace and those not requiring a brace (Figure *34* 34). Generally, patients who required a brace were given a double-upright double hinge brace to use

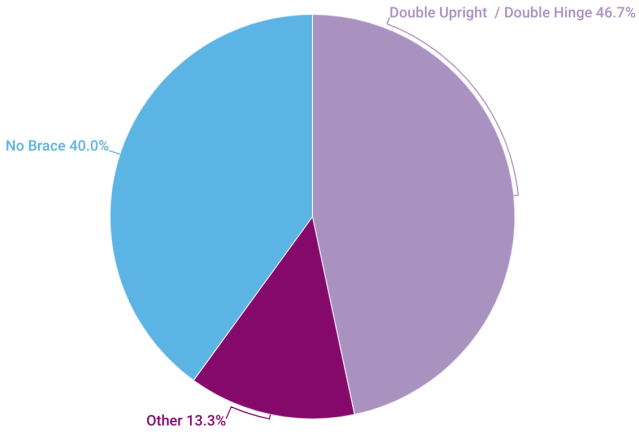

Figure 34: Brace usage in patients who underwent a surgical procedure and an injection.

7.2.2 Weightbearing

A quarter of patients were allowed to fully weight-bear after their treatments (26.7%). Half were asked to partially weight-bear (n = 7; 46.7%). Partial weight-bearing as tolerated was prescribed for 4 patients. The remaining 3 patients were advised to only

toe touch. On average, patients were asked to partially weight-bear for 4.0±2.0 weeks. The remaining 4 patients were not allowed to weight-bear (26.7%) for 6 weeks.

7.3.3 Physiotherapy

Physiotherapy was generally prescribed in patients who had undergone surgery and an injection to their knee (Table 29).

Those who required physiotherapy after a delay were recommended to wait an average 2.2±0.4 weeks after their treatment (minimum delay of 2 weeks and a maximum delay of 3 weeks). 10 (76.9%) patients underwent closed-chain physiotherapy at an average duration of 7.0±2.7 weeks. Open-chain physiotherapy was prescribed for 3 patients (23.1%) at an average duration of 10.0±3.5 weeks.

Table 29: Type of physiotherapy recommended following a knee injection and surgery.

Physiotherapy	Number	Percentage (%)
Delayed	6	40.0
Immediate	7	46.7
None	2	13.3

8. Patient-Reported Outcomes

Patients can complete a series of patient-reported outcome measures for the Registry. The routine questionnaires include the Knee Osteoarthritis Outcome Score (KOOS), Euroqol 5-Dimensional score (E5-5D), and a record of complications. The Kujala Anterior Knee Pain Score is also included for patients with patella injuries. Outcome measures are administered at baseline, 6-weeks, and 6-months post-intervention, then annually thereafter for up to 10 years depending on the intervention.

Clinicians may also request their patient to complete additional questionnaires, including the International Knee Documentation Committee Subjective Knee Form (IKDC), the Lysholm Knee Scoring Scale, the Tegner Activity Scale, or Visual Analogue Score (VAS) for pain.

8.1 Knee Osteoarthritis Outcome Score

The Knee Injury and Osteoarthritis Outcome Scale (KOOS) is patient-reported outcome measure evaluating the patients' perception of their knee function. The KOOS is scored out of 100 and is comprised of 5 sub-scales: Pain, Symptoms, Activities of Daily Living, Sports and Recreation, and Quality of Life. A higher score denotes a better outcome.

The KOOS Pain data currently available in the Registry is shown in Figure 35. Pain scores generally improve following the intervention.

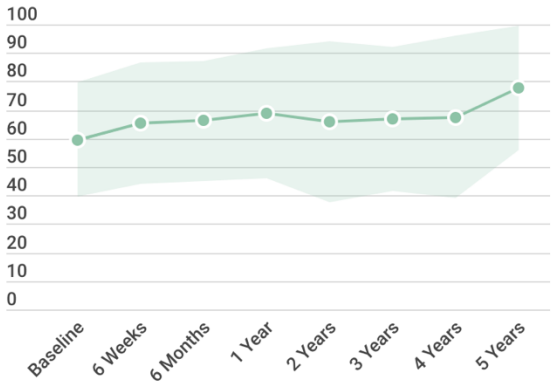

Figure 35: KOOS Pain scores for patients enrolled in the Registry.

KOOS Symptom and Activities of Daily Living scores were also shown to improve following the intervention, particularly during the first 12 months (Figure 35 & Figure 36).

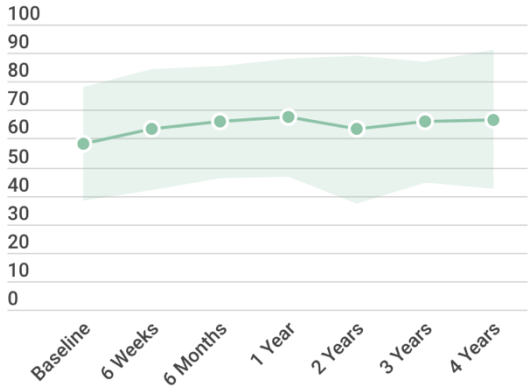

Figure 35: KOOS Symptom scores for patients enrolled in the Registry.

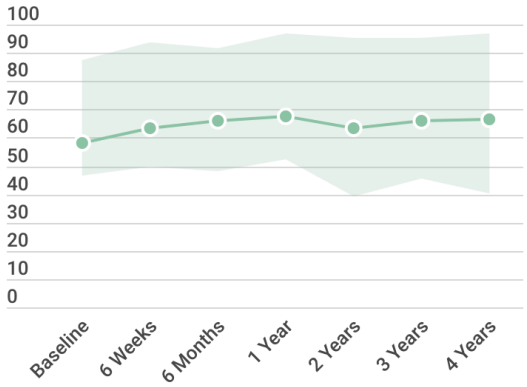

Figure 36: KOOS Activities of Daily Living scores for patients enrolled in the Registry.

KOOS Sport and Quality of Life scores were significantly improved following intervention, both short-term and mid-term (Figure 37 & Figure 38).

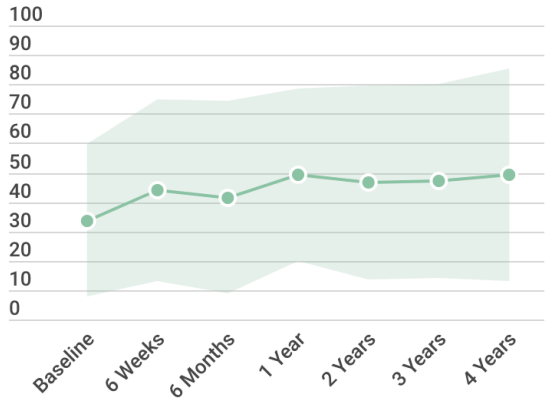

Figure 37: KOOS Sport scores for patients enrolled in the Registry.

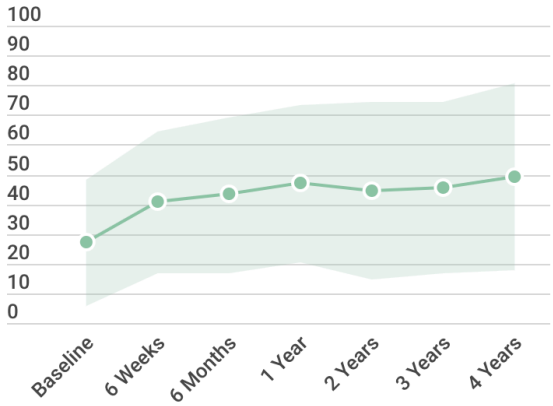

Figure 38: KOOS Quality of Life scores for patients enrolled in the Registry.

The change in total KOOS score over time is shown in Figure 39.

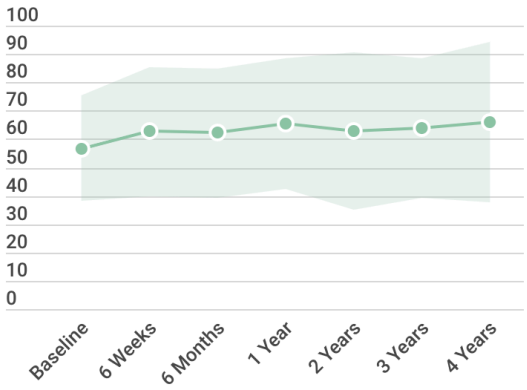

Figure 39: KOOS Total scores for patients enrolled in the Registry.

Generally, participants appeared to score worst at baseline in the KOOS Sport and Quality of Life. This suggested that patients undergoing treatment for a cartilage injury were relatively satisfied with their ability to undertake activities of daily living before their treatment, but that more demanding activities were impacting their quality of life. Of all KOOS scores, both the Sport and Quality of Life scores improved the most after the intervention.

Overall, patients appear to achieve a clinically important improvement in KOOS by 1 year post-intervention. According to KOOS, the minimum clinically important change is 8-10 points.

8.2 EQ-5D

The EQ-5D is an overall health quality of life scale. The scale was developed by the EuroQol Group and has 5 sub-scales as well as an overall index. The five subscales are mobility, self- care, usual activities, pain/discomfort, and anxiety/depression. The instrument has a license fee associated with it depending on the user's implementation. However, users of the ICRS patient registry can collect the EQ-5D at no cost; we are most grateful to the EuroQol Group for allowing us to do so.

The visual analogue scale component of the EQ-5D asks patients to score their overall health on the day they answer the questionnaire, with 0 being equivalent to the worst health they can imagine and 100 being equivalent to the best health they can imagine. Patients in the Registry improved their scores over time following their intervention (Figure 40).

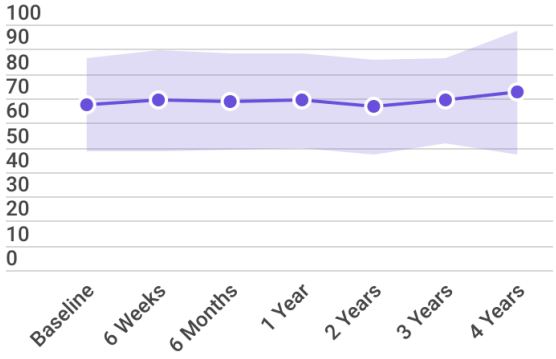

Figure 40: EQ-5D VAS scores for patients enrolled in the Registry.

The other component of the EQ-5D score is the 5L component, which includes the five subscales described previously. A score of 1.0 denotes better health. Figure 41 shows how this score improved post-operatively for the initial 2 years before declining slightly thereafter.

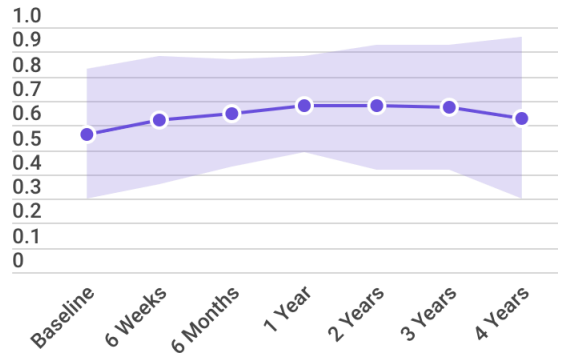

Figure 41: EQ-5D 5L scores for patients enrolled in the Registry.

Generally, the data from the EQ-5D questions suggest that patients' perceptions of their general health improved following treatment.

8.3 Kujala Anterior Knee Pain Scale

The Kujala Anterior Knee Pain Scale is a patient-reported outcome instrument to measure function and symptoms associated with in patients with patellofemoral disorders. The outcome is out of 100 and has 13 questions. Higher scores are indicative of better outcomes. The questions assess the patients' overall pain and swelling as well as the patient's ability to walk, run, climb stairs, and squat.

Figure 42 shows a gradual increase in the Kujala score over time, suggesting that anterior knee pain improved following treatment.

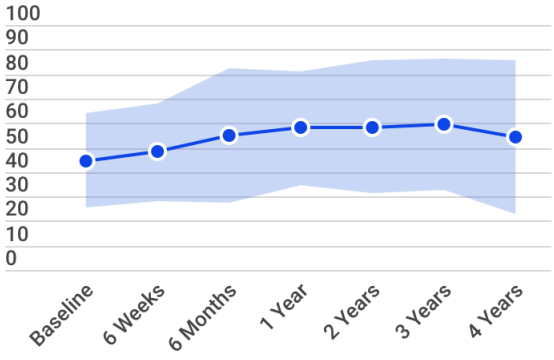

Figure 42: Kujala scores for patients enrolled in the Registry.

8.4 Additional Patient-Reported Outcome Measures

Some patients in the Registry were also asked to complete additional questionnaires including the VAS, Lysholm and Tegner scores. Very little data is currently available for the latter two questionnaires. However, the VAS was completed by 215 patients at baseline. The VAS is a Likert scale that spans between 0 (No pain) and 10 (worst pain imaginable).

Pain scores improved during the initial 12 months and increased slightly at 2 years, but not to the same level as pre-treatment (Figure 43). This was consistent with the trend observed in the KOOS Pain scores.

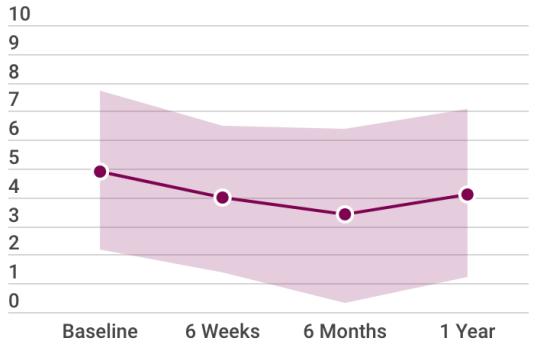

Figure 43: VAS Pain scores for patients enrolled in the Registry.

The data across all patient-reported outcome measures suggest that patients perceived their symptoms and general health to improve following surgery, particularly during the initial 12 months. While some scores appear to worsen after 12 months, it cannot yet be determined whether this accurately represents the overall trend, as the number of patients who have completed the questionnaires at 2 years or beyond are fewer.

9. Post-Intervention Complications

9.1 Patient-Reported Complications

Patients reporting the absence of complications to registries are commonly seen as reliable, but it can be difficult for patients to attribute complications they perceive after treatment correctly. Despite there being 1,819 patient pathways in the Registry, only 88 patients returned data on their complication status following treatment. Most of these patients had no complications to report (Figure 44). However, two-fifths of patients reported some complications. Problems which began within 6 weeks of the treatment were most common. Ongoing pain was the most common (40.0%, Figure 45). Although, pain at 6 weeks may not always be indicative of a complication.

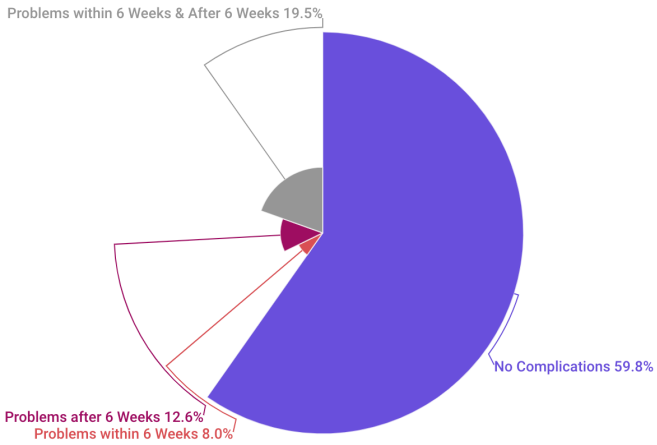

Figure 44: Number of patients reporting complications following treatment.

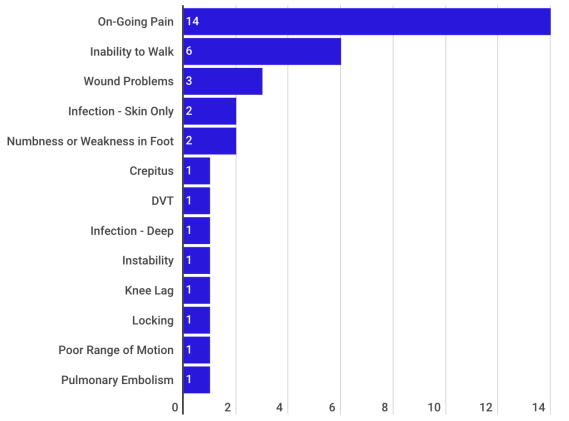

Figure 45: Post-treatment complications as reported by patients.

Twenty patients confirmed whether treatment was required for their complications. Six (30.0%) stated no further treatment was required, whereas 14 (70.0%) disclosed that additional treatment was necessary. Extended physiotherapy (70.0%) and additional painkillers (30.0%) were the most common. However, one-quarter of patients who reported needing further treatment required surgery (Figure 46). It is not clear however, whether these additional procedures were expected, as we do not know whether their initial procedure was a bridging procedure.

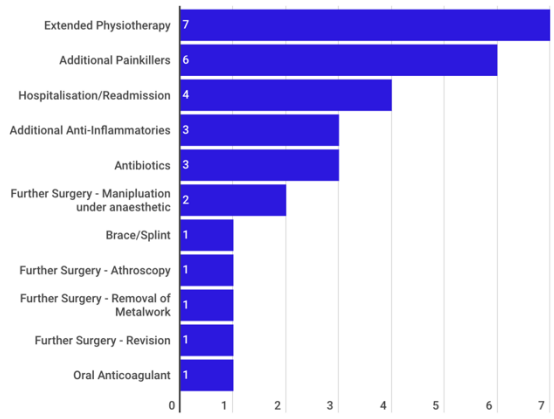

Figure 46: Additional treatment(s) required by patients with complications.

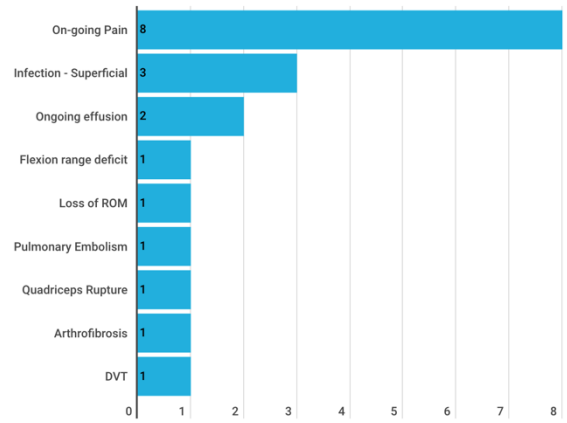

Figure 48: Post-treatment complications as reported by clinicians.

9.2 Clinician-Reported Complications

Fewer clinicians had reported complications for patients; 43 were reported in the Registry (2.4%). Like the data reported by patients, most had no complications (Figure 47). However, half of the entries disclosed a complication. Converse to the data reported by patients, problems that began after 6 weeks of the treatment was most common. Ongoing pain was the most common problem (42.1%, Figure 48). Interestingly, patients are reporting pain as a complication up to 6 weeks following treatment, yet surgeons are reporting it as a complication after 6 weeks. This highlights the potential opportunity for improving patient comprehension during shared clinical decision making to improve patient understand of typical pain duration after surgery.

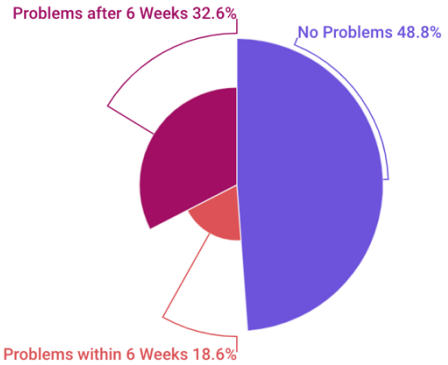

Figure 47: Number of clinicians reporting complications following treatment.

Additional treatment was reported for 12 patients (54.5% of patients with complications). Additional antibiotics (33.3%) and physiotherapy (25.0%) were the most common. However, over half of the treatments were surgical (58.3%; Figure 49).

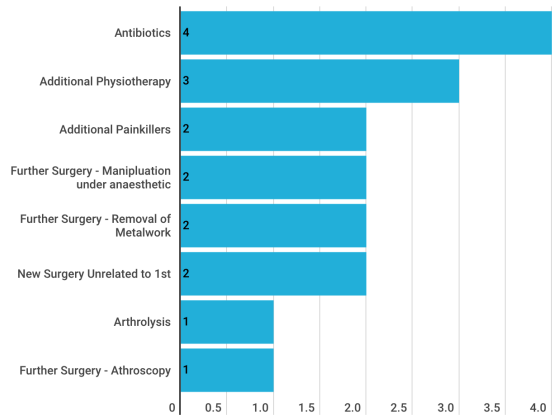

Figure 49: Additional treatment(s) required by patients with complications.

While the information provided is valuable, it is impossible to determine how common complications are following cartilage repair treatments, due to the size of the dataset. We would ask that Users of the Registry therefore keep their patients' records up-to-date to enable further analyses of the data in the future. This includes reporting when no complications have occurred.

10. Summary

The ICRS Patient Registry is a growing database of valuable information that will help us better understand the success and failures of new and current treatments for articular cartilage defects.

The data presented in this annual review suggests that males undergo treatment earlier than females. The reason for this remains unknown. In general, patients enrolled in the Registry are also likely to have undergone previous treatment for their injury at an earlier date. This is particularly the case for those undergoing surgical intervention. The most common reasons for requiring treatment are the treatment of lesions caused by osteochondritis dissecans or chondral damage. Pre-treatment assessments on patients clearly show that these diagnoses significantly impact quality of life, so treating the defects effectively is paramount.

The patella appeared to be the most common location for cartilage damage, with osteochondral repair and cell therapy cartilage reconstruction being the most common surgical approaches for treatment. Stem cells and platelet-rich plasma (PRP) were the most administered injections. In general, the population of patients undergoing injections were older than those undergoing surgery by approximately a decade.

The patient-reported outcome data suggest that patients generally perceive their health and symptoms to improve post-operatively; particularly during the first 12 months. More data on longer-term follow-ups are required to determine whether this is sustained. It should also be noted that not all patients are compliant at completing the questionnaires. Further data on patient compliance will be made available in our next Annual Report.

Patients reporting the absence of complications to registries are commonly seen as reliable, but it can be difficult for patients to attribute complications they perceive after treatment correctly. Complications after cartilage restoration procedures are, thankfully, uncommon. One of the strengths of “Big Data” sets that registries can deliver is that they allow us to capture uncommon events. Given how important it is to allow us to correctly counsel our patients pre-operatively on the risks that our patients may face by undergoing our interventions, further data on post-operative complications would be extremely useful, and we encourage our users to please complete the no complication/complication data set in the future.

When considering all data that is currently within Registry, it is suggested that joint preservation relies on a personalised treatment plan which not only combines surgical approaches, but later during the patient journey, also involves other non-surgical treatments such as injections. As our patients are followed-up longer-term, it will become increasingly interesting to observe how their treatment pathways develop. The data this Registry will produce in coming years will therefore serve as an important adjunct to the long-term randomised controlled clinical trials in joint preservation that are currently underway.

It is clear from this report that there remain many unanswered questions in the field of joint preservation. Therefore, the ICRS community must continue contributing to our Patient Registry. We recommend that clinicians and delegate users of the Registry encourage their patients to enrol. This will improve the amount of data we can capture in the Registry, and provide better opportunities for patient follow-up, without burdening the clinicians.

We are grateful to the ICRS Executive leadership for their ongoing support and encouragement and are indebted to those members of the ICRS and other users who have so generously entered their patient data to enable us to produce this report. We look forward to the dataset growing and the increasingly granular conclusions that we can draw from our combined efforts. None

of this would be possible without the generous financial support of our sponsors and the ICRS. Thank you to you all for your ongoing contribution to the Registry fulfilling its mission statement's aims and objectives.

Appendix A – Prior Treatments

Table A: Type of surgical procedures undergone by patients prior to enrolment in ICRS Patient Registry.

Procedure	Number of Patients	Percentage of Patients (%)
Debridement of Cartilage Defect	280	36.2
Subchondral Marrow Stimulation & Debridement of Cartilage Defect	164	21.2
No Cartilage Procedures	89	11.5
Subchondral Marrow Stimulation	41	5.3
Microfracture Alone	28	3.6
Mosaicplasty/OATS & Debridement of Cartilage Defect	28	3.6
Mosaicplasty/OATS & Subchondral Marrow Stimulation & Debridement of Cartilage Defect	19	2.5
ACI & Subchondral Marrow Stimulation & Cap/Implant & Debridement of Cartilage Defect	16	2.1
Mosaicplasty/OATS	14	1.8
Bone Graft & Debridement of Cartilage Defect	13	1.7
Other	11	1.4
ACI & Cap/Implant & Debridement of Cartilage Defect	10	1.3
Debridement of Cartilage Defect & Microfracture Alone	10	1.3
Subchondral Marrow Stimulation & Bone Graft & Debridement of Cartilage Defect	9	1.2
Debridement of Cartilage Defect & Subchondral Marrow Stimulation	7	0.9
Bone Graft	4	0.5
ACI	3	0.4
Microfracture Alone & Other	3	0.4
Mosaicplasty/OATS & Subchondral Marrow Stimulation & Bone Graft & Debridement of Cartilage Defect	3	0.4
ACI & Subchondral Marrow Stimulation & Cap/Implant & Debridement of Cartilage Defect	2	0.3
Debridement of Cartilage Defect & Mosaicplasty/OATS	2	0.3
Debridement of Cartilage Defect & Other	2	0.3
Scaffold Alone	2	0.3
Subchondral Marrow Stimulation & Cap/Implant & Cap/Implant & Debridement of Cartilage Defect	2	0.3
Augmented Microfracture & Other	1	0.1
Cap/Implant & Debridement of Cartilage Defect	1	0.1
Debridement of Cartilage Defect & Augmented Microfracture	1	0.1
Debridement of Cartilage Defect & Microfracture Alone & Other & Cap/Implant	1	0.1
Mosaicplasty/OATS & ACI & Subchondral Marrow Stimulation & Cap/Implant & Debridement of Cartilage Defect	1	0.1
Mosaicplasty/OATS & Bone Graft & Debridement of Cartilage Defect	1	0.1
Mosaicplasty/OATS & Cap/Implant	1	0.1
Mosaicplasty/OATS & Subchondral Marrow Stimulation	1	0.1
Mosaicplasty/OATS & Subchondral Marrow Stimulation & Bone Graft	1	0.1
Mosaicplasty/OATS & Subchondral Marrow Stimulation & Cap/Implant & Debridement of Cartilage Defect	1	0.1
Other & Cap/Implant	1	0.1
Subchondral Marrow Stimulation & Bone Graft	1	0.1

Table B: Details of non-cartilage procedures carried out on patients prior to their enrolment in the ICRS Patient Registry.

Procedure	Number of Patients	Percentage of Patients (%)
Loose Body Removal	135	25.1
No Other Knee Surgery	93	17.3
Extensor Mechanism Surgery	40	7.4
ORIF	37	6.9
Other	36	6.7
Osteotomy	23	4.3
Meniscal Surgery	22	4.1
ORIF & Hardware Removal	17	3.2
Other & Loose Body Removal	15	2.8
Ligament	9	1.7
Osteotomy & Extensor Mechanism Surgery	9	1.7
Loose Body Removal & ORIF	8	1.5
Patellofemoral Surgery	8	1.5
Hardware Removal	7	1.3
Other & Extensor Mechanism Surgery	7	1.3
Loose Body Removal & ORIF & Hardware Removal	6	1.1
Meniscal Surgery & Ligament Surgery	6	1.1
Osteotomy & Extensor Mechanism Surgery & Hardware Removal	6	1.1
Extensor Mechanism Surgery & Loose Body Removal	5	0.9
Meniscal Surgery & Other	5	0.9
Osteotomy & Hardware Removal	4	0.7
Other & Hardware Removal	4	0.7
Other & ORIF	4	0.7
Osteotomy & Loose Body Removal	3	0.6
Osteotomy & Other & Hardware Removal	3	0.6
Other & Loose Body Removal & ORIF	3	0.6
Other & ORIF & Hardware Removal	3	0.6
Ligament Surgery & Other	2	0.4
Osteotomy & ORIF	2	0.4
Other & Loose Body Removal & Hardware Removal	2	0.4
Extensor Mechanism Surgery & Hardware Removal	1	0.2
Extensor Mechanism Surgery & Loose Body Removal & ORIF	1	0.2
Extensor Mechanism Surgery & Loose Body Removal & ORIF & Hardware Removal	1	0.2
Extensor Mechanism Surgery & Patellofemoral Surgery	1	0.2
Ligament Surgery & Patellofemoral Surgery	1	0.2
Loose Body Removal & Hardware Removal	1	0.2
Meniscal Surgery & Ligament Surgery & Osteotomy	1	0.2
Osteotomy & Extensor Mechanism Surgery & Loose Body Removal	1	0.2
Osteotomy & Extensor Mechanism Surgery & ORIF	1	0.2

Osteotomy & Extensor Mechanism Surgery & ORIF & Hardware Removal	1	0.2
Osteotomy & Other	1	0.2
Osteotomy & Other & Extensor Mechanism Surgery	1	0.2
Osteotomy & Other & Extensor Mechanism Surgery & Loose Body Removal & Hardware Removal	1	0.2
Other & Extensor Mechanism Surgery& Hardware Removal	1	0.2

Table C: Breakdown of the meniscal procedures prior to Registry enrolment.

Meniscus	Number of Patients (% across all meniscal surgery)	Type of Surgery	Number of Patients (% within meniscal type)
Medial Meniscus	144 (55.0)	Partial Meniscectomy	98 (68.1)
		Total Meniscectomy	8 (5.6)
		Meniscectomy (Unknown)	18 (12.5)
		Repair	2 (1.4)
		Transplant	1 (0.7)
		Unknown Surgery	17 (11.8)
Lateral Meniscus	83 (31.7)	Partial Meniscectomy	51 (35.4)
		Total Meniscectomy	25 (17.4)
		Meniscectomy (Unknown)	0 (0.0)
		Repair	1 (0.7)
		Transplant	0 (0.0)
		Unknown Surgery	6 (4.2)
Medial and Lateral Menisci	35 (13.3)	Partial Meniscectomy Medial/Partial Meniscectomy Lateral	21 (60.0)
		Partial Meniscectomy Medial/Total Meniscectomy Lateral	2 (5.7)
		Unknown Meniscectomy Medial/Partial Lateral	1 (2.9)
		Total Meniscectomy Medial/Total Meniscectomy Lateral	3 (8.6)
		Total Meniscectomy Medial/Partial Meniscectomy Lateral	6 (17.1)
		Total Meniscectomy Medial/Unknown Meniscectomy Lateral	1 (2.9)
		Unknown Meniscectomy Medial/Unknown Meniscectomy Lateral	1 (2.9)

Appendix B – Data on Patients with 3 or 4 Locations of Cartilage Damage

Table D: The average area of cartilage damage reported in patients with three or more involved areas.

Type	Number of Locations Involved	Number of Patients	Average Area (mm^2)	SD
Lateral Plateau Medial Femoral Condyle Lateral Femoral Condyle	3	1	6.00	N/A
Medial Plateau Lateral Plateau Lateral Femoral Condyle	3	1	5.00	N/A
Medial Plateau Lateral Plateau Patella	3	3	21.75	24.50
Medial Plateau Patella Lateral Femoral Condyle	3	1	17.60	N/A
Medial Plateau Patella Medial Femoral Condyle	3	4	11.50	6.36
Trochlea Lateral Plateau Femoral Cartilage Damage	3	1	6.25	N/A
Trochlea Lateral Plateau Patella	3	3	8.72	5.88
Trochlea Medial Femoral Condyle Lateral Femoral Condyle	3	4	11.93	6.10
Trochlea Medial Plateau Lateral Plateau	3	1	27.00	N/A
Trochlea Medial Plateau Medial Femoral Condyle	3	5	15.67	13.28
Trochlea Medial Plateau Patella	3	3	9.00	1.73
Trochlea Patella Lateral Femoral Condyle	3	5	12.58	9.02
Trochlea Patella Medial Femoral Cartilage Damage	3	9	19.16	7.64
Medial Plateau Lateral Plateau Patella Lateral Femoral Condyle	4	1	17.00	N/A
Trochlea Lateral Plateau Patella Lateral Femoral Condyle	4	2	17.00	1.41
Trochlea Medial Plateau Lateral Plateau Patella	4	2	14.75	6.01
Trochlea Medial Plateau Patella Lateral Femoral Condyle	4	1	10.80	N/A
Trochlea Medial Plateau Patella Medial Femoral Condyle	4	1	N/A	N/A
Trochlea Patella Medial Femoral Condyle Lateral Femoral Condyle	4	2	78.00	N/A
Trochlea Medial Plateau Lateral Plateau Patella Medial Femoral Condyle Lateral Femoral Condyle	6	2	11.06	2.91

An additional treatment was reported at a third location of the knee for 78 patients (Table D). As with the primary and secondary procedures, the medial condyle was treated the most (Table E).

Table E: Number of locations treated by anatomical site as a third treatment.

	Lateral Condyle		Lateral Plateau		Medial Condyle		Medial Plateau		Patella		Trochlea	
	N	%	N	%	N	%	N	%	N	%	N	%
Number of Patients	6	7.7	4	5.1	24	30.8	6	7.7	15	19.2	23	29.5

Seventy-six of these patients were known to have undergone an osteochondral allograft repair (97.4%). Three-quarters of patients had a plug graft (76.3%), and the remaining quarter had a shell graft (23.7%).

The plugs had a mean diameter of 18.0±5.5mm and a depth of 7.1±2.7mm. The average area was 3.9±2.2cm^2. The shells had a mean depth of 8.4±2.7mm and an average area of 8.7±7.3cm^2.

The third treatment site therefore appeared slightly larger than the second treatment site. One reason for this is that patients requiring the treatment of multiple areas during one procedure may have defects that are larger on average than patients who require the treatment of one singular defect.

Pins were usually used to fix the plugs, but shells tended to be fixed by pins and screws to an equal degree (Figure A). As before, there was not much information on additional bone grafts. Autografts were more common, when reported (Figure B).

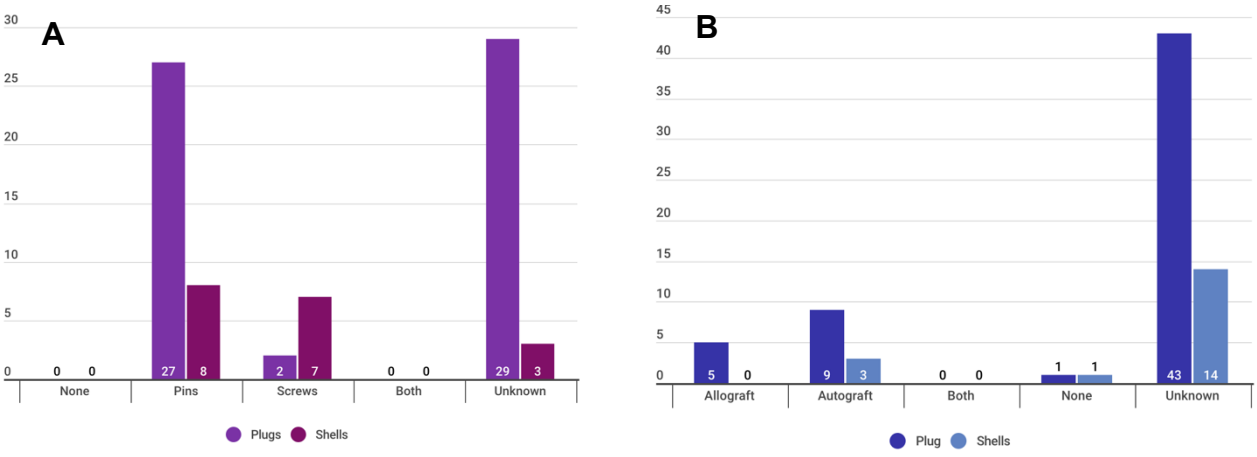

Figure A: Allograft fixation used with the plugs and shells for the third treatment; Figure B: Number of

Some patients underwent treatment at a fourth site during their surgical procedure. Detailed information was available for 22 patients, but the trochlea was the location most commonly reported (Table F)

Table F: Number of locations treated by anatomical site as a fourth treatment.

	Lateral Condyle		Lateral Plateau		Medial Condyle		Medial Plateau		Patella		Trochlea	
	N	%	N	%	N	%	N	%	N	%	N	%
Number of Patients	4	18.2	0	0.0	4	18.2	3	13.6	4	18.2	7	31.8

All patients underwent an osteochondral allograft repair. One-fifth had a shell graft (18.2%). The remaining patients had a plug graft (81.8%).

The plugs had a mean depth of 8.4±12.0mm and an average area of 2.9±1.2cm^2. Whereas the shells had a mean depth of 5.5±2.1mm and an average area of 4.7±4.2cm^2.

Data on fixation was available for 7 patients who underwent a plug graft (38.9%) and 3 of the shell graft patients (75.0%). All grafts reported were fixed by pins. One additional autograft was also reported.

Access to Registry Data for ICRS Members

If you would like to access some of the anonymised raw data held by the ICRS Registry to answer a research question, please submit your proposed title and hypothesis to the Registry Steering Committee via this online form by 30th June 2023: https://icrs.wufoo.com/forms/s1ld01ot1ingwa2/

The ICRS Patient Registry Steering Committee will assess the merits of all entries according to the FINER criteria (Feasibility, Interest, Novelty, Ethics, and Relevance) ahead of the 17th ICRS World Congress in September 2023. The first set of approved proposals will be announced at the meeting, and the anonymised data will be shared with the successful applicants shortly thereafter. It is expected that winning applicants will publish their findings in a peer-reviewed journal.

User Assistance

If you would like to become a user of the Registry, please visit the ICRS website: https://cartilage.org/sign-up-icrs-registry/

SCAN ME

To learn how to use the Registry, visit our tutorials: https://cartilage.org/society/icrs-patient-registry/tutorials/

SCAN ME

Patients can enrol themselves in the Registry if their clinician is registered on the following site: https://secure.amplitude-registry.com/ICRS/patient-portal?pce=true

SCAN ME

If you require assistance or have any questions about using the Registry, please contact us on registry@cartilage.org.

Acknowledgements

We thank the ICRS members and sponsors for their continuing support of the Registry.

Your feedback is important to the ongoing development of the Registry and subsequent annual reports. Please address feedback to us by email on registry@cartilage.org.

This document is accessible at the ICRS website: https://cartilage.org/society/icrs-patient-registry/

The information contained and presented within the ICRS Registry 2022 Annual Report is released solely for educational and scientific purposes. Any statements made within the report regarding products, devices, or treatments do not constitute a specific endorsement by the ICRS. This information and these statements are not to be used for any advertising or commercial marketing without first consulting with the ICRS Steering Committee. Furthermore, the information contained within the report should not act as a substitution for treatment consultation with a qualified medical professional.

Every effort was made to ensure that the information presented within this report was accurate at the time of publication. However, in the unlikely event of discrepancies, the ICRS is not liable for issues arising from such an event.

International Cartilage Regeneration & Joint Preservation Society Cartilage Executive Office (CEO) GmbH
Spitalstrasse 190 / House 3
CH-8623 Wetzikon, Zurich, Switzerland
Email: office@cartilage.org
Phone: +41 44 503 73 70
www.cartilage.org