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

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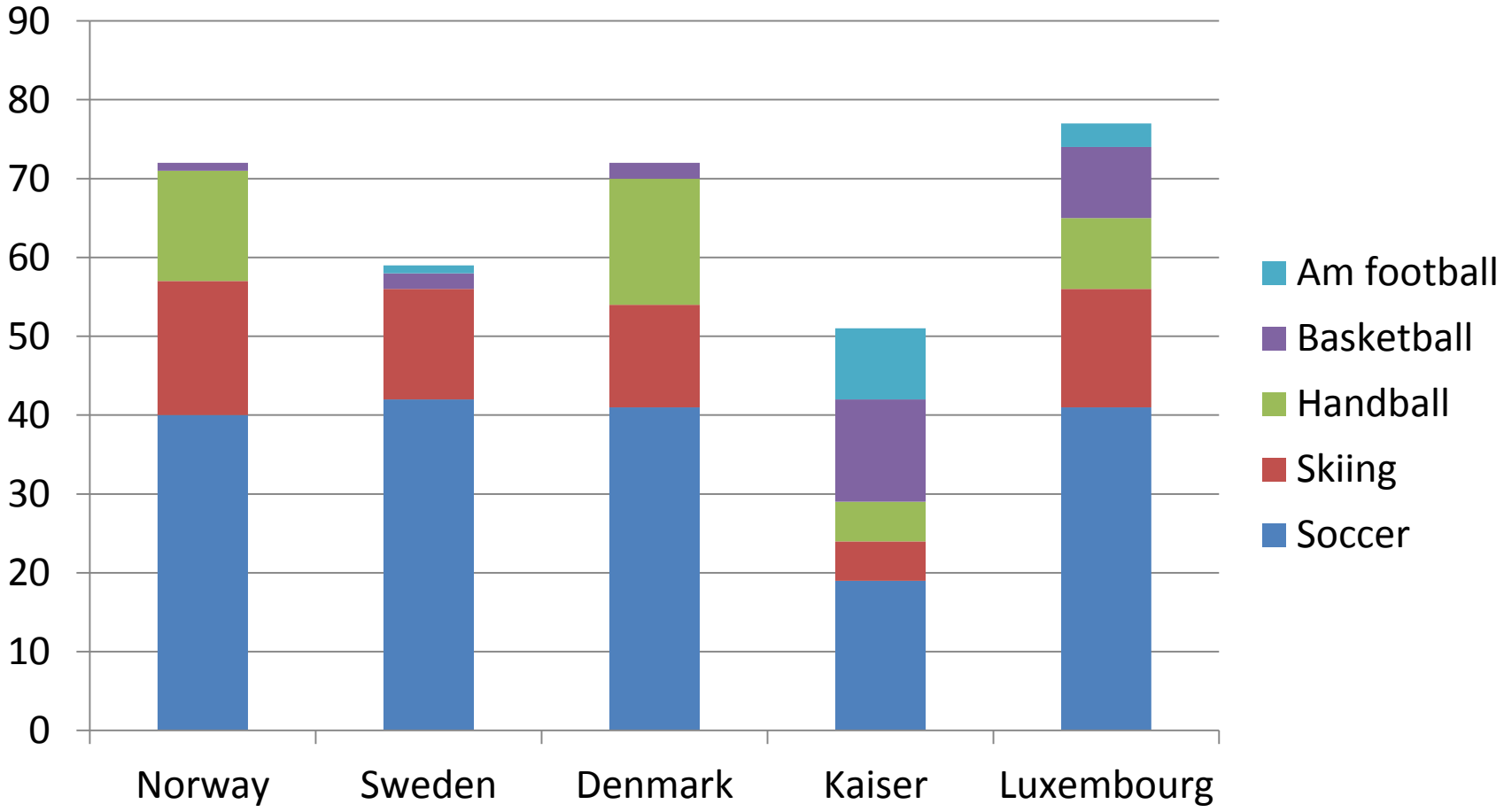
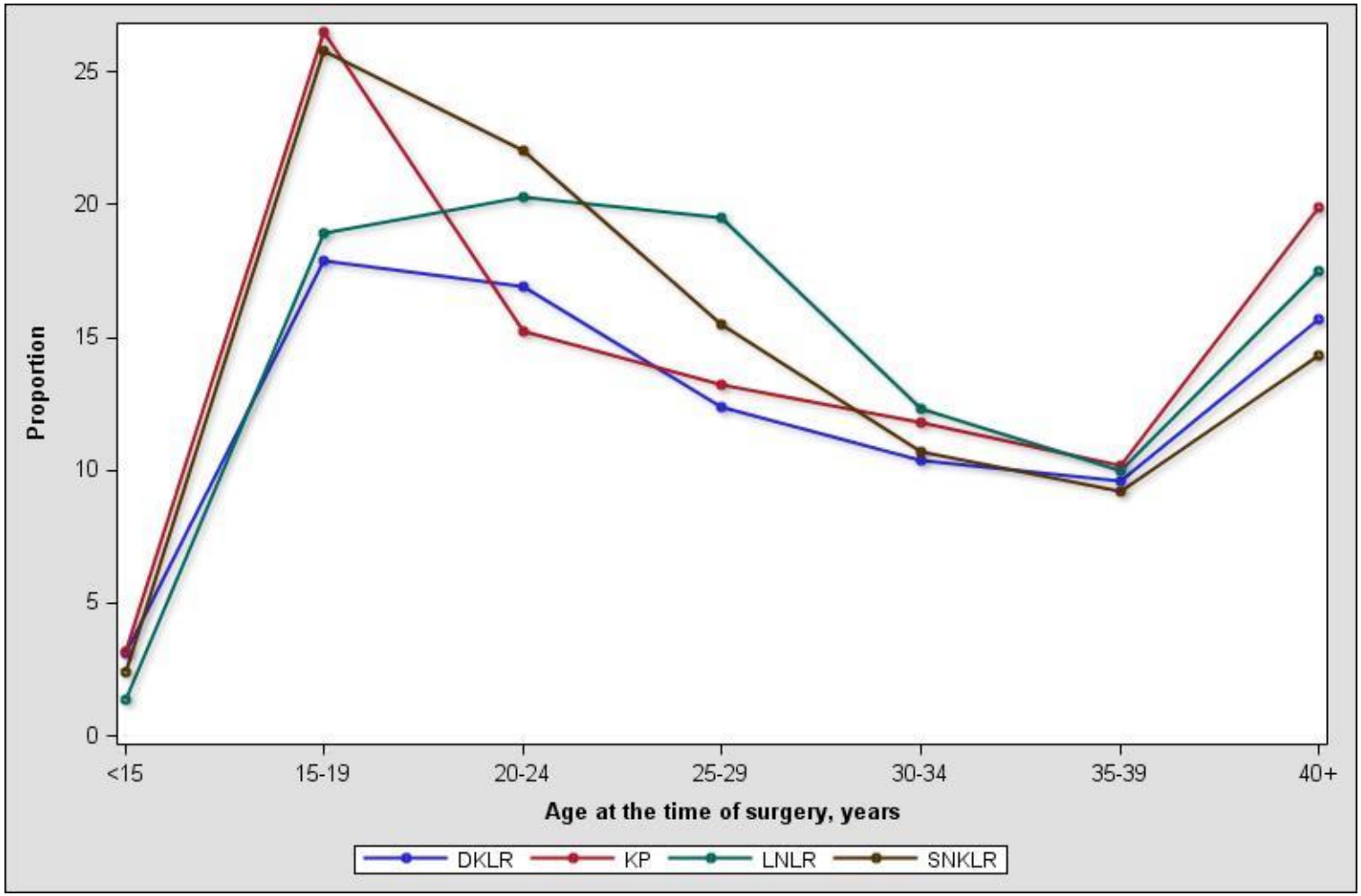
Registry Demographics

	Yr Started	Volume	Mean Age	Male	Female
Norway	2004	19380	27	57%	43%
Sweden	2005	32,466	28	58%	42%
Denmark	2005	25,354	30	60%	40%
Kaiser Permanente	2005	30,398	29	63%	37%
United Kingdom	2012	6105	29	74%	26%
Luxembourg	2011	349	29	70%	30%

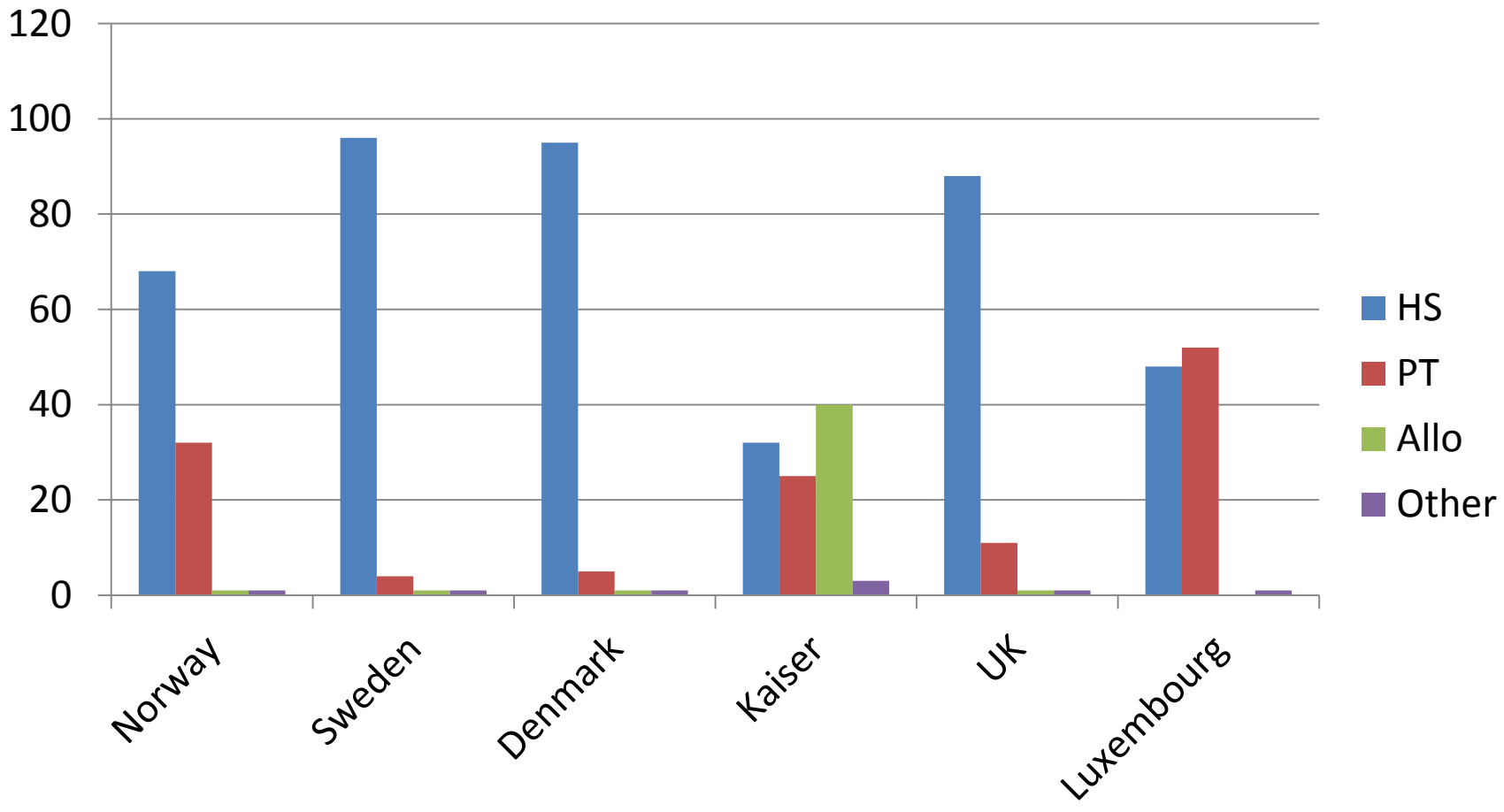
Sports



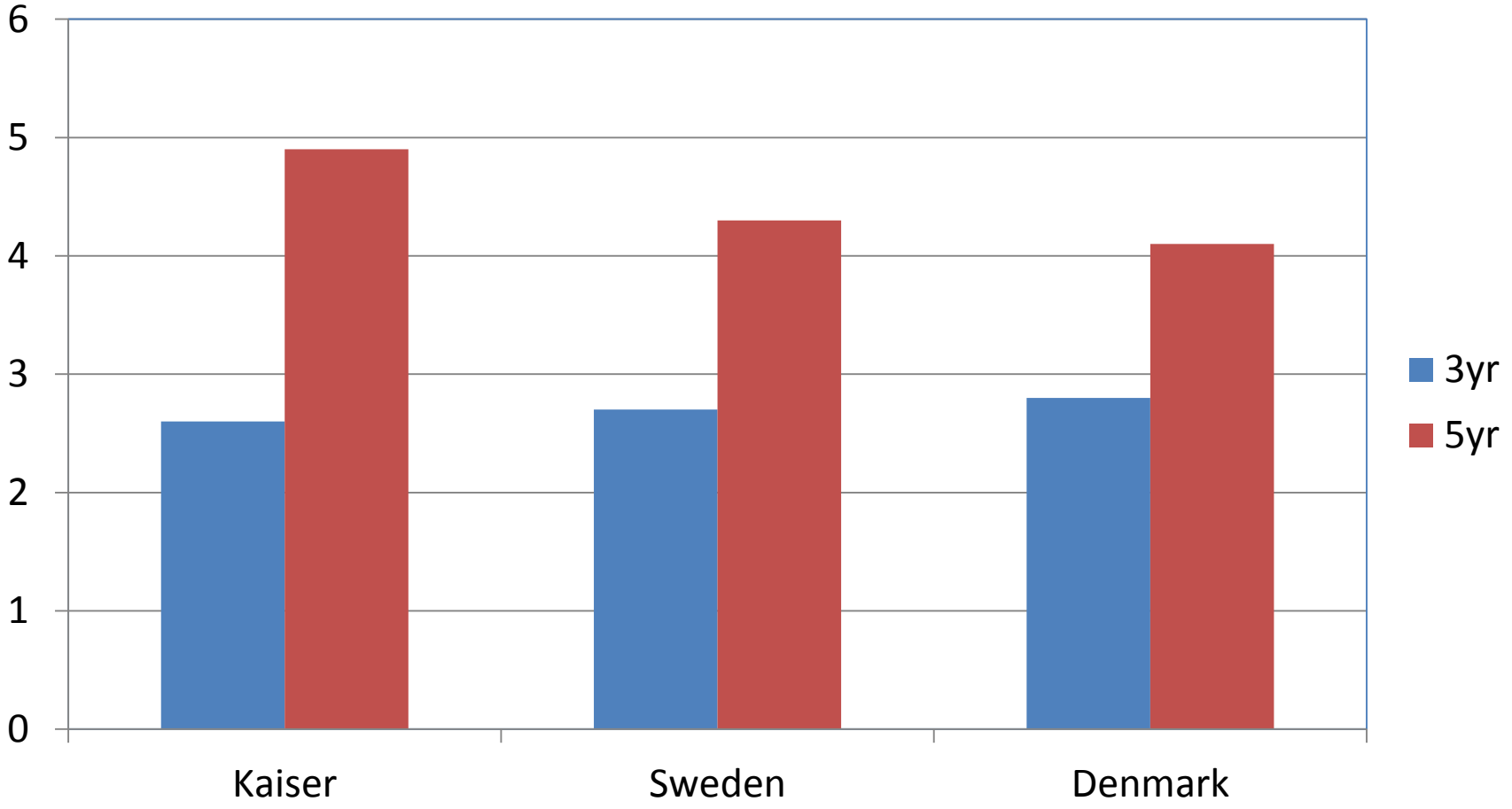
Age at surgery



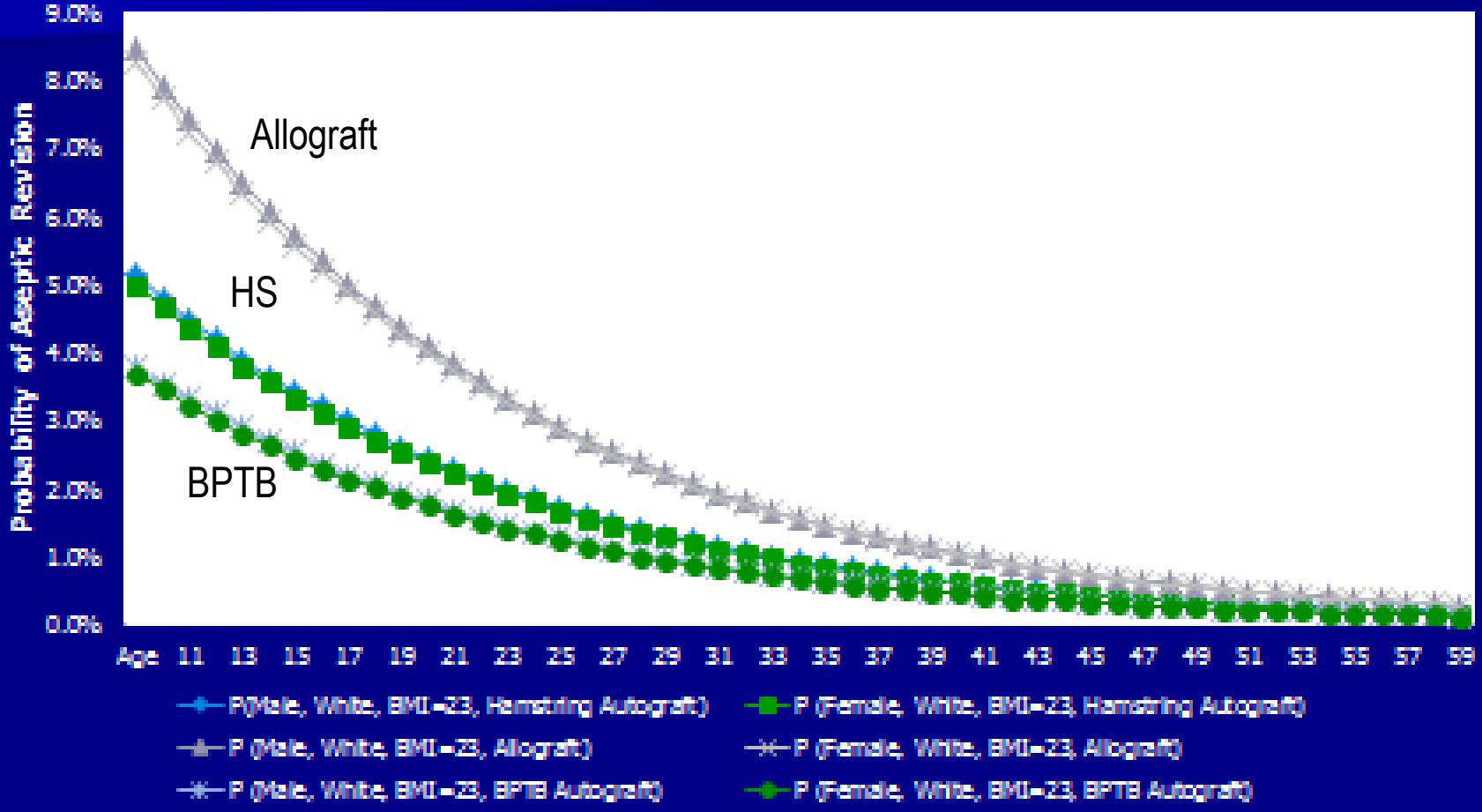
Grafts Utilized



3 yr and 5 yr Revision Rates



Probability of Revision based on Age and Graft Type



Hamstring vs BPTB

The Bone & Joint Journal
Formerly known as *JBJS (Br)*

■ KNEE

Reconstruction of the anterior cruciate ligament

ASSOCIATION OF GRAFT CHOICE WITH INCREASED RISK OF EARLY REVISION

G. B. Maletis,
M. C. S. Inacio,
J. L. Desmond,
T. T. Funahashi

We examined the association of graft type with the risk of early revision of primary anterior cruciate ligament reconstruction (ACLR) in a community-based sample. A retrospective analysis of a cohort of 9817 ACLRs recorded in an ACLR Registry was performed. Patients were included if they underwent primary ACLR with bone–patellar tendon–bone autograft, hamstring tendon autograft or allograft tissue. Aseptic failure was the main endpoint of the

KP 1.8 X higher risk

↑reased Risk of Revision With Hamstring Tendon Grafts Compared With Patellar Tendon Grafts After Anterior Cruciate Ligament Reconstruction

A Study of 12,643 Patients From the Norwegian Cruciate Ligament Registry, 2004-2012

Andreas Persson,*† MD, Knut Fjeldsgaard,† MD, Jan-Erik Gjertsen,† MD, PhD, Asle B. Kjellsen,† MD, Lars Engebretsen,‡§ MD, PhD, Randi M. Hole,† MD, and Jonas M. Fevang,† MD, PhD
Investigation performed at the Department of Orthopaedic Surgery, Haukeland University Hospital, Bergen, Norway

Norway 2.3 X higher risk

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

Lene Rahr-Wagner,*†‡ MD, Theis Muncholm Thillemann,† MD, PhD, Alma Becic Pedersen,‡ MD, PhD, and Martin Lind,† MD, PhD
Investigation performed at the Departments of Clinical Epidemiology and Orthopaedic Surgery, Aarhus University Hospital, Aarhus, Denmark

Denmark 1.4 X higher risk

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

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

Tone Gifstad,*†‡ MD, PhD, Olav A. Foss,†‡ MD, PhD, Lars Engebretsen,§ MD, PhD, Martin Lind,‖ MD, PhD, Magnus Forssblad,¶ MD, PhD, Grethe Albrektsen,‡ PhD, and Jon Olav Drogset,†‡ MD, PhD
Investigation performed at Trondheim University Hospital, Trondheim, Norway

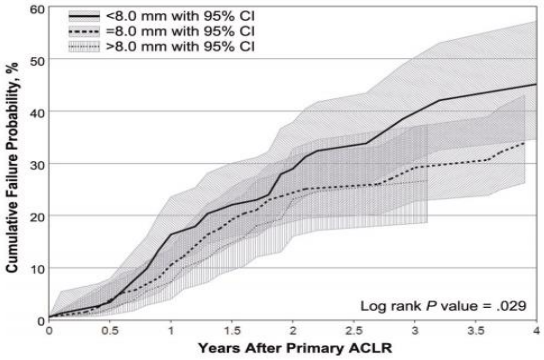
Scandinavia 1.4X higher risk

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

Lindsey Spragg,*† MD, Jason Chen,‡ MA, Raffy Mirzayan,§ MD, Rebecca Love,‡ MPH, RN, and Gregory Maletis,§ MD
Investigation performed at Kaiser Permanente, Baldwin Park and San Diego, California, USA



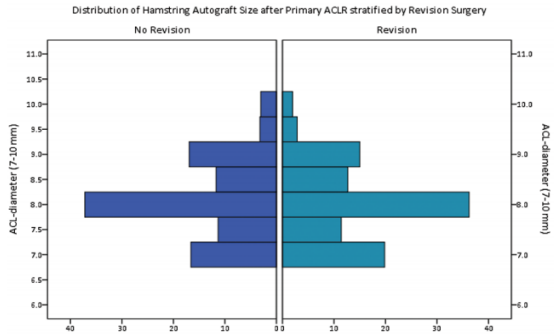
KP

17% ⬇ risk of revision for 0.5mm ⬆ diameter

Graft Diameter as a Predictor for Revision Anterior Cruciate Ligament Reconstruction and KOOS and EQ-5D Values

A Cohort Study From the Swedish National Knee Ligament Register Based on 2240 Patients

Thorkell Snaebjörnsson,*† MD, Eric Hamrin Senorski,* PT, MSc, Olufemi R. Ayeni,‡ MD, MSc, FRCSC, Eduard Alentorn-Geli,§‖¶ MD, PhD, Ferid Krupic,† PhD, Fredrik Norberg,† Jón Karlsson,*† MD, PhD, and Kristian Samuelsson,*†‖ MD, PhD
Investigation performed at Sahlgrenska University Hospital, Mölndal, Sweden



Sweden

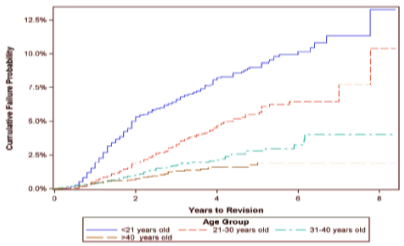
14% ⬇ risk of revision for 0.5mm ⬆ diameter

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%**



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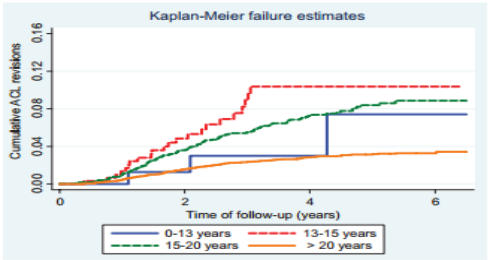
Age-Related Risk Factors for Revision Anterior Cruciate Ligament Reconstruction

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

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

5 year cumulative revision probability

- **< 20 years 8.7%**
- **≥ 20 years 2.8%**



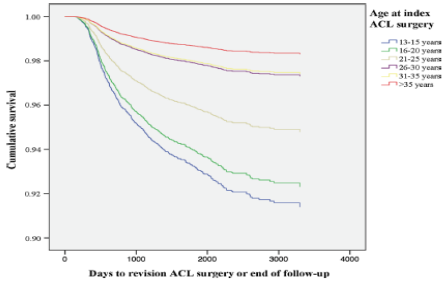
Denmark

Incidence and Outcome After Revision Anterior Cruciate Ligament Reconstruction

Results From the Danish Registry for Knee Ligament Reconstructions

Martin Lind,*† MD, PhD, Frank Menhert,† MS, and Alma B. Pedersen,† MD, PhD
Investigation performed at the Department of Orthopedics, Aarhus University Hospital, Aarhus, Denmark

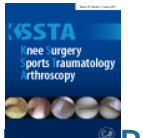
Age 13-15 years 5.3X higher risk than 36-49 years



Sweden

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

Neel Desai[1,2] · Daniel Andernord[2,3,4] · David Sundemo[1,2] · Eduard Alentorn-Geli[5] · Volker Musahl[6] · Freddie Fu[6] · Magnus Forssblad[7] · Kristian Samuelsson[1,2]



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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. Maletis,*† MD, Jason Chen,‡ MA, Maria C.S. Inacio,‡ PhD, and Tadashi T. Funahashi,§ MD
Investigation performed at the Surgical Outcomes and Analysis Department, Kaiser Permanente, San Diego, California, USA

KP

Age <21 7.8X higher risk than > 40

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

Results From the Danish Registry of Knee Ligament Reconstruction

Peter Faunø,*† MD, Lene Rahr-Wagner,† MD, and Martin Lind,† MD, PhD
Investigation performed at Department of Sports Traumatology, Aarhus University Hospital, Aarhus, Denmark

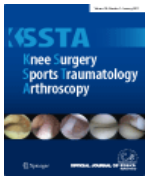
Denmark

Age <20 3.5X higher risk age >20

Knee Surg Sports Traumatol Arthrosc (2016) 24:885–894
DOI 10.1007/s00167-014-3406-6

KNEE

Predictors for additional anterior cruciate ligament reconstruction: data from the Swedish national ACL register



Anne Fältström · Martin Hägglund · Henrik Magnusson · Magnus Forssblad · Joanna Kvist

Sweden

Age <16 5.3X higher risk than age >35

AJSM PreView, published on October 16, 2014 as doi:10.1177/0363546514552788

Patient Predictors of Early Revision Surgery After Anterior Cruciate Ligament Reconstruction

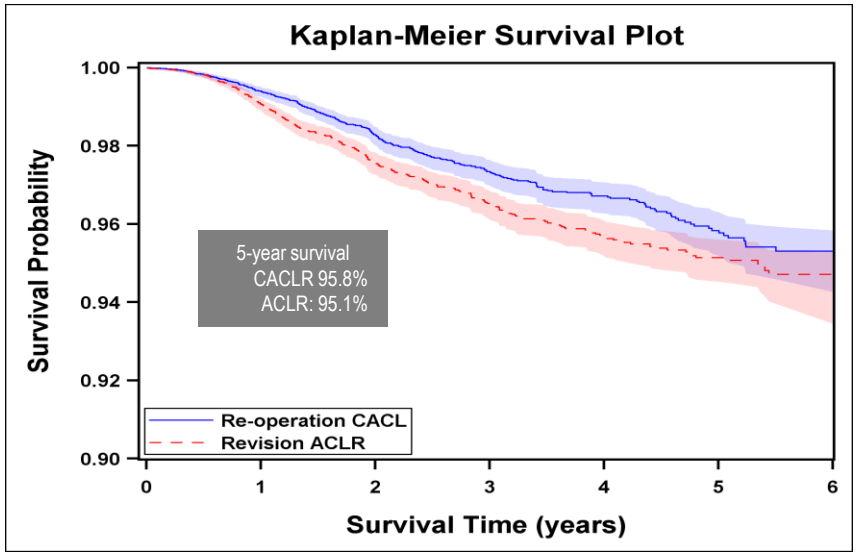
A Cohort Study of 16,930 Patients With 2-Year Follow-up

Daniel Andernord,*†‡§ MD, Neel Desai,§‖ MD, Haukur Björnsson,§‖ MD, Mattias Ylander,§ Jón Karlsson,§‖ MD, PhD, and Kristian Samuelsson,§‖ MD, PhD
Investigation performed at the Department of Orthopaedics, Institute of Clinical Sciences, The Sahlgrenska Academy, University of Gothenburg, Gothenburg, Sweden

Sweden

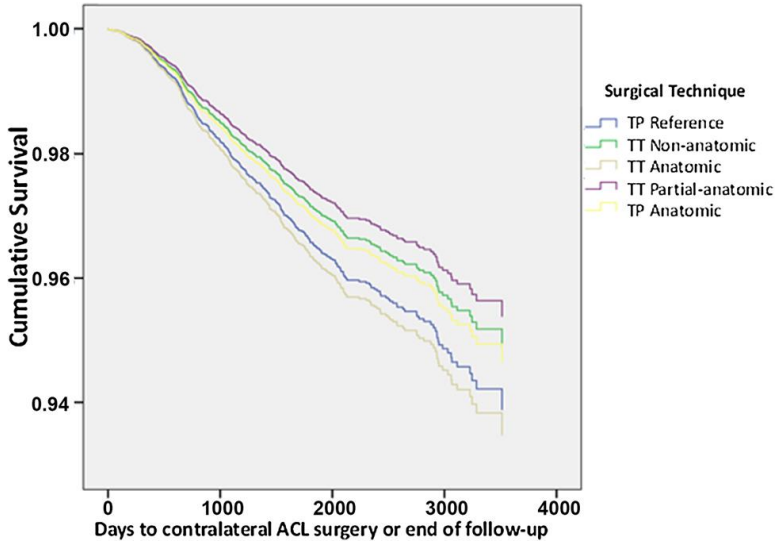
< 20 and soccer 3X higher risk of revision

Graft Survival Compared to CACL Survival



Younger age, females, lower BMI

Sweden



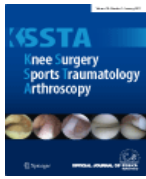
Younger age, females

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

Gregory B. Maletis,*† MD, Maria C.S. Inacio,‡ PhD, and Tadashi T. Funahashi,§ MD
Investigation performed at Kaiser Permanente Surgical Outcomes and Analysis Department, San Diego, California, USA

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 Snaebjörnsson[1,2] · Eric Hamrin Senorski[3] · David Sundemo[1] · Eleonor Svantesson[1] · Olof Westin[1,2] · Volker Musahl[4] · Eduard Alentorn-Geli[5,6,7,8] · Kristian Samuelsson[1,2]



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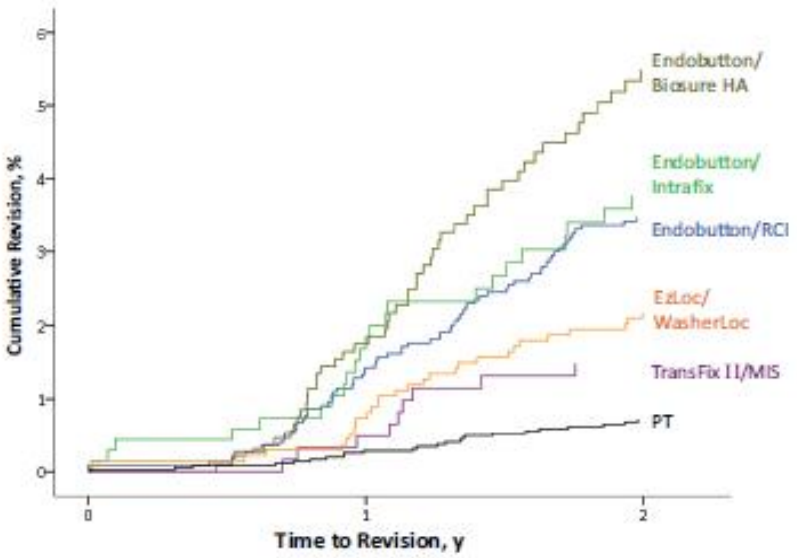
Graft Fixation

Norway



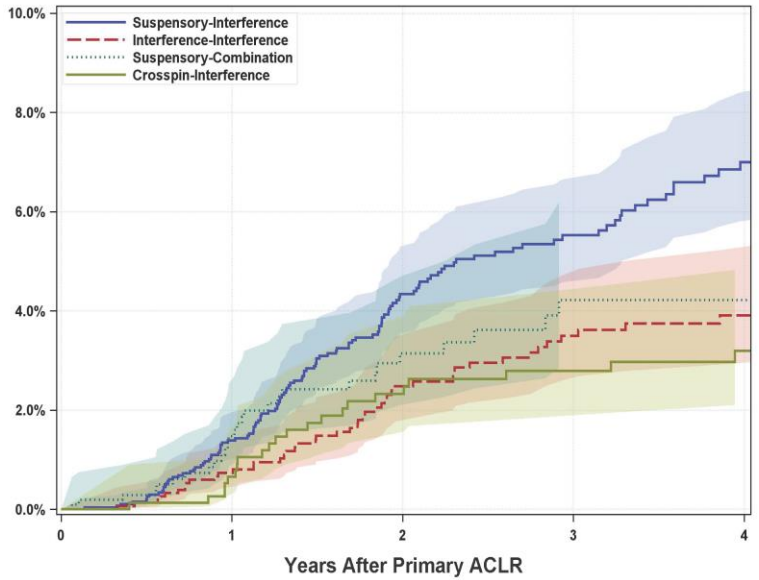
Extratunnel 1.7X higher risk than Intratunnel

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

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

Andreas Persson,*† MD, Asle B. Kjellsen,† MD, Knut Fjeldsgaard,† MD, Lars Engebretsen,‡§ MD, PhD, Birgitte Espehaug,‖ MSc, PhD, and Jonas M. Fevang,† MD, PhD
Investigation performed at the Department of Orthopaedic Surgery, Haukeland University Hospital, Bergen, Norway

KP



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

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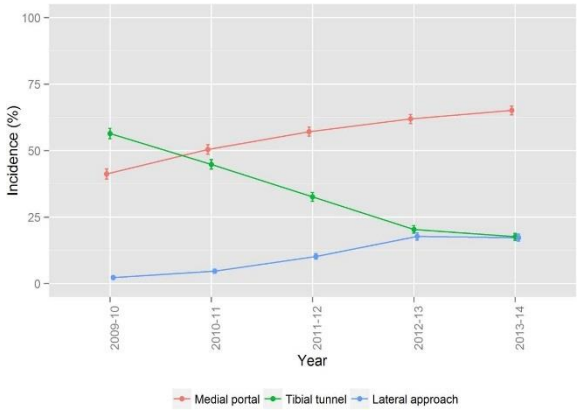
Change in Technique Move to AM portal Drilling

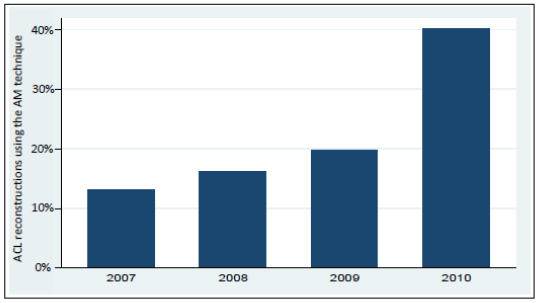


Surgical Technique Trends in Primary ACL Reconstruction from 2007 to 2014

Lisa Tibor, MD, Priscilla H. Chan, MS, Tadashi T. Funahashi, MD, Ronald Wyatt, MD, Gregory B. Maletis, MD, and Maria C.S. Inacio, PhD

Investigation performed at Surgical Outcomes and Analysis, Kaiser Permanente, San Diego, California

Figure 5.3.1: Use of AM technique for femoral tunnel drilling from 2007–2010 (%)



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

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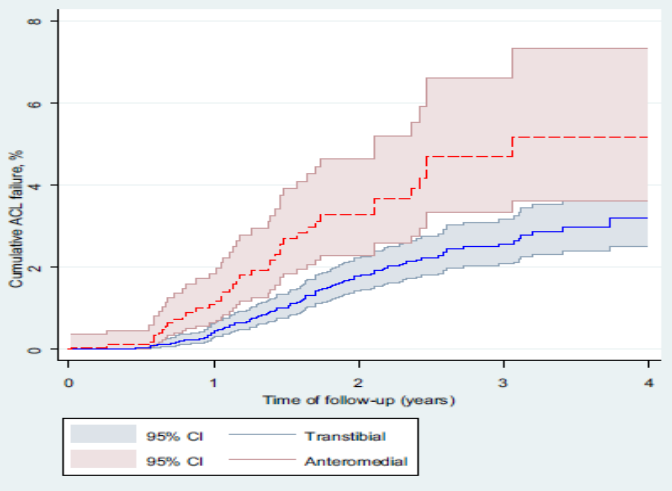
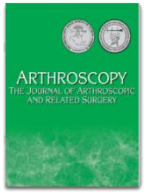
Drilling Method



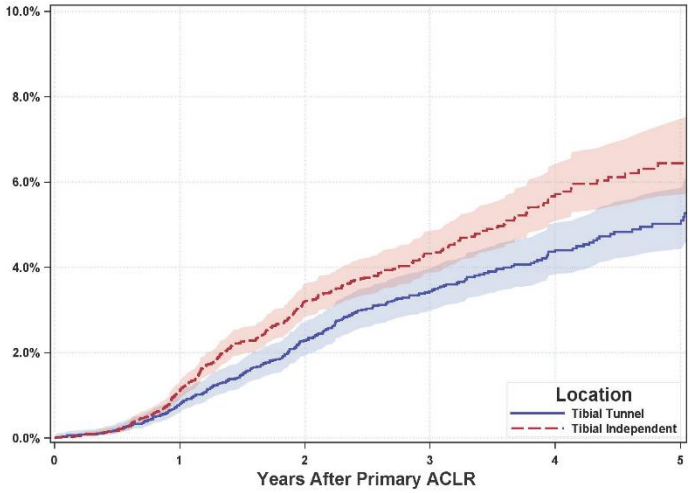
Increased Risk of Revision After Anteromedial Compared With Transtibial Drilling of the Femoral Tunnel During Primary Anterior Cruciate Ligament Reconstruction: Results from the Danish Knee Ligament Reconstruction Register

Lene Rahr-Wagner, M.D., Theis Muncholm Thillemann, M.D., Ph.D., Alma Becic Pedersen, M.D., Ph.D., and Martin Carøe 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



Femoral Drilling Tunnel Method: Risk of Reoperation and Revision After Anterior Cruciate Ligament Reconstruction

Samir Tejwani MD[1], Heather Prentice PhD MPH[1], Ronald Wyatt MD[2], Gregory Maletis MD[1]

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

After adjusting for covariates including fixation No difference

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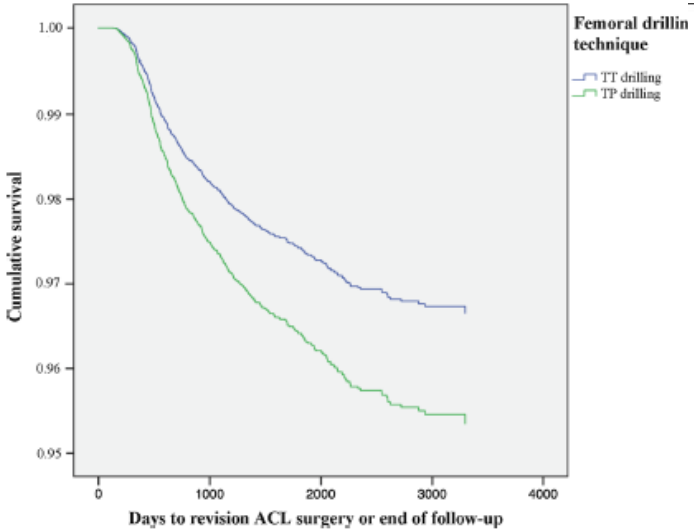
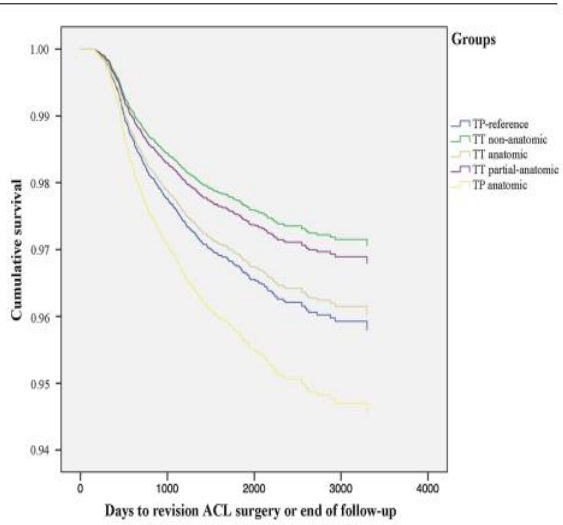
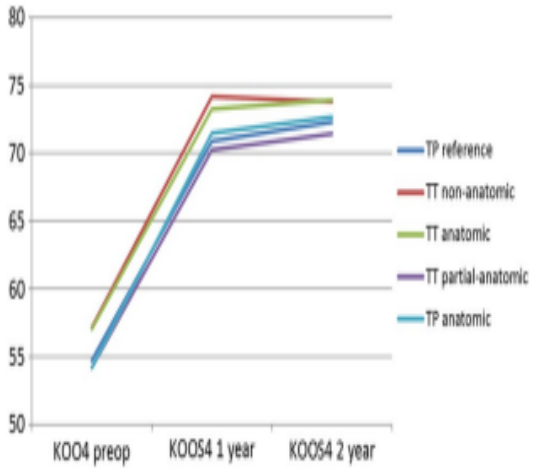
Swedish Registry Drilling method







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

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

Neel Desai[1,2] · Daniel Andernord[2,3,4] · David Sundemo[1,2] · Eduard Alentorn-Geli[5] · Volker Musahl[6] · Freddie Fu[6] · Magnus Forssblad[7] · Kristian Samuelsson[1,2]

No differences in subjective knee function between surgical techniques of anterior cruciate ligament reconstruction at 2-year follow-up: a cohort study from the Swedish National Knee Ligament Register

Eric Hamrin Senorski[1] · David Sundemo[2] · Christopher D. Murawski[3] · Eduard Alentorn-Geli[4,5,6,7] · Volker Musahl[3] · Freddie Fu[3] · Neel Desai[2,8] · Anders Stålman[9] · Kristian Samuelsson[2,8]

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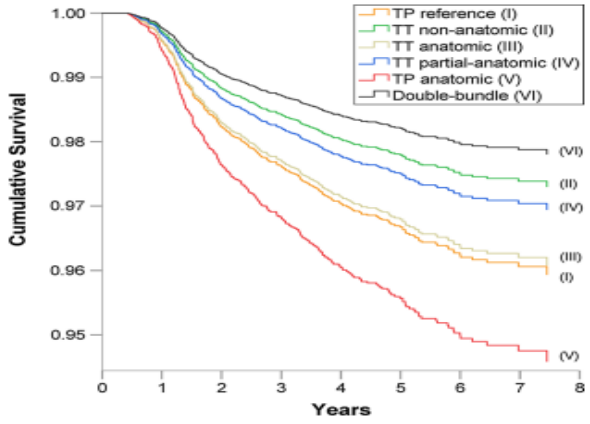
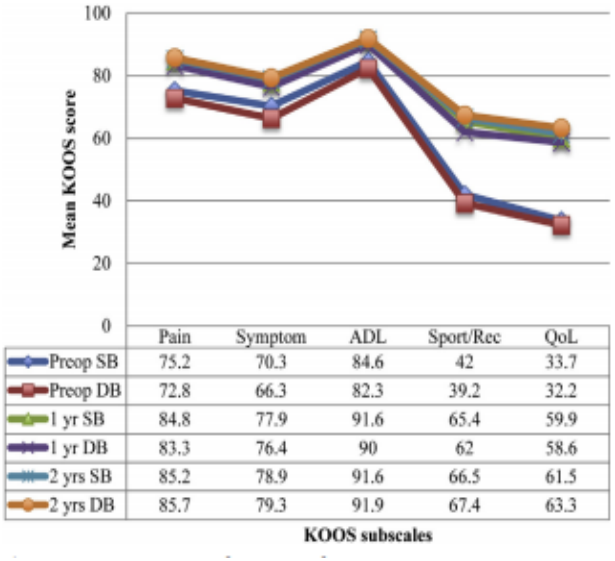
Double Bundle



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

Eleonor Svantesson[2] · David Sundemo[2] · Eric Hamrin Senorski[2] · Eduard Alentorn-Geli[3] · Volker Musahl[4] · Freddie H. Fu[4] · Neel Desai[1,2] · Anders Stålman[5] · Kristian Samuelsson[1,2]

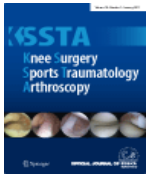


	Pain	Symptom	ADL	Sport/Rec	QoL
Preop SB	75.2	70.3	84.6	42	33.7
Preop DB	72.8	66.3	82.3	39.2	32.2
1 yr SB	84.8	77.9	91.6	65.4	59.9
1 yr DB	83.3	76.4	90	62	58.6
2 yrs SB	85.2	78.9	91.6	66.5	61.5
2 yrs DB	85.7	79.3	91.9	67.4	63.3

KOOS subscales

No Difference in Revision Rates Between Single- and Double-Bundle Anterior Cruciate Ligament Reconstruction: A Comparative Study of 16,791 Patients From the Swedish National Knee Ligament Register

Haukur Björnsson, M.D., Daniel Andernord, M.D., Neel Desai, M.D., Olof Norrby, M.D., Magnus Forssblad, M.D., Ph.D., Max Petzold, Ph.D., Jón Karlsson, M.D., Ph.D., and Kristian Samuelsson, M.D., Ph.D.



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Trends in Graft Utilization

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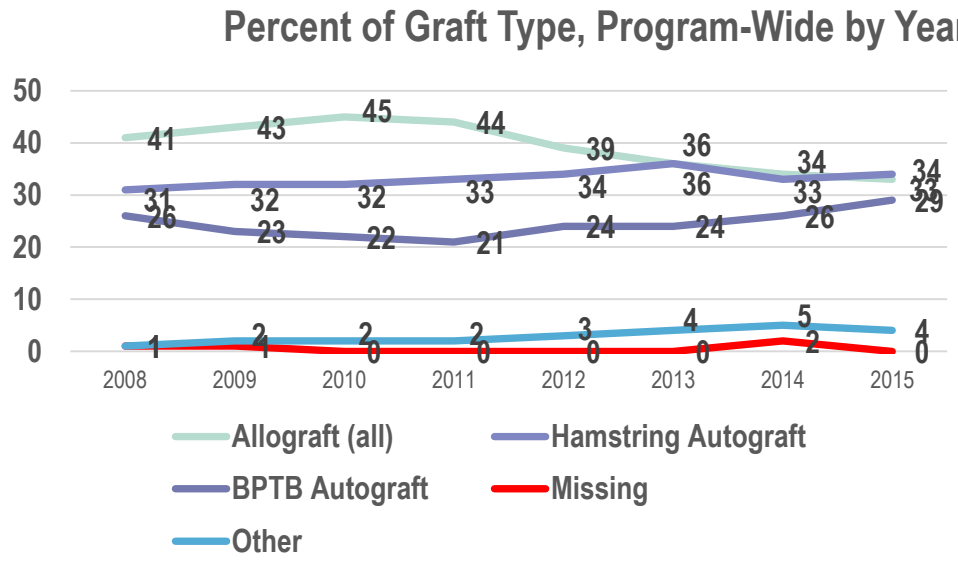

Norway

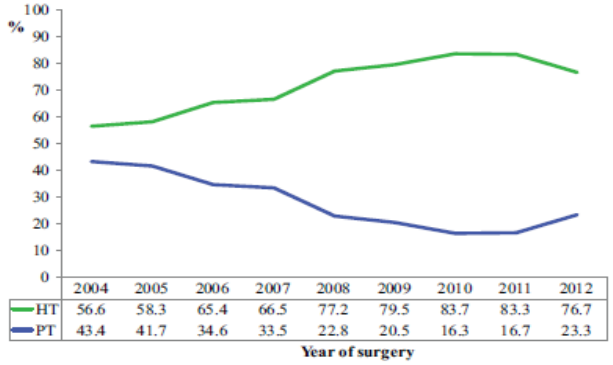

Figure 2. Time trend for graft choice for primary anterior cruciate ligament reconstruction in the Norwegian Knee Ligament Registry.

27% decrease in Allograft use
68% decrease in < 21 year olds

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Unique Outcomes

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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	

Survival Probability by Graft | Clear

Your BMI is: 25.10216

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

GRAFT NAME	PAST YEAR 1	PAST YEAR 2	PAST YEAR 3	PAST YEAR 4	PAST YEAR 5	PAST YEAR 6
Allograft - Achilles	*97.4%*	*89.2%*	*87.8%*	*83.9%*	*83.5%*	*82.4%*
Allograft - BPTB	*95.1%*	*88.1%*	*86.6%*	*84.2%*	*83.2%*	*77.0%*
Allograft - Soft Tissue	*97.6%*	*93.4%*	*90.7%*	*87.8%*	*86.2%*	*85.2%*
Autograft - BPTB	*98.3%*	*94.8%*	*93.5%*	*93.0%*	*91.8%*	*89.3%*
Autograft - Hamstring	*96.5%*	*91.2%*	*89.9%*	*88.6%*	*88.4%*	*88.3%*

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Revision Risk: 40 year old non athlete

Risk of Aseptic Revision after ACLR Surgery

Age (yrs)	40	years		
Height:	6	feet	4	inches
Weight (lbs)	240	lbs		
Injury activity:	Due to non-sport			

Survival Probability by Graft | Clear

Your BMI is: 29.21053

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

GRAFT NAME	PAST YEAR 1	PAST YEAR 2	PAST YEAR 3	PAST YEAR 4	PAST YEAR 5	PAST YEAR 6
Allograft - Achilles	*99.5%*	*99.3%*	*98.7%*	*98.3%*	*97.8%*	*97.6%*
Allograft - BPTB	*99.5%*	*99.0%*	*97.6%*	*97.1%*	*96.8%*	*96.7%*
Allograft - Soft Tissue	*99.8%*	*99.2%*	*98.7%*	*97.9%*	*96.7%*	*96.6%*
Autograft - BPTB	*99.9%*	*99.7%*	*99.5%*	*99.4%*	*99.1%*	*99.1%*
Autograft - Hamstring	*99.9%*	*99.7%*	*99.4%*	*99.3%*	*99.3%*	*99.3%*

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The Kaiser Permanente ACL Risk Calculator (KPARC) can be found at:

https://ec2-54-215-129-112.us-west-1.compute.amazonaws.com/arc/apps/appgroup/9#

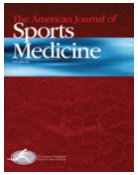
Danish Registry

Influence of anticonception hormone treatment

Relative Risk for Sustaining ACL Injury Using Oral Contraceptives or Not[a]

Variable[b]	Crude RR	Adjusted RR[c]
Never users (n = 7090)	1.0 (reference)	1.0 (reference)
Ever users (n = 6266)	0.89 (0.81-0.96)	0.82 (0.75-0.90)
Recent users (n = 1715)	0.83 (0.73-0.93)	0.81 (0.72-0.89)
New users (n = 842)	0.96 (0.82-1.12)	0.89 (0.76-1.05)
Long-term users (n = 3708)	0.90 (0.81-0.99)	0.80 (0.74-0.91)

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 Muncholm Thillemann, Frank Mehnert, Alma Becic Pedersen and Martin Lind
Am J Sports Med 2014 42: 2897



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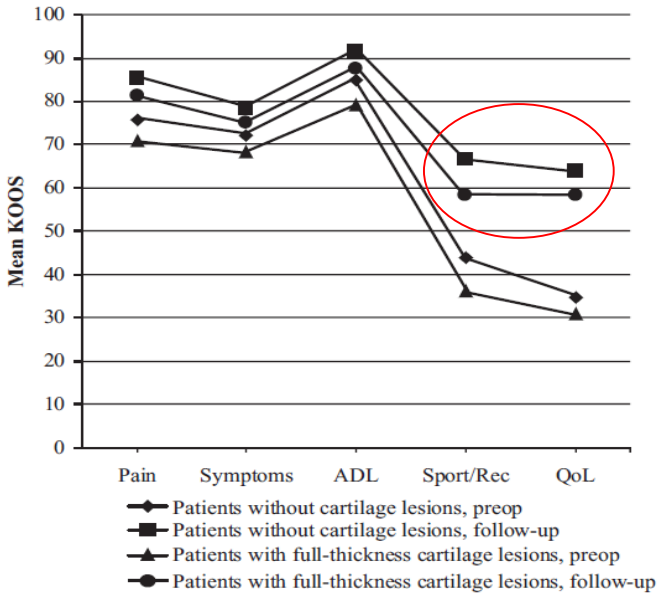
Norwegian registry

Effect of Focal Cartilage Lesion on Patient Reported Outcome



Effect of Meniscal and Focal Cartilage Lesions on Patient-Reported Outcome After Anterior Cruciate Ligament Reconstruction

A Nationwide Cohort Study From Norway and Sweden of 8476 Patients With 2-Year Follow-up

Jan Harald Rotterud,*†‡ MD, Einar A. Sivertsen,*§ MD, PhD, Magnus Forssblad,‖¶ MD, PhD, Lars Engebretsen,#**†† MD, PhD, and Asbjørn Årøen,*# MD, PhD
Investigation performed at Department of Orthopedic Surgery, Akershus University Hospital, Lørenskog, Norway

Effect of Meniscal Repair or Resection on Patient Reported Outcomes at 2 years

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

MM Repair had worse QOL and Other symptoms

Outcomes After Anterior Cruciate Ligament Reconstruction Using the Norwegian Knee Ligament Registry of 4691 Patients

How Does Meniscal Repair or Resection Affect Short-term Outcomes?

Christopher M. LaPrade,*† BA, Grant J. Dornan,† MSc, Lars-Petter Granan,*‡§‖¶ MD, PhD, Robert F. LaPrade,*# MD, PhD, and Lars Engebretsen,*‡§** MD, PhD
Investigation performed at the Oslo Sports Trauma Research Center, Oslo, Norway

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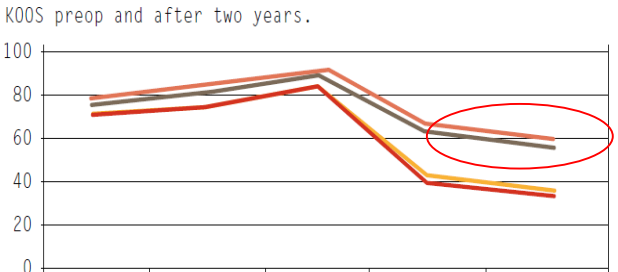
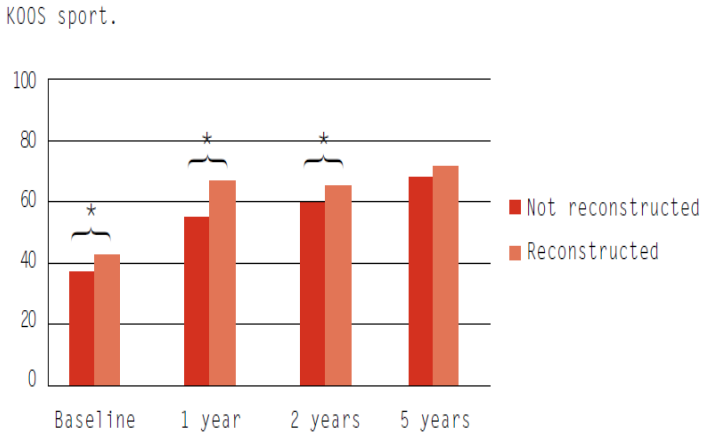
Swedish Registry

KOOS Early and Late Responders



	Symptom	Pain	ADL	Function	Quality of life
Resp. pre op.	71	75	83	41	34
Resp. two yrs	78	85	91	65	60
Late resp. pre op.	71	75	84	44	33
Late reso two yrs	75	81	89	63	56

Reconstructed and Non Reconstructed ACLs



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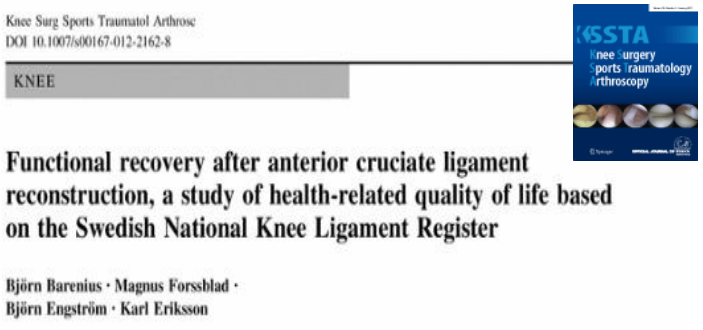
Patient Reported Outcomes

(Norwegian and Swedish Registries)



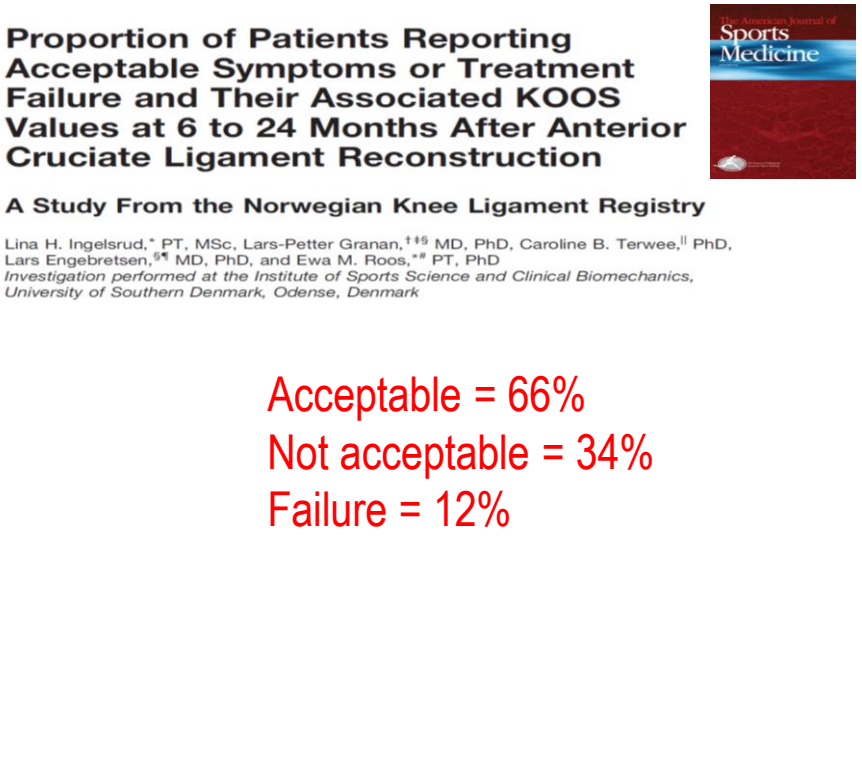
Knee Surg Sports Traumatol Arthrosc
DOI 10.1007/s00167-012-2162-8

KNEE

Functional recovery after anterior cruciate ligament reconstruction, a study of health-related quality of life based on the Swedish National Knee Ligament Register

Björn Barenius · Magnus Forssblad · Björn Engström · Karl Eriksson

Functional recovery = 19.7%
Treatment Failure = 28.9%



Proportion of Patients Reporting Acceptable Symptoms or Treatment Failure and Their Associated KOOS Values at 6 to 24 Months After Anterior Cruciate Ligament Reconstruction

A Study From the Norwegian Knee Ligament Registry

Lina H. Ingelsrud,* PT, MSc, Lars-Petter Granan,†‡§ MD, PhD, Caroline B. Terwee,|| PhD, Lars Engebretsen,§¶ MD, PhD, and Ewa M. Roos,*# PT, PhD
Investigation performed at the Institute of Sports Science and Clinical Biomechanics, University of Southern Denmark, Odense, Denmark

Acceptable = 66%
Not acceptable = 34%
Failure = 12%

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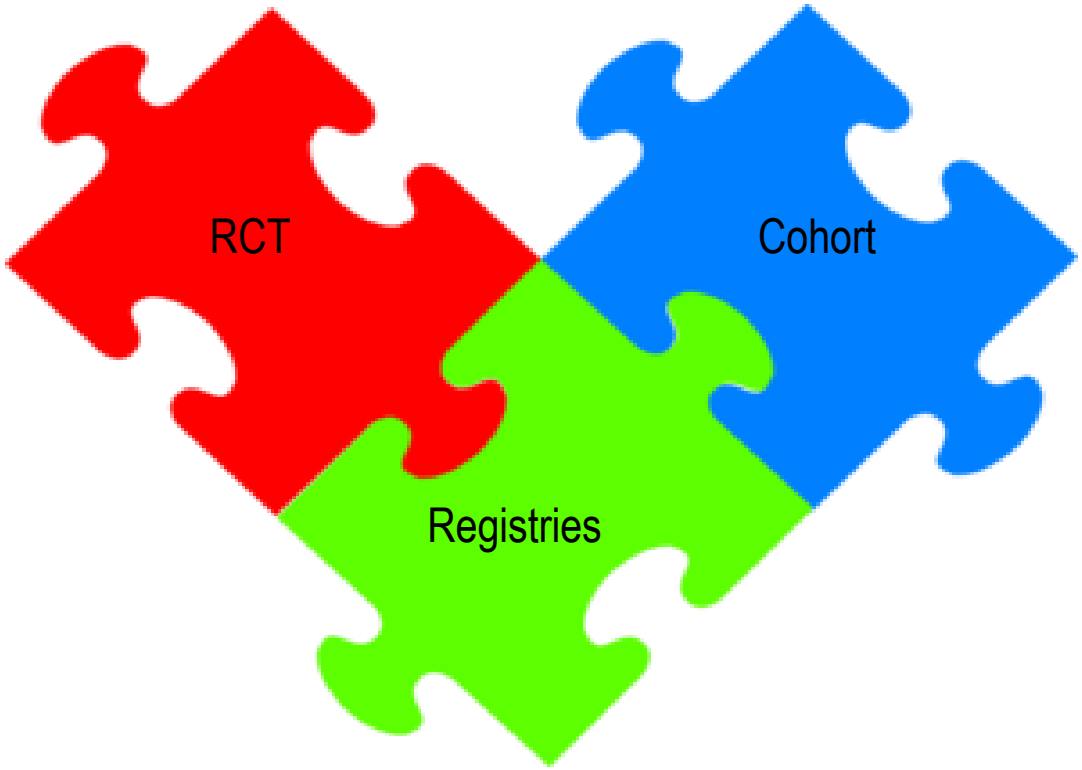
What can we take away?

- 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



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Thank you

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