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Autograft Choice

- Cochrane Review – 2011 – 14 RCT's with 2 yr minimum follow-up
  - BTB – 2.6% re-rupture risk
  - Hamstring – 3.3% re-rupture risk

p = NS

- Review – 2011 – prospective studies with 5 yr minimum follow-up
  - BTB – 4.8% re-rupture risk
  - Hamstring – 7.3% re-rupture risk
  - OR = 1.59, p = 0.20

Magnussen et al, KSSTA, 2011

Autograft Choice – Cohort Study

- MOON Group - 2015
  - N = 2488
  - Trend toward increased HS failure risk
  - OR = 1.60 (95% CI, 0.89-2.90)

Kaeding et al, AJSM, 2015

Autograft Choice – More Power

- Scandinavian Registries – 2014
  - N = 45,998
  - Increased hamstring failure risk
  - OR = 1.59 (95% CI, 1.35-1.89)
- Kaiser Registry (California) – 2016
  - N = 21,304
  - Increased HS failure risk
  - OR = 1.43 (95% CI, 1.13-1.80)

Gifstad et al, AJSM, 2014
Maletis et al, AJSM, 2016

All Patients??

- Kaiser Registry
  - Increased odds of HS failure in the young
  - Age < 20, OR = 1.61 $p < 0.05$
  - Age >20, No significant effect of graft
- Scandinavian Registries
  - Notes the strongest effect of graft type in:
    - Patients under 20 (significant effect noted in older patients as well)
    - Those in cutting / pivoting sports

Maletis et al, AJSM, 2016
Gifstad et al, AJSM, 2014

New MOON Study

- Goals – evaluate the effect of autograft type (hamstring versus BTB) on risk of subsequent ligament disruption in patients age 14-22 involving in cutting sports
- Evaluate the influence of other factors on failure risk of each graft
  - Knee Laxity
  - Age
  - Sex
  - BMI
  - Sport
  - Level

Conclusion – Autograft Choice

- Most data sources demonstrate at least a trend toward increased failure with with hamstring compared to BTB autograft
  - Odds ratios between 1.4 and 1.6
  - Absolute risk difference may be low – particularly in older patients
  - May be affected by other patient factors

Graft Specific Factors - BTB

- Anterior knee pain and kneeling pain are more frequent
  - Cochrane Review – 2011 – demonstrated increased anterior knee and kneeling pain in BTB group
  - Systematic Review – 2011 KSSTA
    - 4 prospective studies, 299 patients
    - PF OA risk
      - BTB Graft = 23.6%
      - Hamstring Graft = 10.6%

p = 0.015

Magnussen et al, KSSTA, 2011

Methods

- Data from the MOON cohort
  - Centers – Vanderbilt, Ohio State, Iowa, Colorado, Cleveland Clinic, Washington University, Hospital for Special Surgery
- Over 3500 ACL reconstructions followed prospectively
  - Graft Failure – Defined as Revision ACLR
  - Patient-Reported outcomes
    - KOOS
    - IKDC
    - Marx Activity Scale

Graft Failure (Revision Surgery)

- Potential Predictors at 2 years post-op
  - Age
  - Sex
  - Smoking Status
  - Sport following injury
  - Associated meniscus injury
  - Knee Laxity

Graft Failure

Odds Ratios for Ipsilateral Graft Tear

	Odds Ratio (95% CI)	SE	*P*
Age	0.91 (0.87-0.94)	0.02	**<.01**
Marx activity score (time zero)	1.11 (1.03-1.20)	0.04	**<.01**
Sport played			
Did not return to sport	Reference		
Football	2.34 (0.28-19.37)	2.53	.43
Basketball	1.37 (0.17-11.11)	1.47	.77
Soccer	2.29 (0.28-18.40)	2.43	.44
Other	1.81 (0.23-14.13)	1.90	.57
Sex			
Male	Reference		
Female	0.79 (0.50-1.25)	0.18	.31
Smoking status			
Never smoked	Reference		
Quit	0.55 (0.17-1.83)	0.34	.33
Current smoker	1.25 (0.47-3.31)	0.62	.65
Meniscal tear status			
No medial meniscal tear	Reference		
Medial meniscal tear	1.03 (0.64-1.67)	0.25	.89
No lateral meniscal tear	Reference		
Lateral meniscal tear	0.74 (0.48-1.14)	0.16	.17

Kaeding et al, AJSM, 2015

Graft Failure and Laxity

- Evaluated in a similar cohort of 2325 patients with complete baseline laxity data
- 2 year follow-up available on 2259 patients (96.8%)
- High-grade pre-recon laxity was defined as:
  - Lachman > 10mm different from contralateral
  - Ant Drawer > 10mm different from contralateral
  - Pivot shift: classified as 3+ (gross pivot)

Magnussen et al, AJSM, 2016

Graft Failure and Laxity

- High-grade pre-operative laxity was noted in 743 patients (31.9%):
  - High grade pivot-shift: 26.5%
  - High-grade Lachman: 14.4%
  - High-grade anterior drawer: 10.0%
- Revision performed in 94 patients (4.2%)
- Laxity was associated with significantly increased odds of ACL graft revision
  - OR=1.87, 95% CI: 1.19 – 2.95, p = 0.007

Magnussen et al, AJSM, 2016

Patient-Reported Outcomes

Variable	Timepoint[a]	Comparison	Significance at T_6 (P)			
			IKDC	$KOOS_{sports/rec}$	$KOOS_{krqol}$	Marx
Patient-reported outcomes[b]	T_0		< .001	< .001	.011	< .001
Age, y	T_6	42:24	.031	.558	.616	.070
Body mass index	T_0	28:23	.022	.0497	.130	.421
Sex	T_0	Female:male	.587	.983	.694	< .001
Smoking status[d]	T_0	Never:quit:current	.021	.448	.034	.899
Ethnicity	T_6	Other:white	.451	.599	.476	.294
Marital status	T_6	Married:other	.872	.293	.865	.245
Medial collateral ligament injury[e]	T_0	Yes:no	.668	.136	.962	.899
Lateral collateral ligament injury[e]	T_0	Yes:no	.818	.723	.993	.454
Medial compartment chondrosis[f]	T_0	Yes:no	.399	.550	.938	.226
Anterior compartment chondrosis[f]	T_0	Yes:no	.858	.334	.911	.548
Lateral compartment chondrosis[f]	T_0	Yes:no	.718	.678	.395	.710
Medial meniscus status	T_0	Normal to no treatment of tear, repair, and excision	.742	.713	.714	.145
Lateral meniscus status	T_0	Normal to no treatment of tear, repair, and excision	.127	.017	.027	.144

Spindler et al, AJSM, 2011

Summary – Patient Reported Outcomes

- Intrinsic Factors associated with poorer patient-reported outcomes (KOOS and IKDC) at 2-6 years post-op
  - Lower pre-reconstruction scores
  - Tobacco use
  - Increased BMI
  - Lateral meniscus pathology

ACL tear : Other factors

- Consistent with other data
  - Age : high revision risk among younger athletes
  - Cutting/pivoting Sports : increased revision risk in soccer players
  - High grade pre-reconstruction laxity

- "Other Intrinsic" Factors Lower pre-reconstruction scores
  - Female sex
  - Tobacco use
  - Increased BMI
  - Lateral meniscus pathology

Key points in ACLR rehabilitation
RTS (Return to sport)

CRITERIA FOR RTP

Global evaluation:

- Strength & neuromuscular control

Isokinetic Evaluation

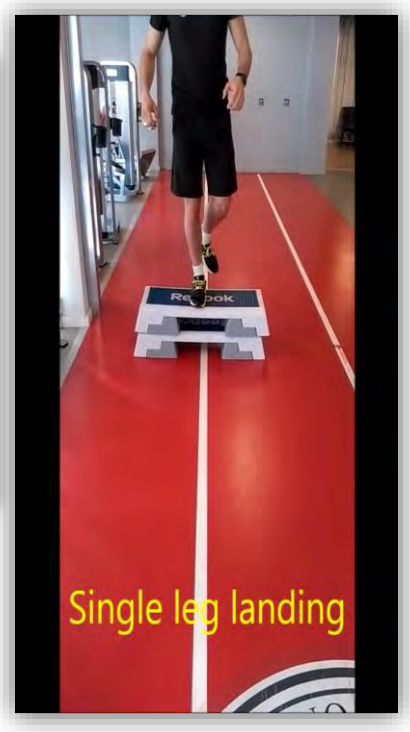
Functionnal tests

-Hop tests

-Illinois

-Excursion balance

-Landing test



Criteria for RTP

Global evaluation:

- Psychological

need objective criteria to determine

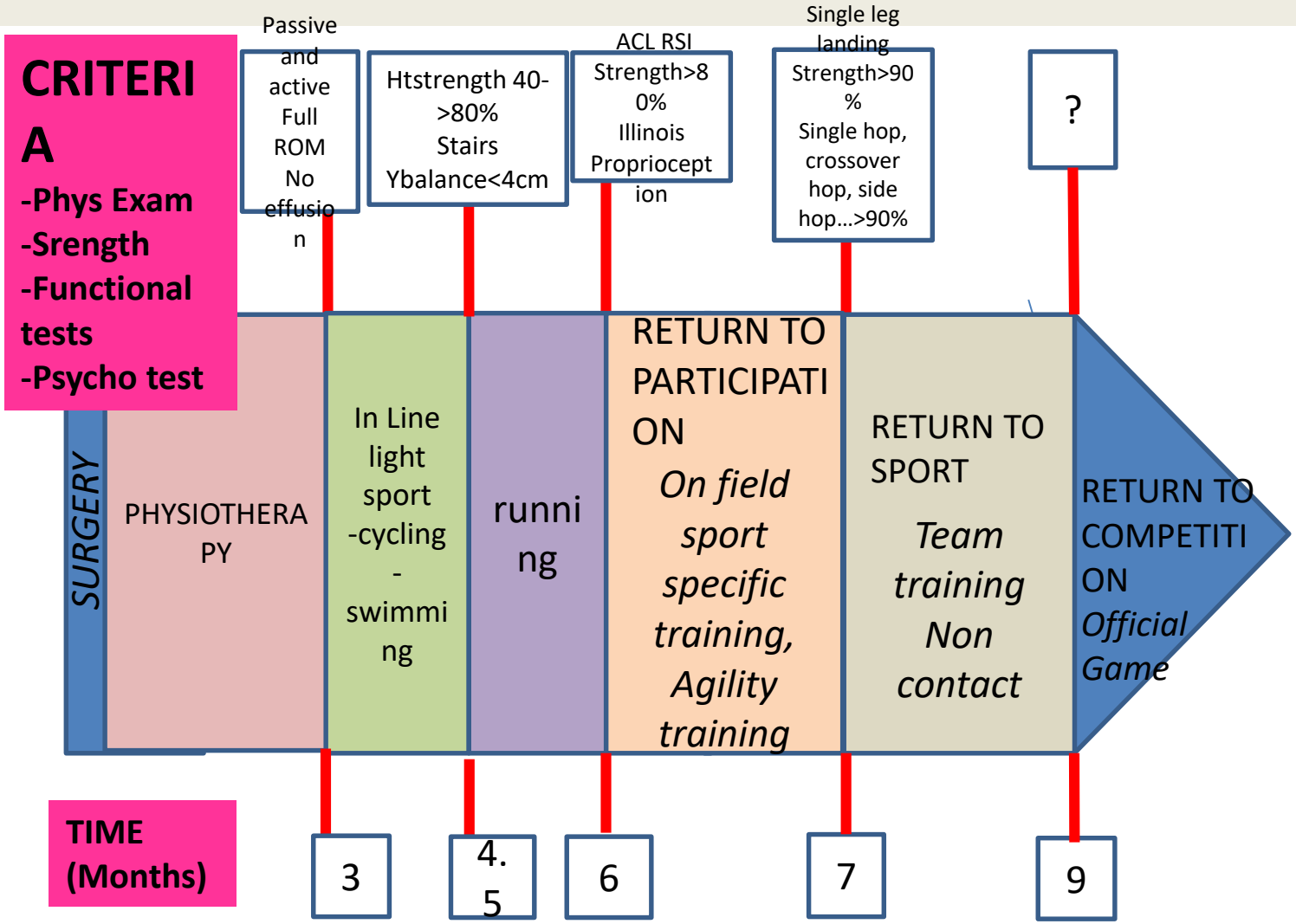
-the athlete's safety following RTP

-the athlete's physical ability to RTP

an athlete may not be able to RTP, despite passing all objective criteria, because of his or her mental state and/or expectations

"Return to sport is not a decision taken in isolation at the end of the recovery and rehabilitation process. Instead, return to sport should be viewed as a continuum, paralleled with recovery and rehabilitation."

Ardern et al BJSM 2016



Actual rate of “Return to play after ACL”?

- Meta-analysis: Forty-eight studies evaluating 5770 participants at a mean follow-up of 41.5 months
- while 82% of patients returned to some form of sports participation following ACL reconstruction surgery,
- only 63% of patients were able to return to their pre-injury level
- and only about half of patients returned to competitive sport after ACL reconstruction surgery

ARDERN CL, WEBSTER KE, TAYLOR NF, et al. Return to sport following anterior cruciate ligament reconstruction surgery: a systematic review and meta-analysis of the state of play. Br J Sports Med 2011; 45: 596-606.

When do they "Return to play after ACL"?

had attempted some form of sport by 12 months following their surgery,

- only **1/3** had returned to their pre-injury level of competitive sport participation

ARDERN CL, WEBSTER KE, TAYLOR NF, et al. Return to the preinjury level of competitive sport after anterior cruciate ligament reconstruction surgery. Two-thirds of patients have not returned by 12 months after surgery. Am J Sports Med 2011; 39: 538-43.

In a more selected population, including motivated professional athletes, it is probable that the rate of return to same level and competition should be better but the patient must be informed about the actual rate in order to fit his/her expectations.

Customized return to play process: Which factors?

- The graft and its bone integration
  - Which graft?
  - Bone integration
    - Up to 4-6 months
    - Caution with soft tissue grafts

POOLMAN RW, ABOUALI JAK, CONTER HJ, BHANDARI M. Overlapping systematic reviews of anterior cruciate ligament reconstruction comparing hamstring autograft with bone-patellar tendon-bone autograft: Why are they different? J Bone Joint Surg Am 2007; 89: 1542-52.

Customized return to play process: Which factors?

- **Psychological factors**
- Some authors have suggested that psychological factors may also contribute to the return-to-sport outcomes, as fear and motivation.
- Other factors can influence the return to play and its quality, like family situation and work involvement.

WEBSTER KE, FELLER JA, LAMBROS C. Development and preliminary validation of a scale to measure the psychological impact of returning to sport following anterior cruciate ligament reconstruction surgery. Phys Ther Sport 2008; 9: 9-15.

Club contract…

Re-injury

When can I go back to play?…"

"…without any risk?"

You mean:
with the same risk than before!"

Risk of new injury (homo or controlateral)

RTS the risk of re-injury (graft rupture) ranges in the literature from **6% to 25%**

- Risk of contralateral ACL injury ranges from **2 to 20.5%**.

Re-rupt

Likelihood of ACL graft rupture: not meeting six clinical discharge criteria before return to sport is associated with a four times greater risk of rupture

Polyvios Kyritsis,[1] Roald Bahr,[1,2] Philippe Landreau,[1] Riadh Miladi,[1] Erik Witvrouw[1,3]

Br J Sports Med 2016

concluded that athletes who did not meet the discharge criteria before returning to professional sport had **four times greater risk** on sustaining an ACL graft rupture compared with those who met all six RTS criteria. In addition, hamstring to quadriceps strength ratio deficits were associated with an increased risk of an ACL graft rupture.

Risk of new injury (homo or controlateral)

- Systematic review of six level I or II prospective studies **at least 5 years following ACL R**, using either a patellar tendon or hamstring tendon autograft.

- Ipsilateral ACL graft rupture rate ranged from 1.8 to 10.4%, with a pooled percentage of 5.8%. Contralateral injury rate ranged from 8.2 to 16.0%, with a pooled percentage of 11.8%.

- **They concluded that the risk of ACL tear in the contralateral knee (11.8%) was double the risk of ACL graft rupture in the ipsilateral knee (5.8%).**

WRIGHT RW, MAGNUSSEN RA, DUNN WR, et al. Ipsilateral graft and contralateral ACL rupture at five years or more following ACL reconstruction. A systematic review. J Bone Joint Surg Am 2011; 93(12): 1159-65.

Young age and High level of activity

- Young patients (<18 years) had the highest risk of graft rupture and they have also been shown to be up to seven times more likely to sustain a contralateral ACL injury than patients aged greater than 18 years.

SHELBOURNE KD, GRAY T, HARO M. Incidence of subsequent injury to either knee within 5 years after anterior cruciate ligament reconstruction with patellar tendon autograft. Am J Sports Med 2009; 37: 246-51.

Young age and High level of activity

- Systematic review: athletes younger than 25 years who returned to sport have a **secondary <u>ACL injury rate of 23%</u>**.
- **Younger age and a return to high level of activity** are predominant factors associated with secondary ACL injury.
- Nearly **1 in 4 young athletic patients who sustain an ACL injury and return to high-risk sport will go on to sustain another ACL injury at some point in their career**, and they will likely sustain it early in the return-to-play period.

WIGGINS AJ, GRANDHI RK, SCHNEIDER DK, STANFIELD D, WEBSTER KE, MYER GD. Risk of Secondary Injury in Younger Athletes After Anterior Cruciate Ligament Reconstruction: A Systematic Review and Meta-analysis. Am J Sports Med 2016.

Conclusion

- Return to same level sport?
  - –63%
- Return to competitive sport?
  - –50%…and 30% at 12 months!!