# New Zealand ACL Registry
# Annual Report 2023

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Acknowledgements:
The New Zealand ACL Registry Trust would like to thank the Accident Compensation Corporation for its funding assistance. We also receive funding from our industry partners: DePuy, Arthrex and Smith & Nephew. We are also grateful for the participation of New Zealand Orthopaedic Surgeons for participating in the Registry, both through financial contributions and enrolling their patients.

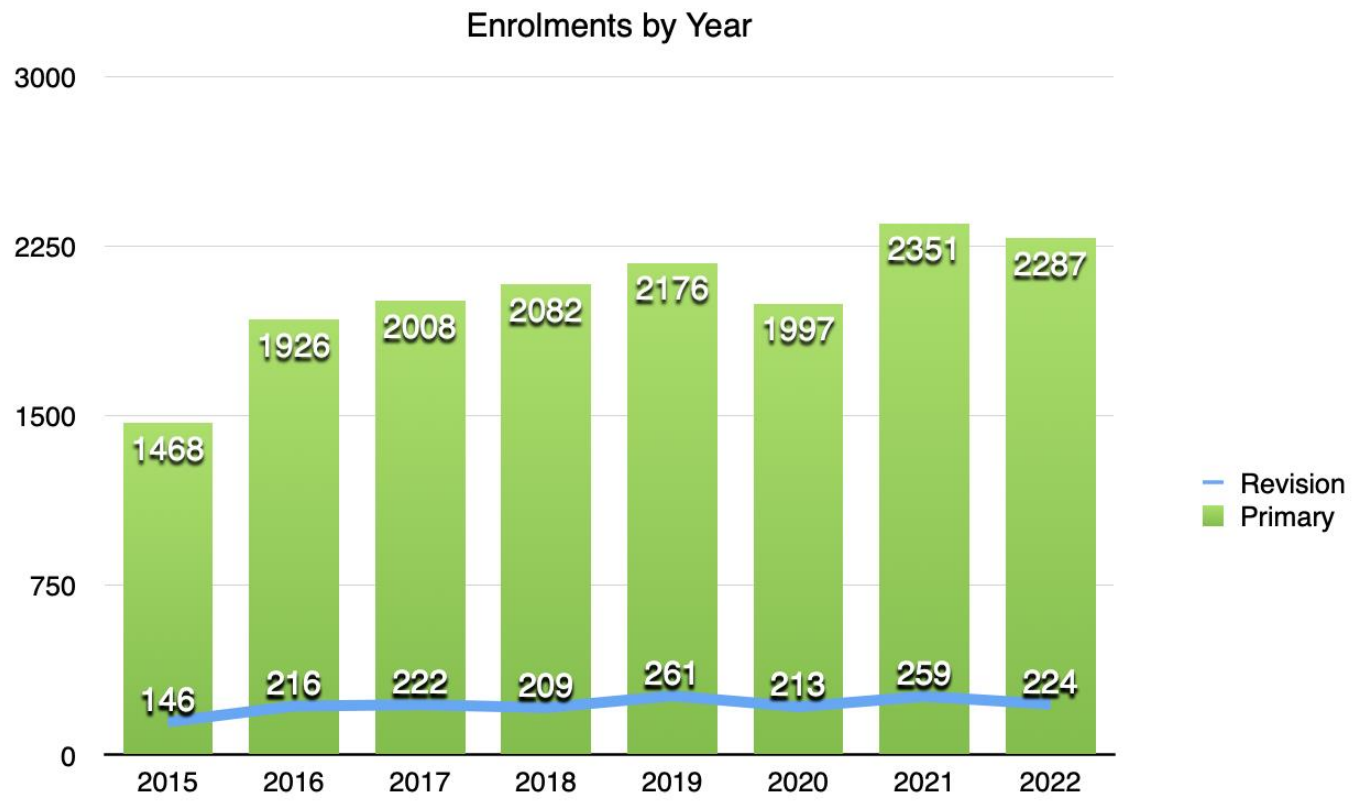
## ACL Registry Trust Structure:

The ACL Registry Trust has been registered as a charitable Trust under New Zealand law. The Trustees are Hamish Love, Orthopaedic Surgeon, Christchurch, Mark Clatworthy, Orthopaedic Surgeon, Auckland and David Barker, Accountant, Christchurch.
The Registry has a permanent database Administrator, Charlotte Smith and employs a part-time data entry assistant.

Introduction:

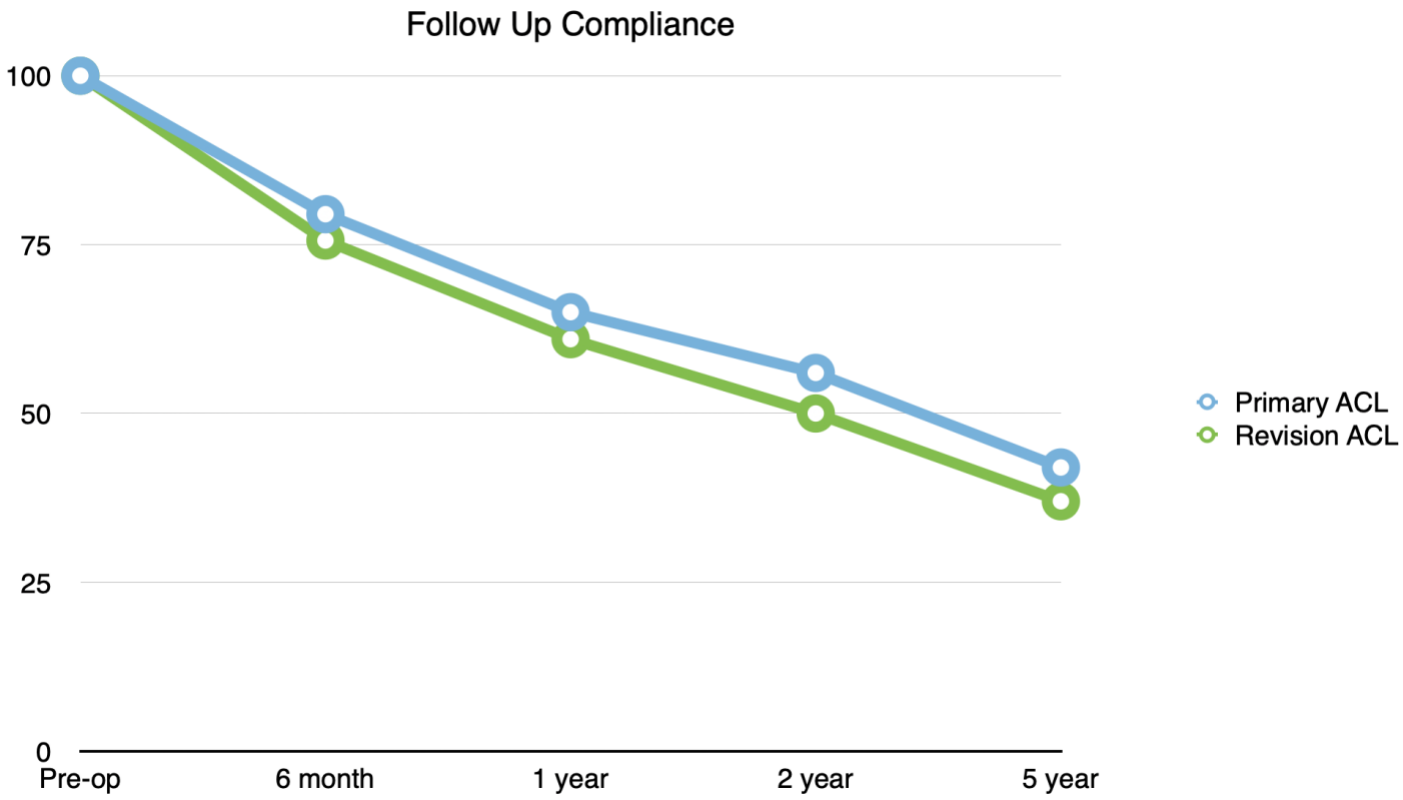
The New Zealand ACL Registry is now in its ninth year of operation. We are progressing towards our goal of capturing all ACL procedures done in New Zealand. The number of Surgeons and Hospitals involved in the Registry has been steadily growing over the last 12 months. In September 2015, there were 68 participating Surgeons, now this number is 134. In the 12 months to 9 August 2023, 2562 new patients were enrolled in the Registry. The numbers through the year continued to grow, and we estimate we enrolled around 82% of the 2757 ACL reconstructions performed in New Zealand last year. As at 9 August 2023, 19865 patients have been enrolled in the ACL Registry.

The ACL Registry has received Protected Quality Assurance Activity status from the Minister of Health. Participation in the ACL registry is a compulsory NZOA CME requirement, similar to Joint Registry participation.




Data set integrity:

The Registry continues to work hard on maintaining a complete date set. The majority of individuals requiring ACL reconstruction are young, mobile and often hard to keep a track of. As a consequence, the well-established Typically, registries only achieve a 50% follow up at the two-year mark, dropping off to less than 40% at the five-year mark. Currently we are achieving over 56% follow up at two years for our primary ACLs and 42% at five years, and better than that at all preceding time points. There are some issues with getting patients to complete all sections of all forms, resulting in some incomplete data sets. We are confident that patient reporting of significant complications is being completed accurately. In 2020 we completed a comprehensive audit of reoperation rates, cross-referencing with ACC data. There were a number of previously unrecorded reoperations captured through this process. This has increased the integrity of the data set in relation to capturing complications. This ACC cross-referencing will be an ongoing process to ensure we have the most complete data possible.




Future directions:
International collaboration:
The New Zealand ACL Registry Clinical Advisors remain in regular contact with other Registries around the world. They are working towards international collaboration on major research projects and developing structural arrangements to ensure compatibility between the data sets we collect.

Non-operative patient enrolment:
In conjuction with the College of Sports & Exercise Physicians, we have commenced enrolment in a non-operative arm. Patients with MRI-proven ACL rupture, who choose non-operative management of their ACL injury, will be eligble for enrolment.
Sports Physicians and Surgeons enrol patients into the registry. They are then followed up in a similar manner to operatively managed patients at 6 months, 1, 2 and 5 years. PROMs scores, failure of management requiring ACL reconstruction or other surgical intervention, eg meniscectomy, will be recorded.
Unfortunately, there has been very limited uptake by the Sports & Exercise Physicians and enrolment rates have been low.

Research Projects:
The New Zealand ACL Registry is pleased to be involved with providing data that leads to quality research in ACL injuries and their treatment. As at the beginning of August 2023, there were 17414 patients who have completed 6 months post-op, 16276 past 1 year post-op, 14135 past 2 years and 7417 at 5 years. The data set is now reaching numbers where meaningful research can be completed.
The publications , projects and presentations over the last 12 months include:

Published in The American Journal of Sports Medicine January 2023
Comparative Study of ACL Reconstructions with Hamstring vs Patellar Tendon Graft in Young women: A Cohort Study from the New Zealand ACL Registry

Published in the Knee Surgery, Sport Traumatology, Arthroscopy March 2023:
Quad Tendon Autograft is Comparable to Hamstring Tendon and Bone-Patella-Bone up to 2 Years After Isolated Primary Anterior Cruciate Ligament Reconstruction

Published in the Knee Surgery, Sport Traumatology, Arthroscopy May 2023:
Meniscal Repair Failure Following Concurrent Primary Anterior Cruciate Ligament Reconstruction: Results from the New Zealand ACL Registry

Published in The American Journal of Sports Medicine September 2023
Comparison of Knee Pain and Difficulty with Kneeling between Patellar Tendon and Hamstring Tendon Autografts Following Anterior Cruciate Ligament Reconstruction: A Study from the New Zealand ACL Registry

Upcoming submissions:

Risk Factors for Reoperation for Arthrofibrosis Following Primary Anterior Cruciate Ligament Reconstruction

Investigating the Association Between Timing of ACL Reconstruction and Patient Outcomes: A Study from the New Zealand ACL Registry

Validating the Capture Rate of Revisions by the New Zealand ACL Registry: An Analysis of All-Cause Reoperation following Primary ACL Reconstruction

Early Results of Combined ACL Reconstruction with a Lateral Extra-Articular Procedure from the New Zealand ACL Registry

Return to Sport and Patient Satisfaction after ACL Reconstruction

Presentations:

2023 International Society of Arthroscopy, Knee Surgery and Orthopaedic Sports Medicine (ISAKOS) Congress, Boston, Massachusetts, USA

1) Higher Return to Sport with Patellar Tendon Autograft Versus Hamstring Tendon Autograft Following Anterior Cruciate Ligament Reconstruction: Results from the New Zealand ACL Registry
**Richard Rahardja**, Hamish Love, Mark Clatworthy, Simon W. Young

2) Higher Risk of Medial Meniscal Repair Failure Following Concurrent Anterior Cruciate Ligament Reconstruction with a Hamstring Tendon Autograft: Results from the New Zealand ACL Registry
**Richard Rahardja**, Hamish Love, Mark Clatworthy, Simon W. Young

3) Risk Factors for Reoperation for Arthrofibrosis Following Anterior Cruciate Ligament Reconstruction: Results from the New Zealand ACL Registry
**Richard Rahardja**, Hamish Love, Mark Clatworthy, Simon W. Young

4) Patellar Tendon Autograft is Associated with Difficulty Kneeling but Does Not Result in a More Painful or Symptomatic Knee Compared to Hamstring Tendon Autograft after Anterior Cruciate Ligament Reconstruction: Results from the New Zealand ACL Registry
**Richard Rahardja**, Hamish Love, Mark Clatworthy, Simon W. Young

5) ACL Reconstruction With Hamstring Tendon is Associated with a Sixfold Increase in Failure Rates Compared With Patella Tendon Grafts in Young Females – A Cohort Study From The New Zealand ACL Registry
Anika Tiplady, **Hamish Love**

6) Risk Factors for Reoperation for Arthrofibrosis Following Anterior Cruciate Ligament Reconstruction: Results from the New Zealand ACL Registry
Simon W Young

7) Patient Reported Outcomes and Revision Rates After Primary Anterior Cruciate Ligament Reconstruction Without a Concomitant Knee Injury: A Comparison of Quadriceps, Hamstring and Bone-Patellar-Tendon-Bone Autografts with Minimum 2 Year Follow-Up.
Marc Hirner

8) New Zealand Registry
Hamish Love

2023 American Academy of Orthopaedic Surgeons (AAOS) Annual Meeting, Las Vegas, Nevada

1) Higher Return to Sport with Patellar Tendon Autograft Versus Hamstring Tendon Autograft Following Anterior Cruciate Ligament Reconstruction: Results from the New Zealand ACL Registry
**Richard Rahardja**, Hamish Love, Mark Clatworthy, Simon W. Young

2) Patellar Tendon Autograft is Associated with Difficulty Kneeling but Does Not Result in a More Painful or Symptomatic Knee Compared to Hamstring Tendon Autograft after Anterior Cruciate Ligament Reconstruction: Results from the New Zealand ACL Registry
**Richard Rahardja**, Hamish Love, Mark Clatworthy, Simon W. Young

3) Lower Risk of Revision with Suspensory Tibial Fixation Versus Interference Tibial Fixation of Hamstring Tendon Autografts in Anterior Cruciate Ligament Reconstruction: Results from the New Zealand ACL Registry
**Richard Rahardja**, Hamish Love, Mark Clatworthy, Simon W. Young

4) ACL Reconstruction With Hamstring Tendon is Associated with a Sixfold Increase in Failure Rates Compared With Patella Tendon Grafts in Young Females – A Cohort Study From The New Zealand ACL Registry
Anika Tiplady, **Hamish Love**

*Results:*

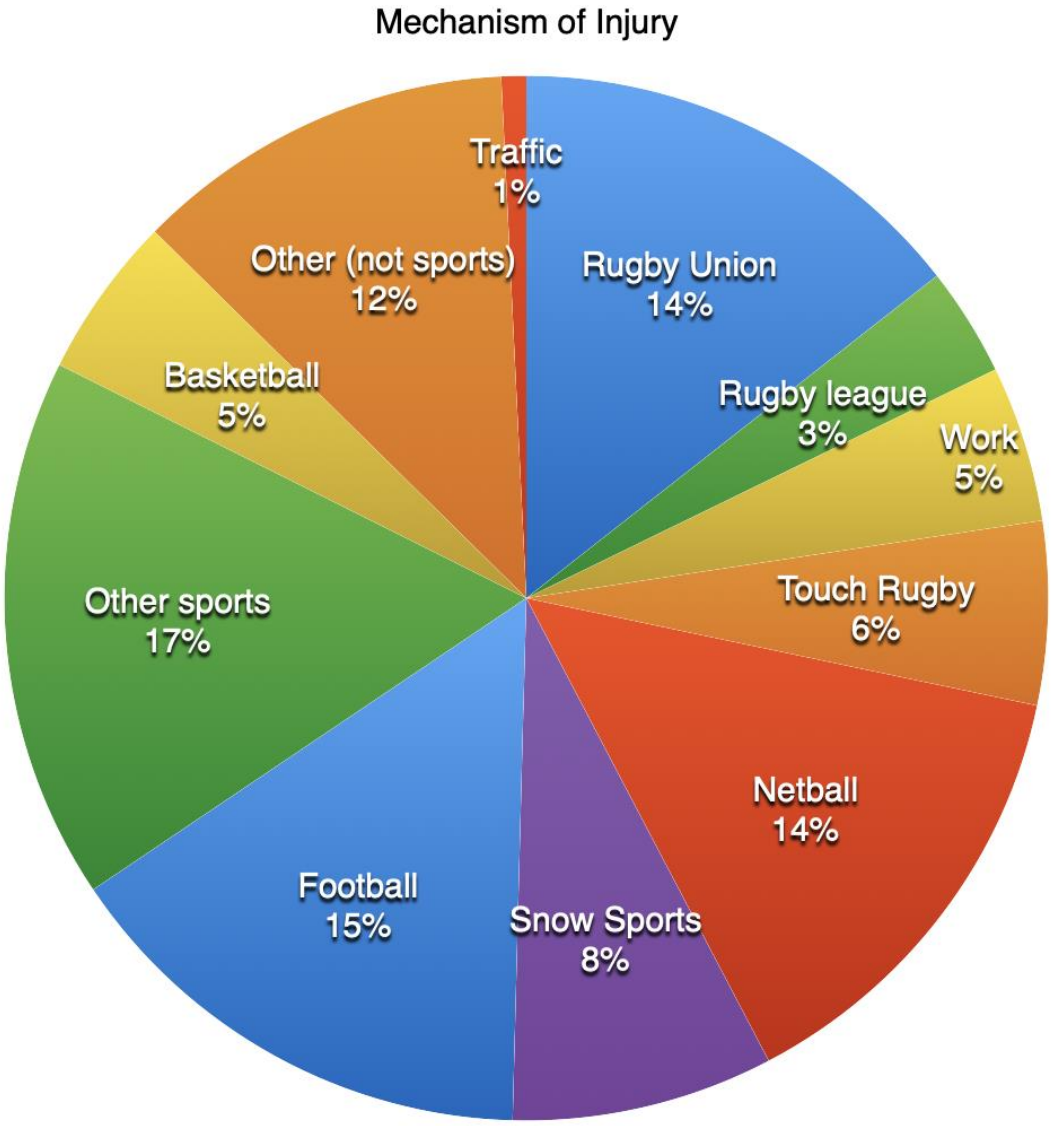
As of August 2023, 19881 patients had been enrolled in the ACL registry. 17950 primary and 1931 revision ACL reconstructions were recorded.

Operations by Hospital (all procedures cumulative)

| Hospital | Number | Percent |
|---|---|---|
| Auckland Surgical Centre | 2839 | 14.5 |
| Mercy/Ascot | 2831 | 14.5 |
| Forte | 1738 | 8.9 |
| SX, North Harbour | 1351 | 6.9 |
| SX Christchurch | 1037 | 5.3 |
| St Georges | 927 | 4.8 |
| SX, Hamilton | 766 | 4 |
| SX, Wellington | 669 | 3.5 |
| Grace | 604 | 3.1 |
| SX, N Shore Surg Centre | 539 | 2.8 |
| Wakefield | 509 | 2.6 |
| SX, New Plymouth | 492 | 2.4 |
| Manuka Street | 479 | 2.4 |
| SX, Invercargill | 456 | 2.3 |
| Braemar | 450 | 2.2 |
| Royston | 449 | 2.2 |
| Mercy Dunedin | 394 | 2 |
| Anglesea | 367 | 1.8 |
| Bidwill | 357 | 1.8 |
| Ormiston | 346 | 1.7 |
| Bowen Hospital | 341 | 1.7 |
| Northland Orthopaedics | 292 | 1.5 |
| SX, Rotorua | 230 | 1.3 |
| Crest | 217 | 1.1 |
| Belverdale | 165 | 0.9 |
| Churchill | 147 | 0.7 |
| Boulcott | 122 | 0.6 |
| Kensington | 106 | 0.6 |
| SX Brightside | 95 | 0.5 |
| Chelsea | 80 | 0.5 |
| Selina Sutherland | 77 | 0.5 |
| Franklin | 67 | 0.1 |
| Burwood | 24 | 0.1 |
| Masterton | 20 | 0.1 |
| Unspecified | 18 | 0.1 |
| SX, Central Lakes | 15 | 0.0 |
| Southland, Invercargill | 8 | 0.0 |
| Wanganui | 2 | 0.0 |
| Northshore | 2 | 0.0 |
| Nelson | 2 | 0.0 |
| Middlemore | 1 | 0.0 |
| SX Napier | 1 | 0.0 |
| Timaru | 1 | 0.0 |
| Aorangi | 1 | 0.0 |
| St Marks Surgical Centre | 1 | 0.0 |
| SX Palmerston North | 1 | 0.0 |
| Whangarei | 1 | 0.0 |

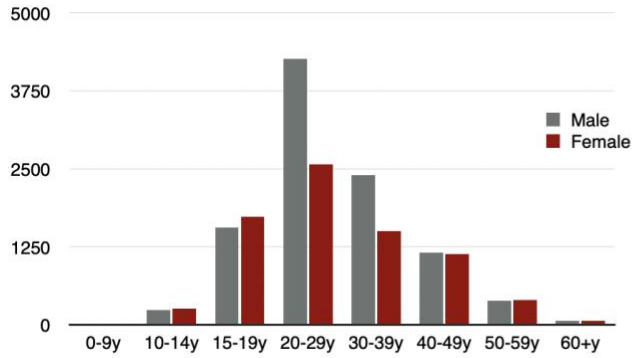
*Mechanism of Injury:*

Rugby, in its various forms, remains the most common mechanism of injury (23% of patients), with football (15%), netball (14%) and snow sports (8%) being the other common codes.

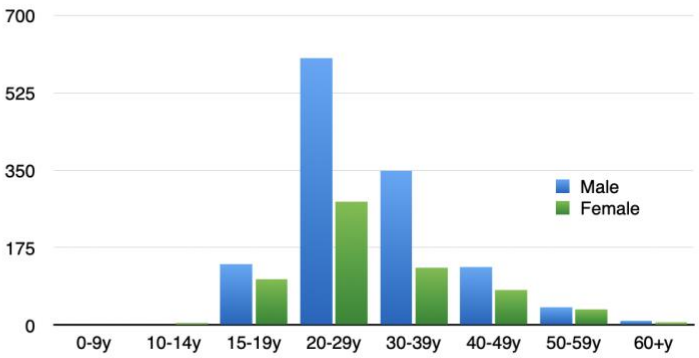



*Demographics:*

| | Primary ACL Reconstruction | Revision ACL reconstruction |
|---|---|---|
| Male: female | 10078:7650 (57% male) | 1272:638 (66.6% male) |
| Average age at surgery | 29.4y (7.9-79) | 30y (13.2-72.3y) |
| Delay to surgery | 9.7 months | 16.3 months |



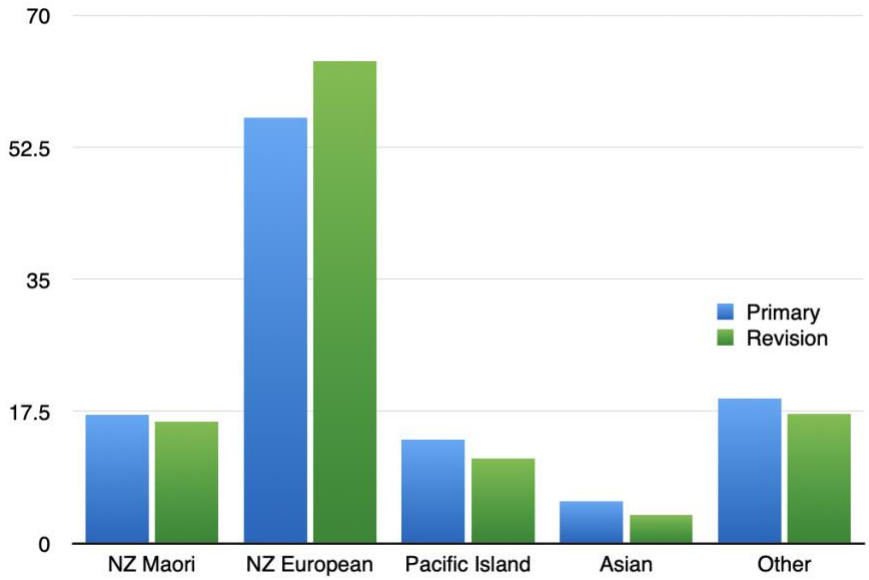

Age distribution: Primary



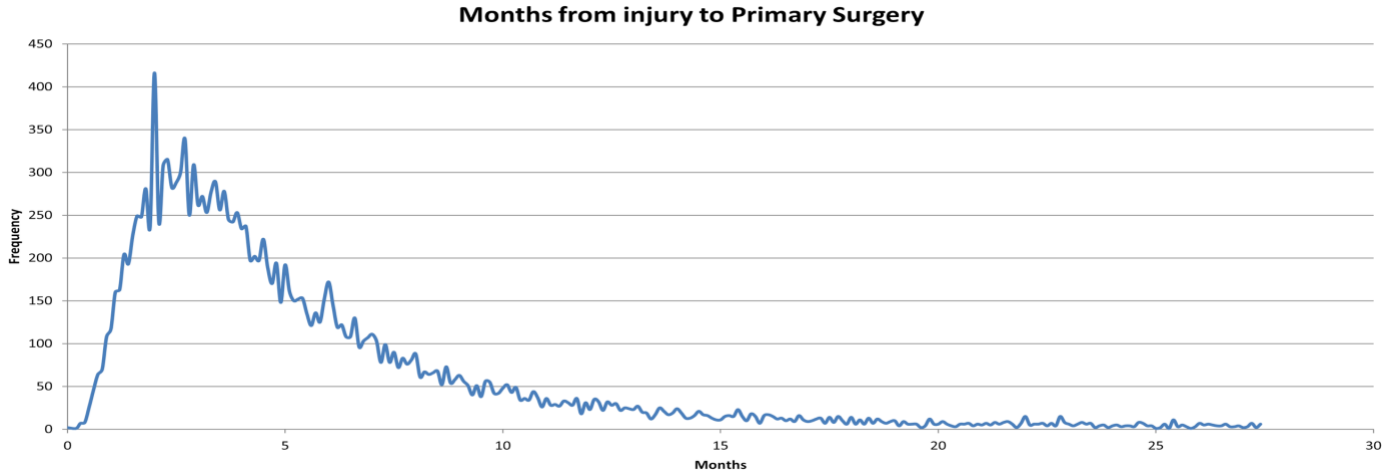

Age distribution: Revision

The majority of patients receive a primary ACL reconstruction within 6 months of injury. Median time is around 4.4 months. The long tail on the curve pushes the average time out to 9.7 months. Personalised reporting this year contains each surgeons time interval to surgeon compared with the national rates.

## Ethnicity

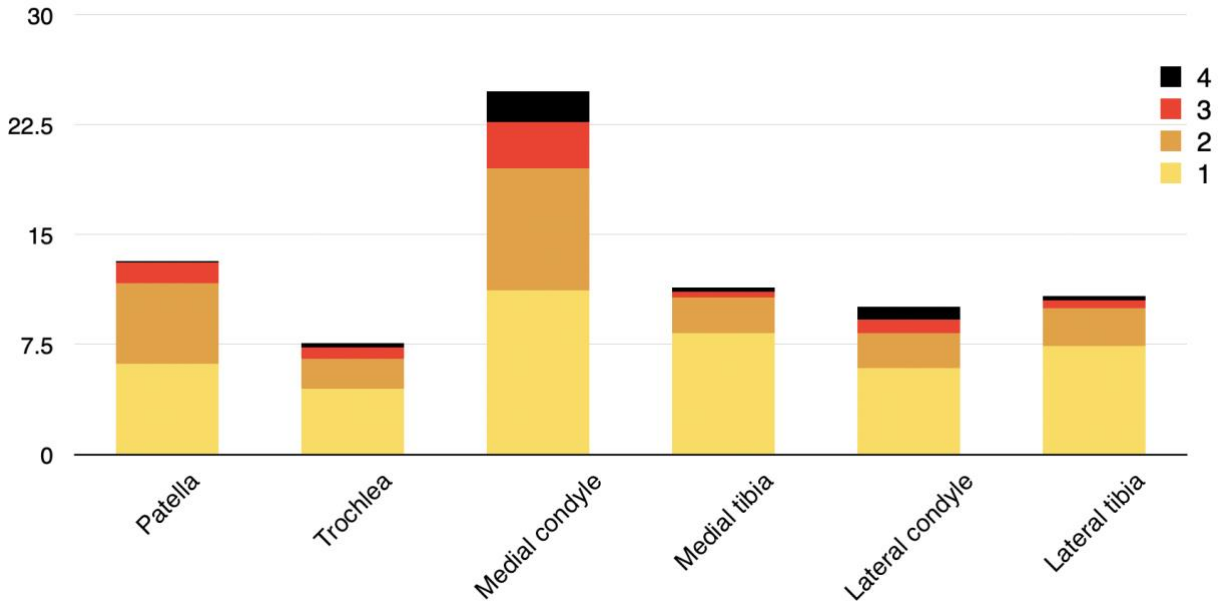


Delay to Surgery



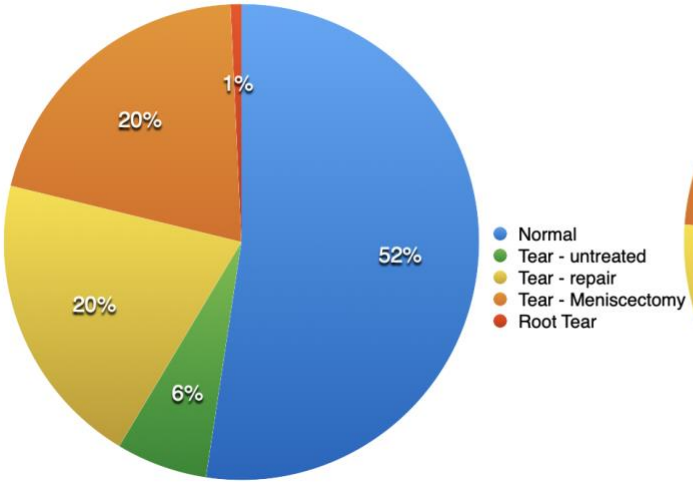

*Chondral injury:*

Chondral injuries were common at the time of surgery, the most frequently and severely affected area was the medial femoral condyle, being damaged in 24.8% of cases, it was also the area most frequently associated with higher grade chondral injuries (ICRS grade 3 and 4).
The majority of the injuries were not treated (80.2%). Chondroplasty was completed in 5.8% and microfracture in 2.8%. The chondral treatment field was not completed in 11% of operative data forms.

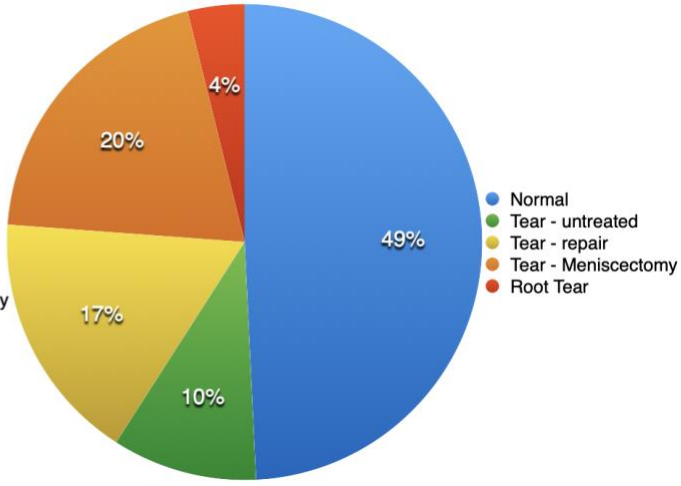


*Meniscal injury:*

About 1/3 of menisci have significant tears requiring treatment at the time of ACL reconstruction (40% medial, 37% lateral). The meniscus are found to be similarly reparable on the medial and lateral sides (20% and 17%). Implants are used six times more often as the more traditional sutures techniques on the lateral side and 11 times more often on the medial side of the knee.



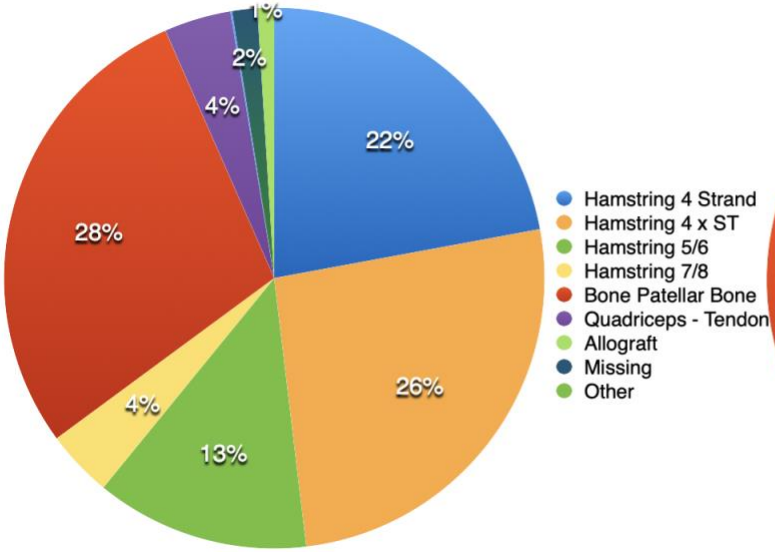

Medial meniscus



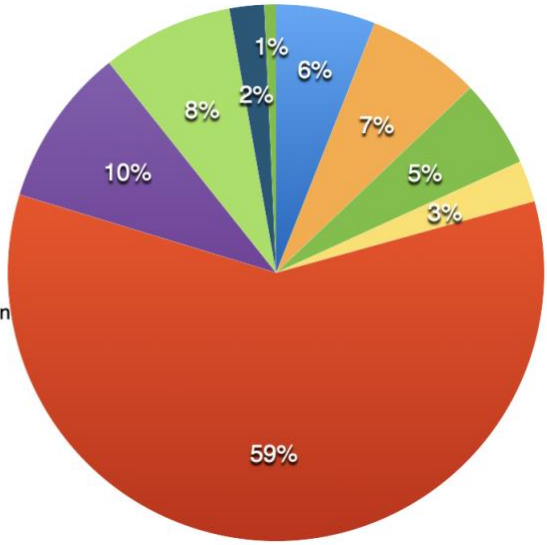

Lateral meniscus

*Graft Choice:*

For primary ACL reconstruction, the predominant graft choice is hamstring, accounting for 64.9% of all primary ACLs. 22.1% are 4 strand grafts with semitendinosis and gracilis. The majority of the others are quadrupled semitendinosis grafts (26%), although there is a trend for an increasing use of 6 to 8 strand grafts (16.8%). BTB is the next most popular graft, making up 28.5% of primary ACLs.



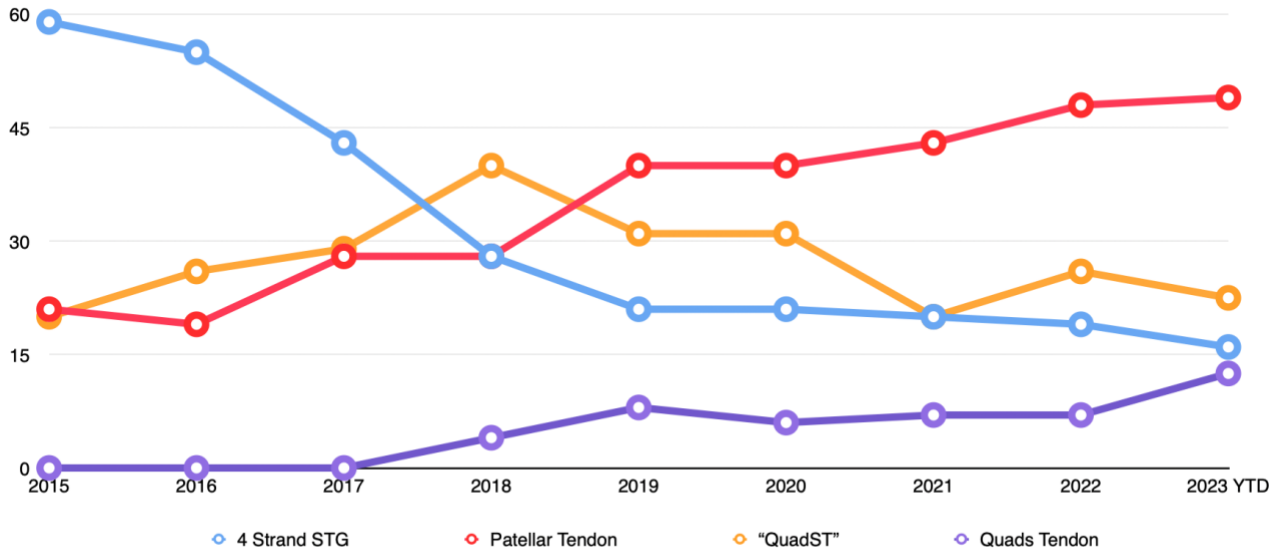

Graft choice: Primary




Graft choice: Revision

*Trends in graft choice:*

There has been a continued upswing in the popularity of both patellar and quads tendon grafts
Anecdotally, this reflects surgeon concern about the emerging published evidence of inferior survival rates in hamstring grafts, particularly in comparison to patellar tendon grafts[1]. Patellar tendon now accounts for 49% of all primary ACL reconstructions. Quads tendon grafting use continues to incease, but still only accounts for 12.5% of primary procedures.



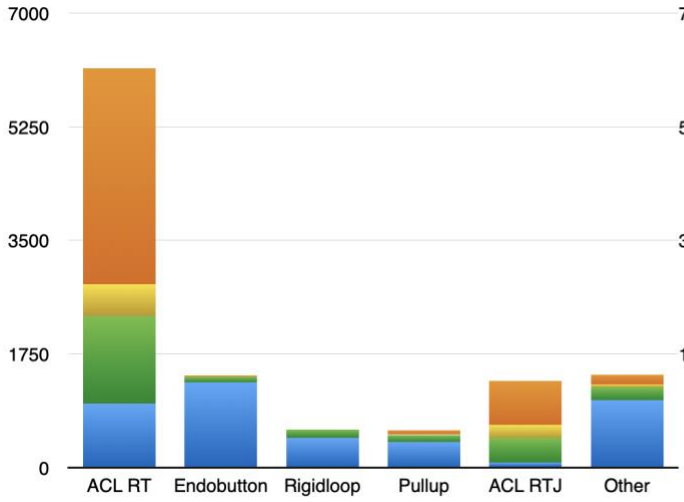

*Tunnel drilling technique:*

Tibial tunnel drilling data indicates that almost all are completed with antegrade drilling techniques. However, the operative data form was not completed in 16.5% of cases. 16 physeal sparing cases were recorded.
Femoral tunnel drilling was via an anteromedial portal in 72.5% of cases, transtibial in 10.4% and outside-in with a Flipcutter technique in 0.4% of cases. Data was missing in 16.5% of cases. An analysis of survival rates showed no difference in survival rates comparing trans-tibial and anteromedial drilling techniques[2].

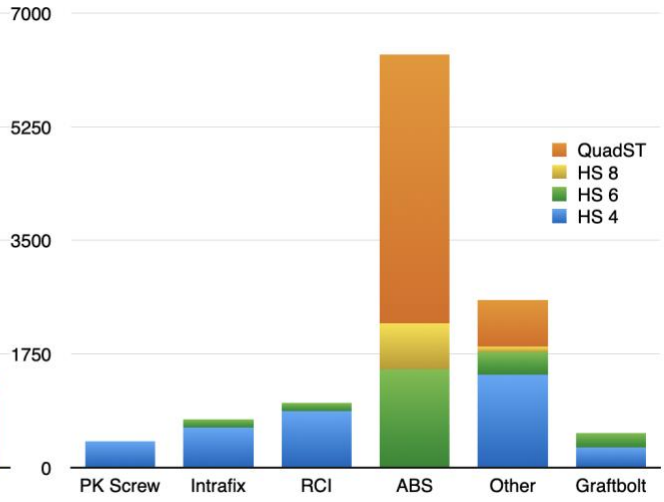
[1] *Impact of Graft Choice on Revision and Contralateral Anterior Crutiate Ligament Recontruction: Results from the New Zealand ACL Registry*. Richard Rhardjah, Mark Zhu, Hamish Love, Mark Clatworthy, Andrew Paul Monk, Simon W Young.

[2] *No Difference in Revision Anterior Cruciate Ligament (ACL) Reconstruction between Anteromedial Portal and Transtibial Drilling of the Femoral Graft Tunnel: Results from the New Zealand ACL Registry*. Richard Rahardja, Mark Zhu, Hamish Love, Mark G. Clatworthy, Andrew Paul Monk, Simon W. Young

*Graft fixation technique: Hamstring Primary Patients*

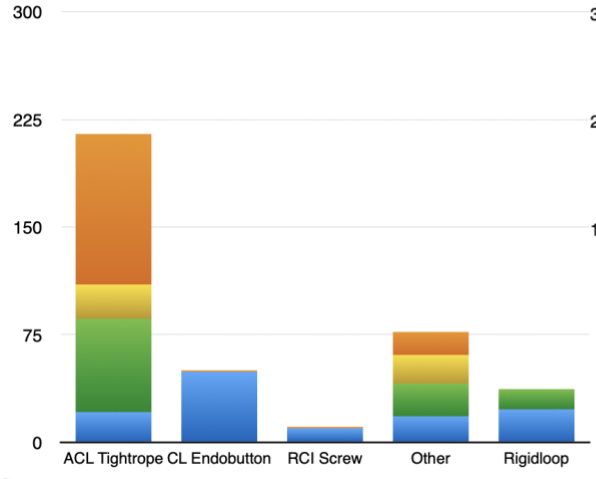



*Femoral fixation*

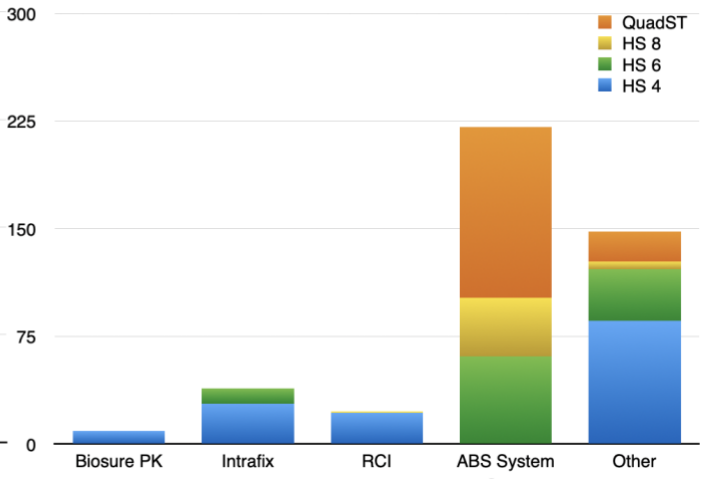



*Tibial fixation*

*Graft fixation: Hamstring Revision Patients*

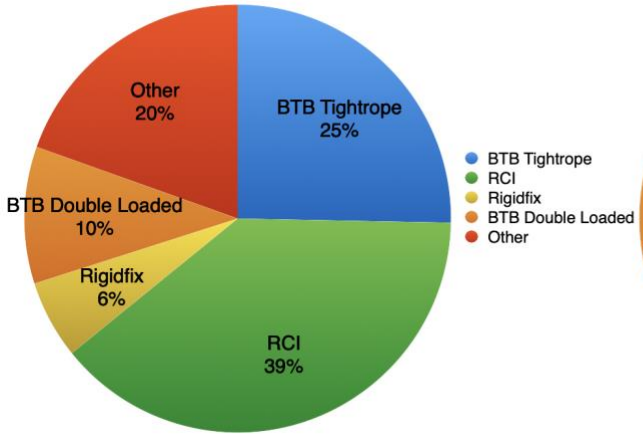



*Femoral fixation*

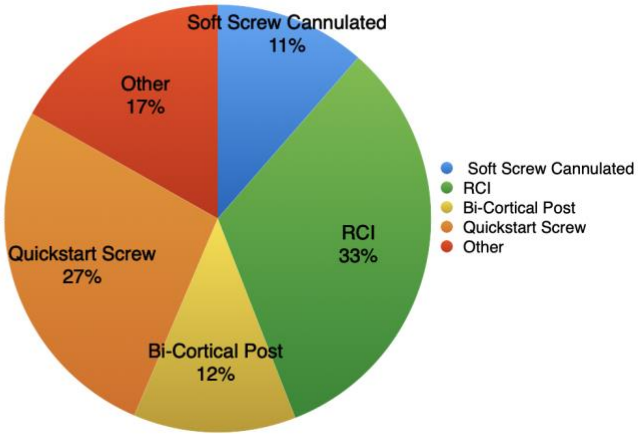



*Tibial fixation*

*Graft fixation: Patellar tendon Primary Patients*

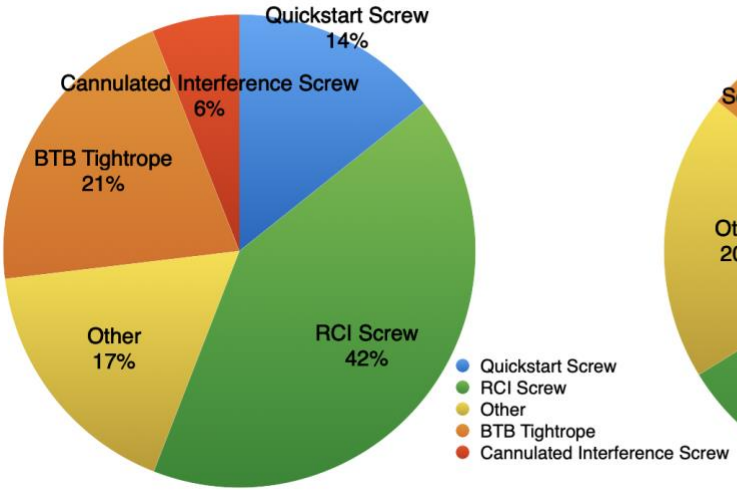



*Femoral fixation*

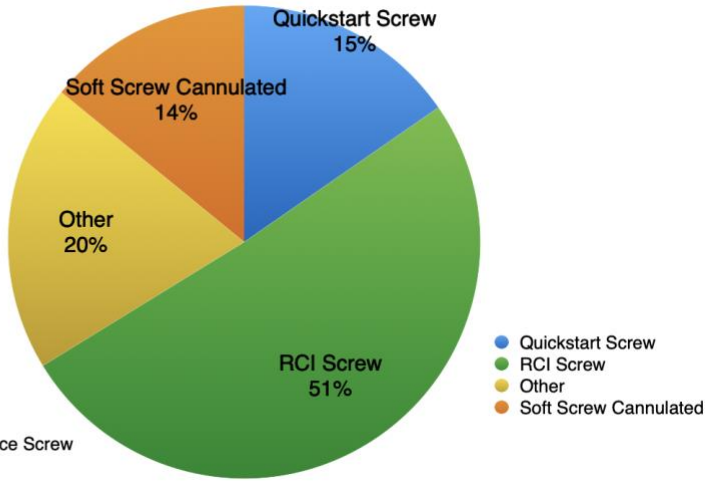



*Tibial fixation*

*Graft fixation: Patellar tendon Revision Patients*




*Femoral Fixation*




*Tibial Fixation*

*Antibiotic use:*

| | |
|---|---|
| Cephazolin | 69% |
| Cefuroxime | 1.4% |
| Augmentin | 2% |
| Vancomyacin/ceph | 17.4% |
| Other | 0% |
| None recorded | 9.6% |

*Thromboprophylaxis:*

| | |
|---|---|
| None | 56% |
| Aspirin | 16.7% |
| TEDs | 11.2% |
| ICD | 12.8% |
| Clexane | 3.1% |
| Other | 0.2% |

*Complications*:

| Intraoperative Complication | Number |
|---|---|
| Implant Failure | 164 |
| Patella Rupture | 8 |
| Hamstring Amputation | 26 |
| Tunnel/Graft Mismatch | 6 |
| Inadequate graft | 34 |
| Contaminated Graft | 3 |
| Other | 130 |

| Post-operative complication | |
|---|---|
| Infection (Includes 29 with reoperation) | 99 |
| DVT/PE (includes 5 re-operation) | 50 |
| Arthrofibrosis (Includes 303 with re-operation) | 387 |
| Implant-irritation/removal (includes 57 re-operation) | 100 |
| Other hospital admission/reoperation (not meniscus, chondral or Arthrofibrosis) | 140 |
| Meniscal Resection/Repair (includes 98 with no re-operation) | 521 |
| Chondral Repair (includes 16 with no re-operation) | 118 |
| Donor site problem: Hamstring | 392 |
| Donor site problem: Patella | 117 |
| Complex regional pain syndrome | 9 |
| Patella tendon rupture (Includes 1 re-operation) | 5 |
| Other (no re-operation) | 118 |
| Septic Arthritis (Includes 4 re-operations) | 9 |

| Recurrent Instability | |
|---|---|
| Atraumatic | 159 |
| Traumatic | 608 |
| Not recorded (failures but no revision) | 116 |
| Graft Rupture Implant Failure | 5 |
| Not specified | 76 |

| Revision ACL Reconstruction Number of procedures not patients | 572 |
|---|---|

Complications are captured in 4 ways.

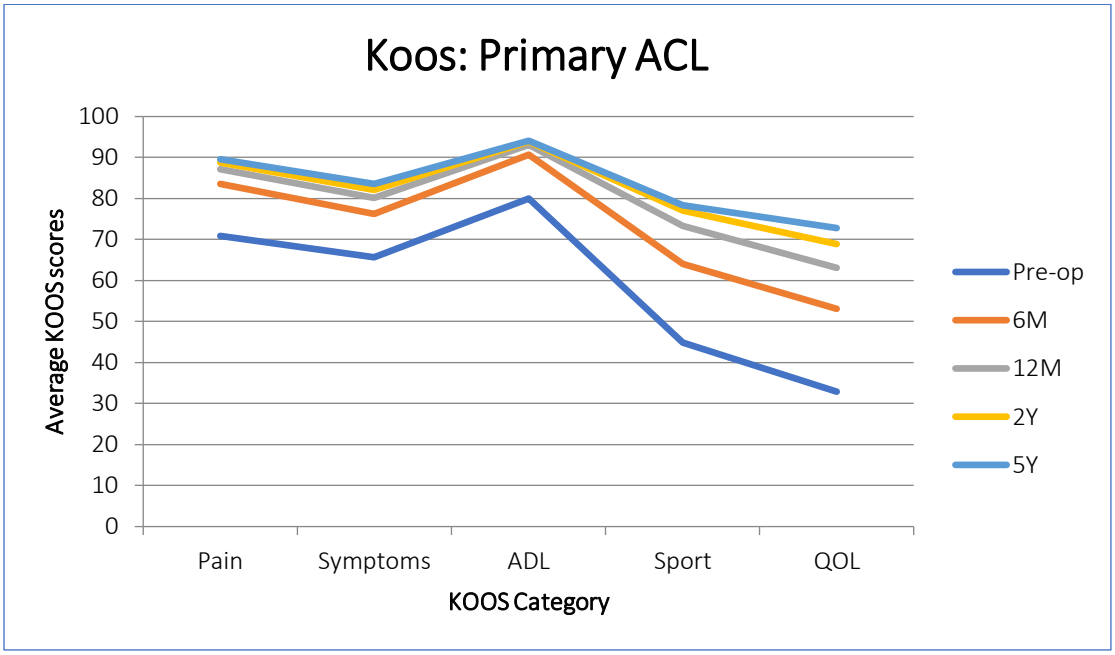
- Operative complications are recorded on the operative data form by the treating surgeon.
- Post-op complications identified by treating surgeons are recorded on the complications form and returned to the registry.
- Patients completing follow up questionnaires are asked if they have had any complications relating to their ACL surgery or further injuries to their knee.
- Finally, a cross-referencing with ACC data on further procedures related to the original surgery claim ensures a complete data set regarding subsequent surgery to the same knee.

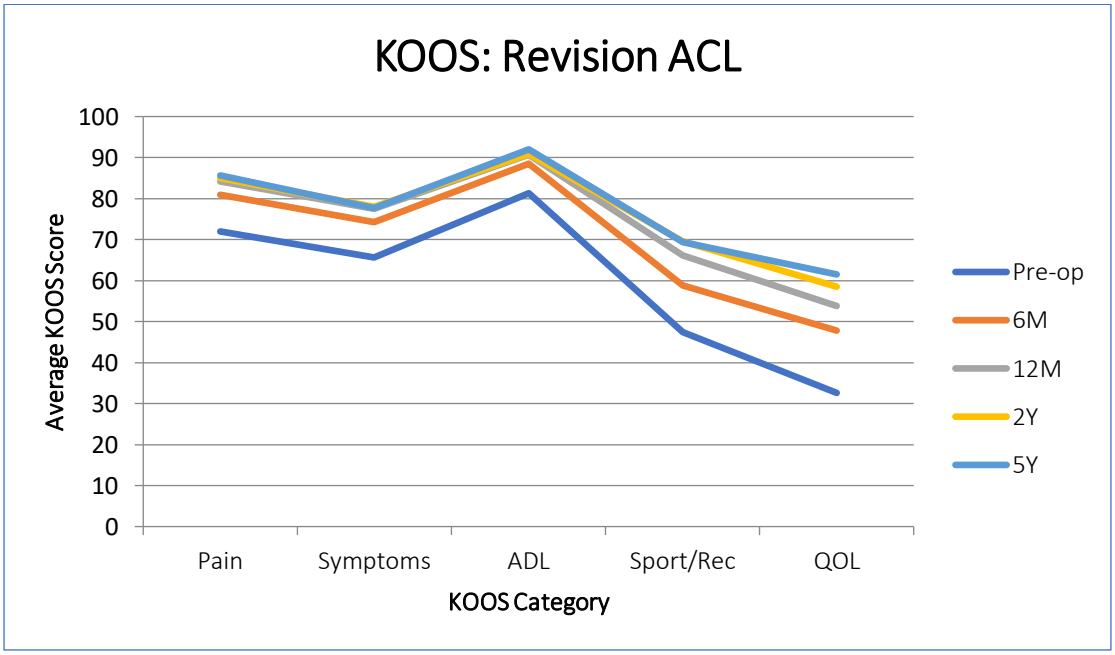
* Complications are recorded if they are significant to require hospital readmission or reoperation.
**The exception to this is donor site problems. These are listed if the patient reports significant symptoms related to the graft harvest site.

*Outcome scores:*

The KOOS score is a validated outcome questionnaire for ACL injuries and surgery. A 5 point scale from 0: none, to 4: Extreme, is completed for each of the subscales. These include:

- Pain: amount of pain in the last week
- Symptoms: Knee injury symptoms in the last week e.g. swelling, grinding, ability to straighten knee.
- ADL: Functional problems with activities of daily living, e.g. descending stairs
- Sport/Recreation: The degree of difficulty in physical tasks performed in the last week e.g. squatting pivoting etc.
- Quality of Life: Awareness of knee problems and confidence in the knee.

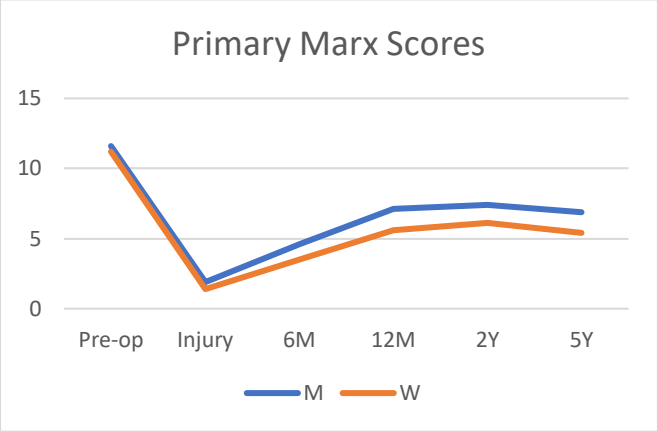


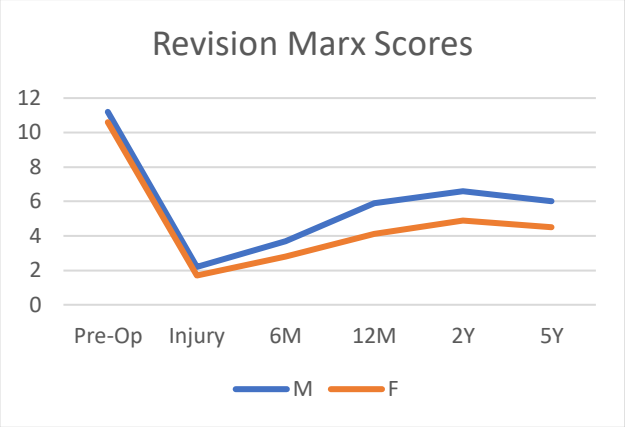



The scores in our cohort over time are very similar to those presented in other registry data. KOOS scores show improvement over all time points in primary ACL reconstruction. Revision KOOS scores show less improvement overall, in spite of a similar starting point.

*Marx Scores:*

The Marx score is a measurement of how often the individual engages in ACL-dependent physical activities including running, cutting, decelerating and pivoting. The Marx scores show a poorer return to activity after revision surgery when compared with primary ACL reconstruction.

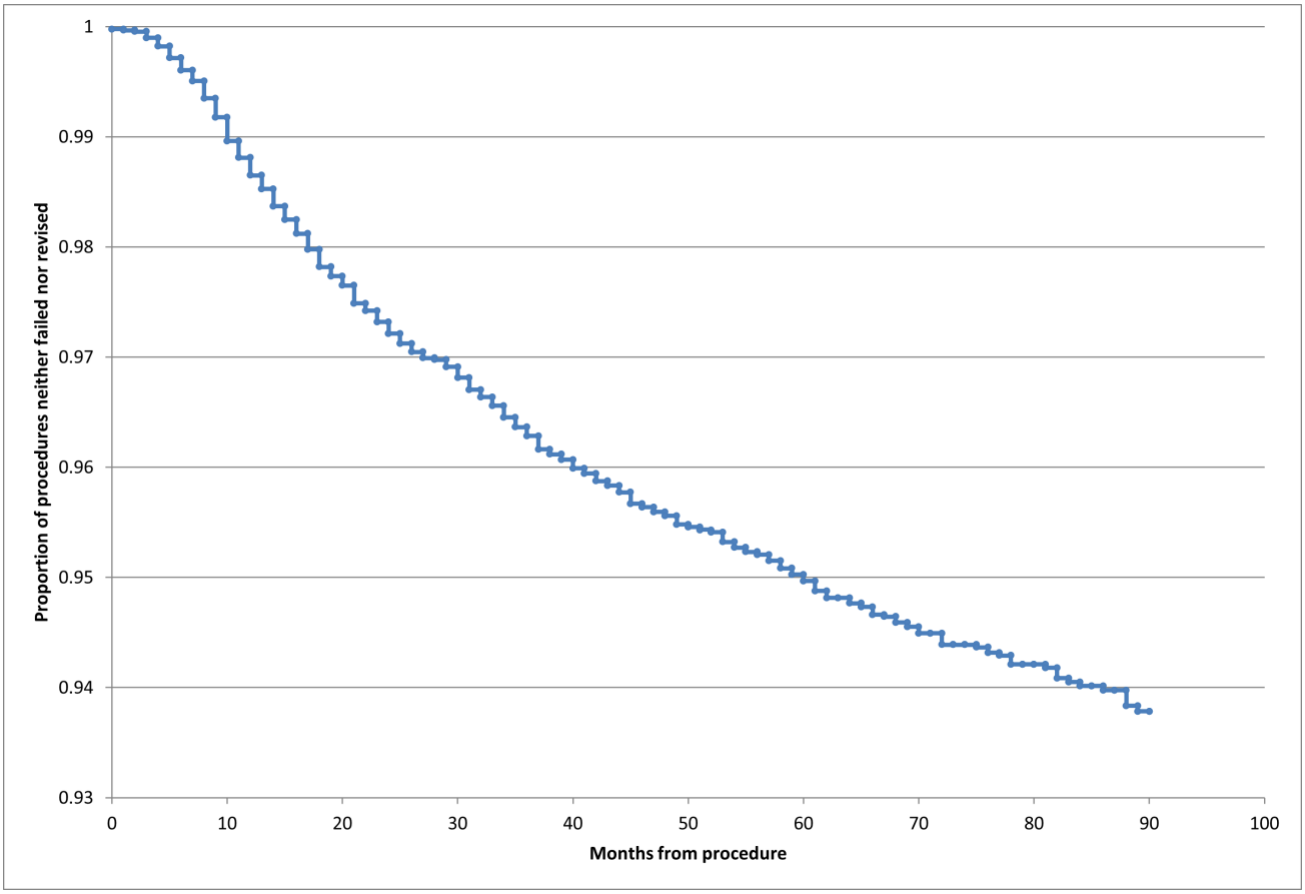


Survivorship:

Cumulative survival for ACL reconstruction in the NZ ACL Registry is 94% (95%CI 93.2-94.7)

Cumulative graft survival: All patients



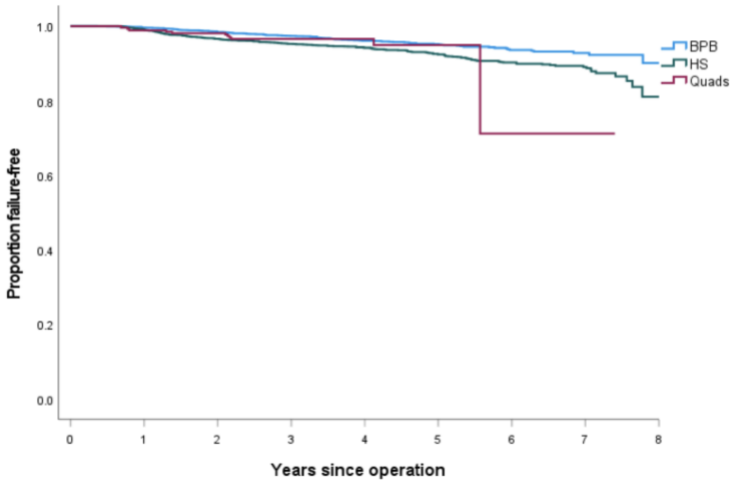

Independent patient-related risk factors for graft rupture and revision included[3]:

- Age. Patient <18y old have the greatest risk of re-injury. Those >36y old were at the lower risk of re-injury or revision surgery
- Male gender. Increased risk of graft rupture (RR 1.81) and of revision (RR 1.65) compared with females (p = 0.001)
- Early ACL reconstruction (within 6 months of injury) had a higher risk of revision compared with delayed reconstruction (>12 months post injury.

[3] *Patient Risk Factors for Revision Anterior Cruciate Ligament (ACL) Reconstruction in the New Zealand ACL Registry* Richard Rahardja, Mark Zhu, Hamish Love, Mark G. Clatworthy, Andrew Paul Monk, Simon W. Young

Graft Choice:

There is a trend in registry data showing that patella tendon grafts have lower revision rates compared with hamstring grafts. 1.3% vs 2.7% (adjusted HR = 2.51; 95% CI 1.55 – 4.06; p<0.001)[4]. However there was an increased rate of contralateral ACL rupture in the patellar tendon group 1.8% vs 0.9% (adjusted HR = 1.91; 95% CI 1.15 – 3.16; p = 0.012).



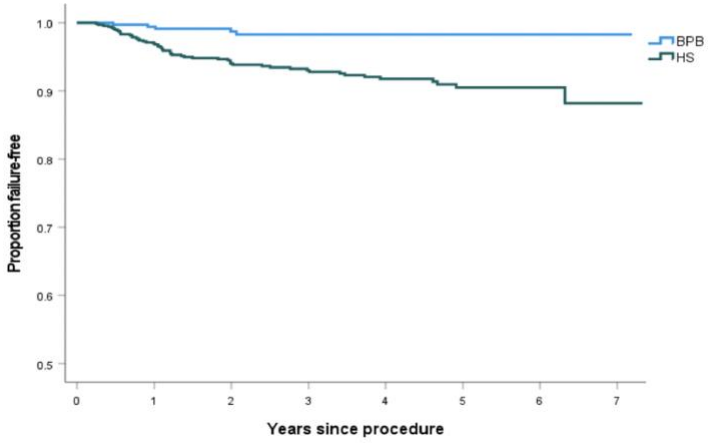

Our data is showing a strong trend towards increasing use of BPB grafts and increasing use of quad tensons. Initial quads graft techniques used in New Zealand showed a high failure rate. However modifications to graft preparations and implants have been associated with much improved outcomes since that initial experience. Zhou, Van Niekerk, Hirner et al 2023[5] study suggested Quad tendons were non- inferior to hamstring grafts when considering graft survival and return to sport. However risk factors such as age, gender, and specific groups such as hamstring grafts in females under 25 need to be taken into account. More research needs to be undertaken in the future regarding quads grafts and survival when we have more data to anaslyse as Quad grafts currently make up 12.5% of grafts in 2023 YTD.

[4] *Impact of Graft Choice on Revision and Contralateral Anterior Cruciate Ligament Reconstruction: Results from the New Zealand ACL Registry* Richard Rahardja, Mark Zhu Hamish Love, Mark G. Clatworthy, Andrew Paul Monk, Simon W. Young.

[5] *Quad Tendon Autograft is Comparable to Hamstring Tendon and Bone-Patella-Bone up to 2 Years After Isolated Primary Anterior Cruciate Ligament Reconstruction.* Yushy Zhou, Atua Fuimaono-Asafo, Chris Frampton, Michael van Niekerk & Marc Hirner

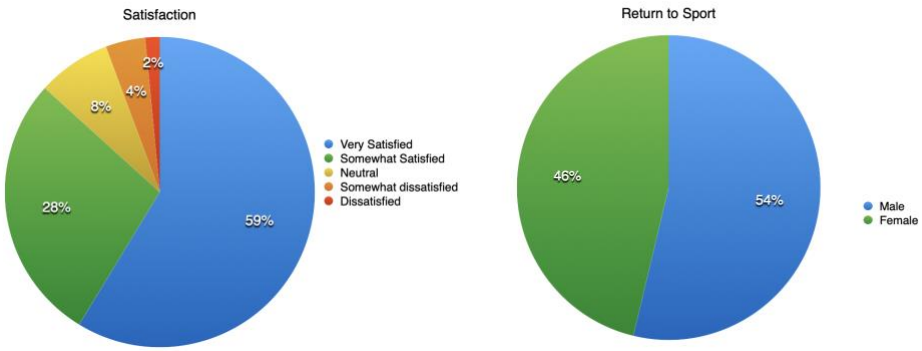
## *Female Failure by Graft Type*

When you separate out female graft failures, there is a greater failure rate of Hamstring grafts in younger female patients[6] .




Satisfaction

Additional questions have been added to the PROMS to determine patients return to sport and satisfaction with their ACL reconstruction. The preliminary results suggest that 72% of all male patients are returning to sport versus 62% of all female patients. Overall 59% of patients are very satisfied with their ACL reconstruction. When this is added to the satisfied category 86% of patients of all ages and genders are reporting this rating or better. Further indepth research is being carried out on this data.




[6]*Comparitive study of ACL Graft Failure (hamstring vs patella) amoung young females – A cohort study: Results from the New Zealand ACL Registry*. Anika Tiplady, Hamish Love, Chris Frampton

Conclusions:

The Registry is producing a high quality and robust data set. This will enable us to generate meaningful information on patient outcomes and research into the variables of ACL injury and reconstruction. Our primary goal is to improve the quality of patient care in the management of ACL injuries. The Trustees of the ACL Registry wish to express their gratitude to all participating Surgeons and to the New Zealand Orthopaedic Association, in particular its Knee Society, for making the ACL Registry possible.