Putting All of the Registry Data Together: What Does This Tell Us

ISAKOS Congress
Shanghai China  6/7/17

Gregory B. Maletis, MD
Kaiser Permanente ACL Registry
I have no disclosures
## Registry Demographics

<table>
<thead>
<tr>
<th></th>
<th>Yr Started</th>
<th>Volume</th>
<th>Mean Age</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Norway</td>
<td>2004</td>
<td>19380</td>
<td>27</td>
<td>57%</td>
<td>43%</td>
</tr>
<tr>
<td>Sweden</td>
<td>2005</td>
<td>32,466</td>
<td>28</td>
<td>58%</td>
<td>42%</td>
</tr>
<tr>
<td>Denmark</td>
<td>2005</td>
<td>25,354</td>
<td>30</td>
<td>60%</td>
<td>40%</td>
</tr>
<tr>
<td>Kaiser Permanente</td>
<td>2005</td>
<td>30,398</td>
<td>29</td>
<td>63%</td>
<td>37%</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>2012</td>
<td>6105</td>
<td>29</td>
<td>74%</td>
<td>26%</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>2011</td>
<td>349</td>
<td>29</td>
<td>70%</td>
<td>30%</td>
</tr>
</tbody>
</table>
Age at surgery
Grafts Utilized

- **Norway**: HS, PT, Allo, Other
- **Sweden**: HS, PT, Allo, Other
- **Denmark**: HS, PT, Allo, Other
- **Kaiser**: HS, PT, Allo, Other
- **UK**: HS, PT, Allo, Other
- **Luxembourg**: HS, PT, Allo, Other
3 yr and 5 yr Revision Rates

Kaiser
Sweden
Denmark

3yr
5yr
Probability of Revision based on Age and Graft Type

- Allograft
- HS
- BPTB
Hamstring vs BPTB

Reconstruction of the anterior cruciate ligament

ASSOCIATION OF GRAFT CHOICE WITH INCREASED RISK OF EARLY REVISION

We examined the association of graft type with the risk of early revision of primary anterior cruciate ligament reconstruction (ACL-R) in a community-based sample. A retrospective analysis of a cohort of 387 ACL-Rs recorded in an ACL-R Registry was performed. Patients were included if they underwent primary ACL-R with bone-patellar tendon-bone autograft, hamstring tendon autograft or allograft tissue. Aseptic failure was the main endpoint of the study.

Comparison of Hamstring Tendon and Patellar Tendon Grafts in Anterior Cruciate Ligament Reconstruction in a Nationwide Population-Based Cohort Study

Results From the Danish Registry of Knee Ligament Reconstruction

Lower Risk of Revision With Patellar Tendon Autografts Compared With Hamstring Autografts

A Registry Study Based on 45,998 Primary ACL Reconstructions in Scandinavia

Norway 2.3 X higher risk

Denmark 1.4 X higher risk

Scandinavia 1.4X higher risk
Does One Size Fit All
Hamstring Diameter Makes a Difference

The Effect of Autologous Hamstring Graft Diameter on the Likelihood for Revision of Anterior Cruciate Ligament Reconstruction

KP
17% ↓ risk of revision for 0.5mm ↑ diameter

Sweden
14% ↓ risk of revision for 0.5mm ↑ diameter

June 4, 2017

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Age Makes a Difference
Age-Related Risk Factors

5 year cumulative revision probability
- < 21 years 9.0%
- 21-30 years 5.5%
- 31-40 years 2.8%
- > 40 years 1.9%

5 year cumulative revision probability
- < 20 years 8.7%
- > 20 years 2.8%

Age 13-15 years 5.3X higher risk than 36-49 years

KP
Denmark
Sweden

Revision surgery in anterior cruciate ligament reconstruction: a cohort study of 17,682 patients from the Swedish National Knee Ligament Register

Results from the Danish Registry for Knee Ligament Reconstructions

Investigation performed at the Department of Orthopedics, Aarhus University Hospital, Aarhus, Denmark

Investigation performed at the Surgical Outcomes and Analysis Department, Kaiser Permanente, San Diego, California, USA
Age Related Risk Factors

**Age-Related Risk Factors for Revision Anterior Cruciate Ligament Reconstruction**

A Cohort Study of 21,304 Patients From the Kaiser Permanente Anterior Cruciate Ligament Registry

Gregory B. Maltezis,¹ MD, Jason Chen,¹ MA, Maria C.S. Inacio,¹ PhD, and Tadashi T. Funahashi,¹ MD
Investigation performed at the Surgical Outcomes and Analysis Department, Kaiser Permanente, San Diego, California, USA

**Risk for Revision After Anterior Cruciate Ligament Reconstruction Is Higher Among Adolescents**

Results From the Danish Registry of Knee Ligament Reconstruction

Peter Fauna,¹ MD, Lene Rahn-Wagner,¹ MD, and Martin Lind,¹ MD, PhD
Investigation performed at Department of Sports Traumatology, Aarhus University Hospital, Aarhus, Denmark

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**Sweden**

Age <16 5.3X higher risk than age >35

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**Denmark**

Age <20 3.5X higher risk age >20

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**Sweden**

< 20 and soccer 3X higher risk of revision
Graft Survival Compared to CACL Survival

Swedish data shows younger age, females, and lower BMI as risk factors for ACLR surgery.

Adolescents and female patients are at increased risk for contralateral anterior cruciate ligament reconstruction: a cohort study from the Swedish National Knee Ligament Register based on 17,682 patients.

Thorkell Snaebjornsson,1,2, Eric Hamrin Senorski,3, David Sundemo1,3, Eleonor Svanestroem3, Olof Westin1,2, Volker Musahl1, Edvard Alentorn-Geli1,5,7,8, Kristian Samuelsson1,2

Risk Factors Associated With Revision and Contralateral Anterior Cruciate Ligament Reconstructions in the Kaiser Permanente ACLR Registry

Gregory B. Matellis,1 MD, Maria C.S. Inacio,1 PhD, and Tadashi T. Funahashi,3 MD

Investigation performed at Kaiser Permanente Surgical Outcomes and Analysis Department, San Diego, California, USA.
Graft Fixation

Extratunnel 1.7X higher risk than Intratunnel

Extrachannel 1.4-1.7 X higher risk than Interference and Crosspin fixation

Norway

KP

Registry Data Highlight Increased Revision Rates for Endobutton/ Bioseure HA in ACL Reconstruction With Hamstring Tendon Autograft

A Nationwide Cohort Study From the Norwegian Knee Ligament Registry, 2004-2013

Andreas Persson,1 MD, Ase B. Kalheim,1 MD, Knut Falsbakk2,2 MD, Lars Engedal,1 MD, PhD, Brygge Eriksrud,2 MS, PhD, and Jonas M. Fossang,1 MD, PhD

1Department of Orthopedic Surgery, Haukeland University Hospital, Bergen, Norway

Kaiser Permanente
Change in Technique  Move to AM portal Drilling

Validation and outcome studies from the Danish Knee Ligament Reconstruction Registry
A study in operatively treated anterior cruciate ligament injuries

PhD dissertation

Lene Rahr-Wagner
Drilling Method

Increased Risk of Revision After Anteromedial Compared With Transibial Drilling of the Femoral Tunnel During Primary Anterior Cruciate Ligament Reconstruction: Results from the Danish Knee Ligament Reconstruction Register

Lene Ritz-Wagner, M.D., Theis Munchholm Thillemann, M.D., Ph.D., Alma Becc Pedersen, M.D., Ph.D., and Martin Caroe Lind, M.D., Ph.D.

Denmark
4 yr revision rate AM 5.2% vs TT 3.2%

After adjusting for covariates 2X higher risk with AM portal

KP
5 yr risk of revision  AM 6.4% vs TT 5.0%

After adjusting for covariates including fixation  No difference
TT had a decreased risk of revision compared to TP
HR 0.7

TP anatomic had a 1.3 X higher risk than TP reference

No Difference in KOOS based on drilling technique
Double Bundle anterior cruciate ligament reconstruction is superior to single-bundle reconstruction in terms of revision frequency: a study of 22,460 patients from the Swedish National Knee Ligament Register.

Kasper Björnsson, M.D., Daniel Andersson, M.D., Niel Decal, M.D., Olek Morby, M.D., Magnus Forsblad, M.D., Ph.D., Mats Petri, M.D., Ph.D., and Kristian Samuelsson, M.D., Ph.D.
Trends in Graft Utilization

27% decrease in Allograft use
68% decrease in < 21 year olds
Unique Outcomes
# Revision Risk: 16 year old soccer player

## Risk of Aseptic Revision after ACLR Surgery

| Age (yrs)  | 16 years |
| Height:    | 5 feet 11 inches |
| Weight (lbs) | 180 lbs |

**Injury activity:** Soccer

**Your BMI is:** 25.10216

Your probability of surviving (not experiencing an aseptic revision) after your FIRST ACLR Surgery is:

<table>
<thead>
<tr>
<th>GRAFT NAME</th>
<th>PAST YEAR 1</th>
<th>PAST YEAR 2</th>
<th>PAST YEAR 3</th>
<th>PAST YEAR 4</th>
<th>PAST YEAR 5</th>
<th>PAST YEAR 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allograft - Achilles</td>
<td>97.4%</td>
<td>89.2%</td>
<td>87.8%</td>
<td>83.9%</td>
<td>83.5%</td>
<td>82.4%</td>
</tr>
<tr>
<td>Allograft - BPTB</td>
<td>95.1%</td>
<td>88.1%</td>
<td>86.6%</td>
<td>84.2%</td>
<td>83.2%</td>
<td>77.0%</td>
</tr>
<tr>
<td>Allograft - Soft Tissue</td>
<td>97.6%</td>
<td>93.4%</td>
<td>90.7%</td>
<td>87.8%</td>
<td>86.2%</td>
<td>85.2%</td>
</tr>
<tr>
<td>Autograft - BPTB</td>
<td>98.3%</td>
<td>94.8%</td>
<td>93.5%</td>
<td>93.0%</td>
<td>91.8%</td>
<td>89.3%</td>
</tr>
<tr>
<td>Autograft - Hamstring</td>
<td>96.5%</td>
<td>91.2%</td>
<td>89.9%</td>
<td>88.6%</td>
<td>88.4%</td>
<td>88.3%</td>
</tr>
</tbody>
</table>
### Revision Risk: 40 year old non athlete

**Risk of Aseptic Revision after ACLR Surgery**

<table>
<thead>
<tr>
<th>Age (yrs)</th>
<th>40 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height:</td>
<td>6 feet 4 inches</td>
</tr>
<tr>
<td>Weight (lbs)</td>
<td>240 lbs</td>
</tr>
<tr>
<td>Injury activity:</td>
<td>Due to non-sport</td>
</tr>
</tbody>
</table>

**Your BMI is:**

29.21053

Your probability of surviving (not experiencing an aseptic revision) after your FIRST ACLR Surgery is:

<table>
<thead>
<tr>
<th>GRAFT NAME</th>
<th>PAST YEAR 1</th>
<th>PAST YEAR 2</th>
<th>PAST YEAR 3</th>
<th>PAST YEAR 4</th>
<th>PAST YEAR 5</th>
<th>PAST YEAR 6</th>
</tr>
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<tr>
<td>Allograft - Achilles</td>
<td>99.5%</td>
<td>99.3%</td>
<td>98.7%</td>
<td>98.3%</td>
<td>97.8%</td>
<td>97.6%</td>
</tr>
<tr>
<td>Allograft - BPTB</td>
<td>99.5%</td>
<td>99.0%</td>
<td>97.6%</td>
<td>97.1%</td>
<td>96.8%</td>
<td>96.7%</td>
</tr>
<tr>
<td>Allograft - Soft Tissue</td>
<td>99.8%</td>
<td>99.2%</td>
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<td>99.4%</td>
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<td>99.4%</td>
<td>99.3%</td>
<td>99.3%</td>
<td>99.3%</td>
</tr>
</tbody>
</table>
The Kaiser Permanente ACL Risk Calculator (KPARC) can be found at:

### Influence of anticonception hormone treatment

#### Relative Risk for Sustaining ACL Injury Using Oral Contraceptives or Not

<table>
<thead>
<tr>
<th>Variable</th>
<th>Crude RR</th>
<th>Adjusted RR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never users (n = 7090)</td>
<td>1.0 (reference)</td>
<td>1.0 (reference)</td>
</tr>
<tr>
<td>Ever users (n = 6266)</td>
<td>0.89 (0.81-0.96)</td>
<td>0.82 (0.75-0.90)</td>
</tr>
<tr>
<td>Recent users (n = 1715)</td>
<td>0.83 (0.73-0.93)</td>
<td>0.81 (0.72-0.89)</td>
</tr>
<tr>
<td>New users (n = 842)</td>
<td>0.96 (0.82-1.12)</td>
<td>0.89 (0.76-1.05)</td>
</tr>
<tr>
<td>Long-term users (n = 3708)</td>
<td>0.90 (0.81-0.99)</td>
<td>0.80 (0.74-0.91)</td>
</tr>
</tbody>
</table>

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*Is the Use of Oral Contraceptives Associated With Operatively Treated Anterior Cruciate Ligament Injury?: A Case-Control Study From the Danish Knee Ligament Reconstruction Registry*

Lene Rahr-Wagner, Theis Munckholm Thillemann, Frank Mohrert, Alma Becc Pedersen and Martin Lind

Effect of Focal Cartilage Lesion on Patient Reported Outcome

No difference in KOOS with Meniscal resection or LM repair compared to isolated ACLR

MM Repair had worse QOL and Other symptoms
Swedish Registry

KOOS Early and Late Responders

Reconstructed and Non Reconstructed ACLs

KOOS preop and after two years.

<table>
<thead>
<tr>
<th></th>
<th>Symptom</th>
<th>Pain</th>
<th>ADL</th>
<th>Function</th>
<th>Quality of life</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resp. pre op.</td>
<td>71</td>
<td>75</td>
<td>83</td>
<td>41</td>
<td>34</td>
</tr>
<tr>
<td>Resp. two yrs</td>
<td>78</td>
<td>85</td>
<td>91</td>
<td>65</td>
<td>60</td>
</tr>
<tr>
<td>Late resp. pre op.</td>
<td>71</td>
<td>75</td>
<td>84</td>
<td>44</td>
<td>33</td>
</tr>
<tr>
<td>Late reso two yrs</td>
<td>75</td>
<td>81</td>
<td>89</td>
<td>63</td>
<td>56</td>
</tr>
</tbody>
</table>

KOOS sport.

- Not reconstructed
- Reconstructed

Baseline | 1 year | 2 years | 5 years
Patient Reported Outcomes
( Norwegian and Swedish Registries)

Functional recovery = 19.7%
Treatment Failure = 28.9%

Acceptable = 66%
Not acceptable = 34%
Failure = 12%
What can we take away?

- Many similarities between the Kaiser (US) and European Registries.
- Understanding the similarities and differences should improve cross-cultural acceptance of results.
- Outcomes that are consistent across Registries should be able to be relied upon.
- Different registries may be uniquely positioned to tackle different problems.
- There are still many unanswered questions.
Registries are one piece of the puzzle in trying to answer those important questions regarding ACL Reconstructions
Thank you