



CENTER OF ORTHOPAEDICS AND TRAUMATOLOGY
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ACL Reconstruction

Sports related aspects – Requirement of
high joint mobility

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Do we have to adapt our management?



Restoration of natural knee kinematics impossible after ACL - reconstruction



- Single bundle ACL-reconstruction restores AP and partially rotational stability but not femorotibiale kinematics
 - amount of excursion was similar (according to Lachmann-Test)
 - posterior subluxation of the lateral femur by 5mm

Logan, Williams et al. AJSM 2004

- Increase in external rotation of 3.8° after ACL reconstruction

Tashman, Collon et. al. AJSM 2004

- Pathological knee kinematics after ACL reconstruction

Brandsson et al: AJSM 2002

Knee function after ACL-R



Lower limb kinematics and kinetics between operated versus contralateral side and age matched healthy subjects

- 1) No difference in peak flexion angle during walking and running compared with controls (strong evidence)
- 2) Less tibial internal rotation for ACL-R knees than contralateral side (strong evidence)
- 3) No difference in external rotation during walking
- 4) Lower peak flexion moment during walking and going up- and down-stairs for the injured side than contralateral side (strong evidence)

Knee function after ACL-R



Lower limb kinematics and kinetics between operated versus contralateral side and age matched healthy subjects

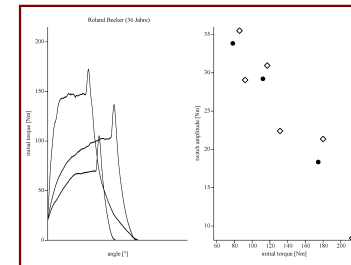
- 1) No difference in peak flexion angle during walking and running compared with controls (strong evidence)
- 2) Less tibial internal rotation for ACL-R knees than contralateral side (strong evidence)
- 3) No difference in external rotation during walking
- 4) Strong evidence of lower peak flexion moment during walking and going up- and downstairs for the injured side than contralateral side (strong evidence)

Quadriceps strength after ACL-R



Protocol

1. 5 sec. of maximal isometric contraction
2. Isometric contraction of 90%, 70%, 50%, 30% and 100% of the MVC
3. Superimposed twitches (0,5msec, 100 mA)



$$VA = \left(1 - \frac{\text{twitch amplitude at MVC [Nm]}}{\text{calculated twitch amplitude at resting quadriceps muscle [Nm]}} \right) * 100 [\%]$$

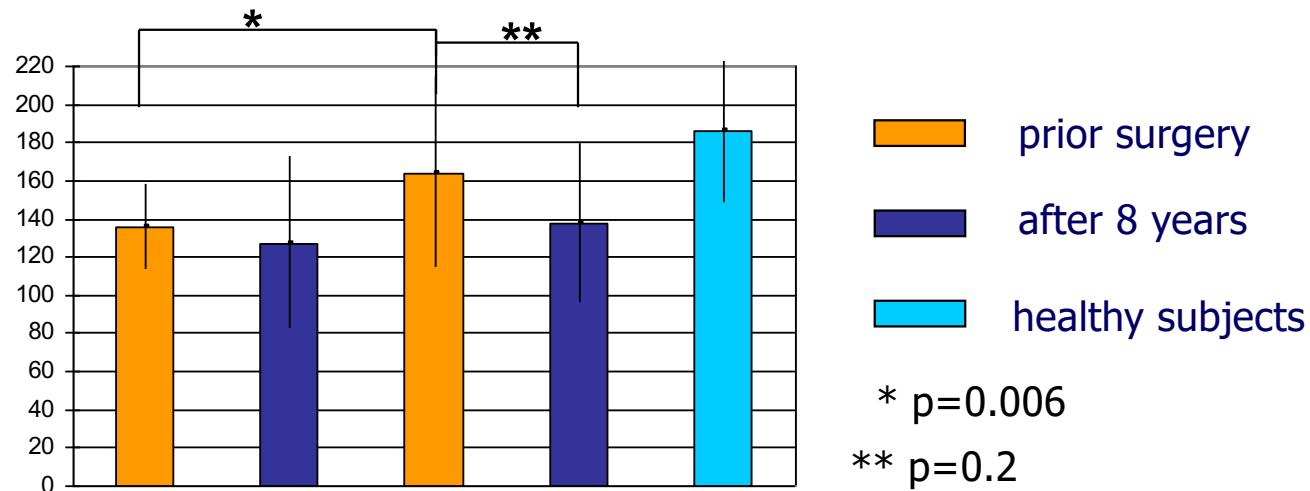
Quadriceps strength after ACL-R



| 1. Clinical results: | prior surgery | after 8 years |
|----------------------|---------------|---------------|
| IKDC | 50.1 points | 85.4 points |
| Tegner | 4.1±2 points | 7.1±2 points |
| KT 1000 | 6.1±3 mm | 1.8±1,5 mm |

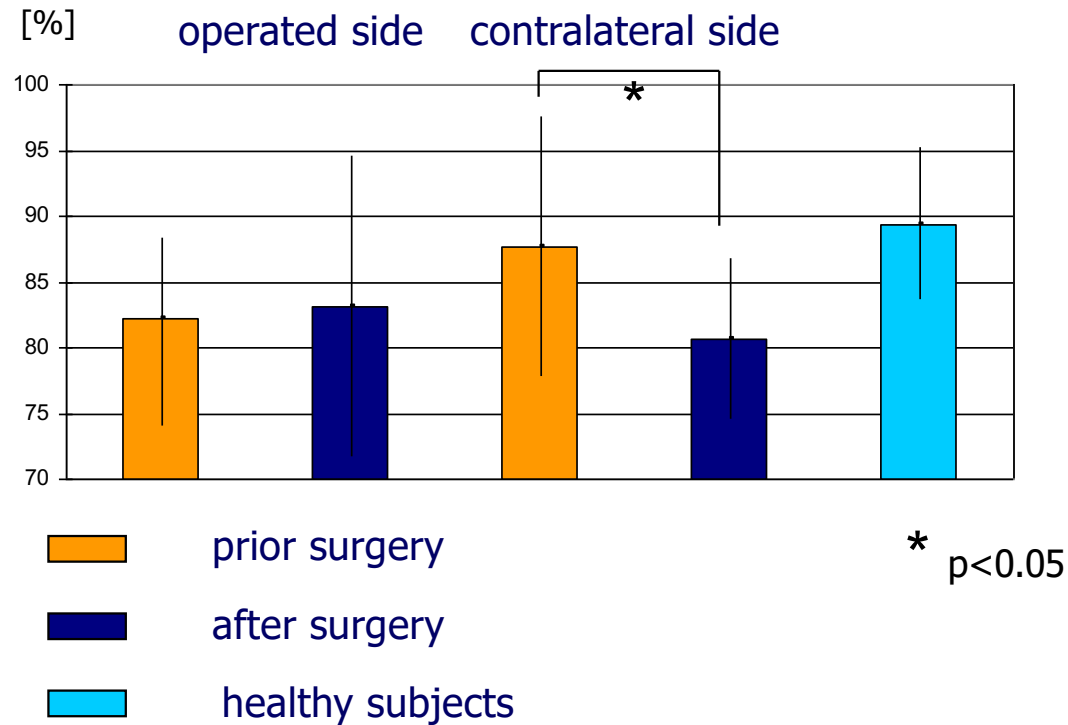
2. Maximal voluntary contraction

[Nm] operated side contralateral side



Quadriceps strength after ACL-R

3. Voluntary activation



Quadriceps strength after ACL-R



1. Impaired muscle function after ACL reconstruction on both the operated and contralateral side

Significant decrease of MVC and VA after 2 years
Differential response between copers and non-copers

(Urbach, JBJs 2001)
(Williams, J Biomechanics 2005)

2. MVC remained decreased 8 years after ACL reconstruction
BUT: Decrease in MVC on the non-operated side

Full activation but bilateral muscle weakness after 3 months

(Drechsler Eur J Appl Physiology 2006)

Inferior muscle strength after conservative and operative treatment after > 5 years

(Holder-Powell Eur J Appl Physiology 2001)

3. VA did not change 8 years after ACL reconstruction
BUT: Decrease in VA on the non-operated side

Permanent alteration of central activation patterns

Different magnitude of quadriceps-, hamstring- and soleus muscle activation (Hurd J Orthop. Research 2007)

Quadriceps strength after ACL-R



4. The usefulness of the „One leg hop – Test“ questionable to quantify muscle strength in the IKDC
5. The effect of isolated or combined knee injuries on MVC and VA remains unclear after 8 years.

Quadriceps activation deficits also after meniscus resection (Becker 2001)

Return to Sport - “external factors”



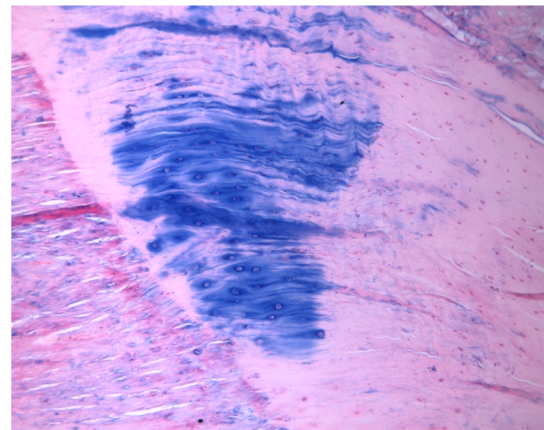
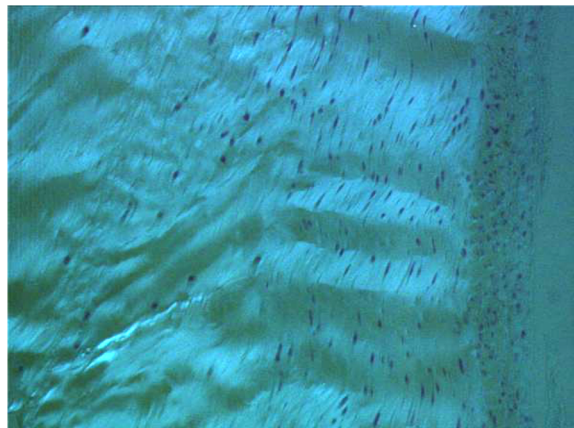
- Intensity and frequency of rehabilitation
- Motivation of the athlete
- Social environment of the athlete (trainer, family, friends)



Return to Sport - “internal factors”



- Biomechanical properties of the graft
- Remodelling of the graft
- Graft function
- Comorbidities

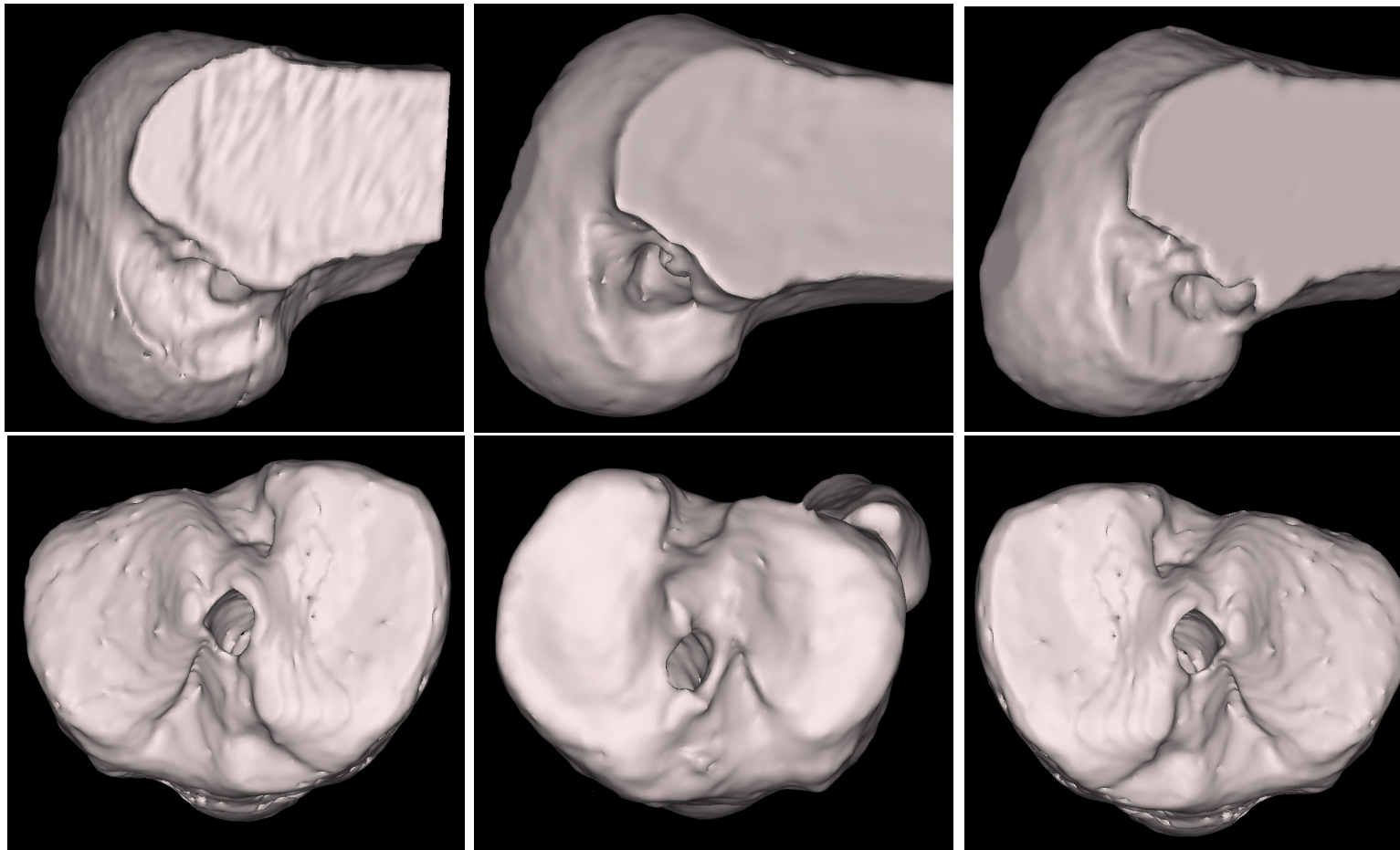


Cause of failure



- Another trauma 30%
- Surgical related reason 25%
 - Tunnel placement
 - Transplant
- Biological reason
 - Chron. synovitis
 - Arthrofibrose
- Combined reason 40%
 - Missed combined instabilities
 - Varusmalalignment
- Infection < 1%

Graft function - tunnel placement



Courtesy S. Kopf

Criteria for Return to Sport



- No pain
- No swelling
- **Free range of motion**
- Regain of muscle strength and knee function
- Normalisation of the gait
- Natural joint stability



Criteria for Return to Sport



Review based on six domains: 209 studies

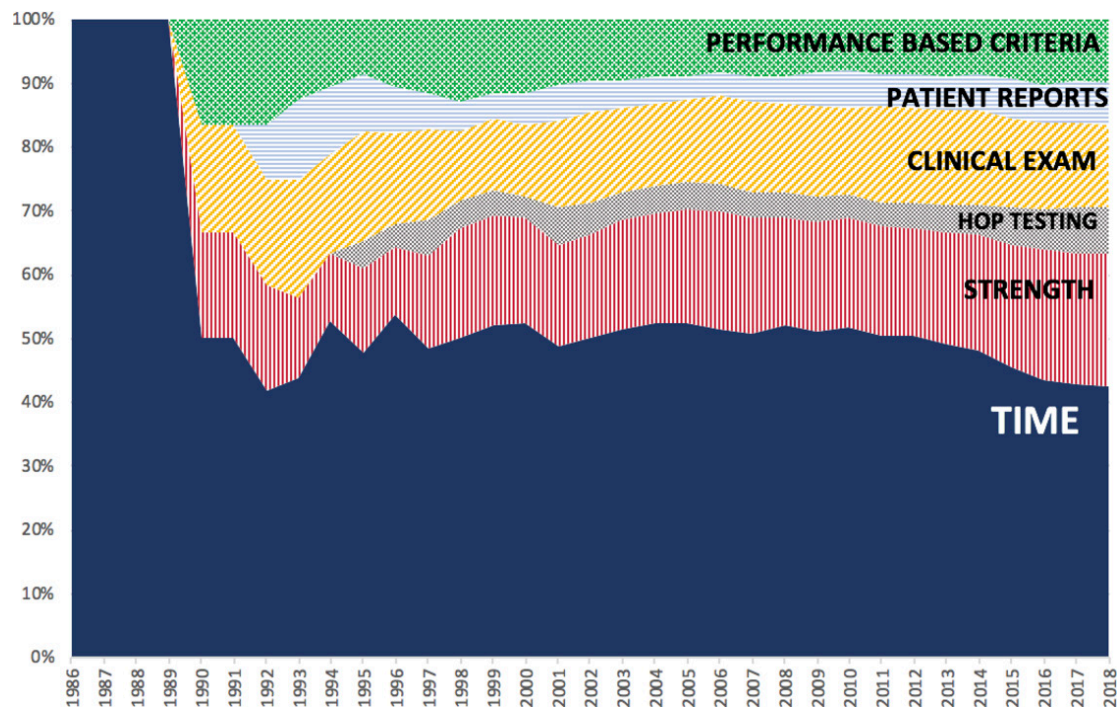
- Time (85%)
42% sole criterium
- Strength (42%)
- Hop testing (41%)
- Clinical examination (26%)
- Patients report (12%)
- Performance based criteria (20%)

Months <6 = 24%
6-9 = 72%
≥ 12 = 3%

Limb Symmetry Index
≥ 90% = 22%
≥ 85% = 9%
≥ 80% = 11%
≥ 65% = 1%

Single leg hop test 28%
≥ 90% = 17%
≥ 85% = 5%
≥ 80% = 2%

Criteria for Return to Sport



Return to Participation



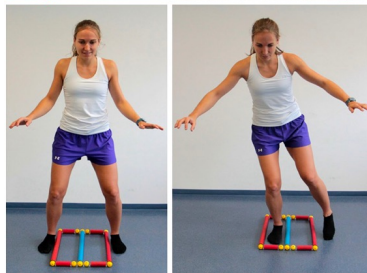
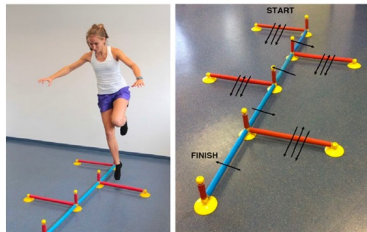
Return to Sport



Return to Performance

RTS before 9 months after ACL reconstruction 7 fold increased risk of reinjury

Back in action



TL-ST Two leg stability

OL-ST One leg stability

TL-CMJ Two leg counter movement jump

OL-CMJ One leg counter movement jump

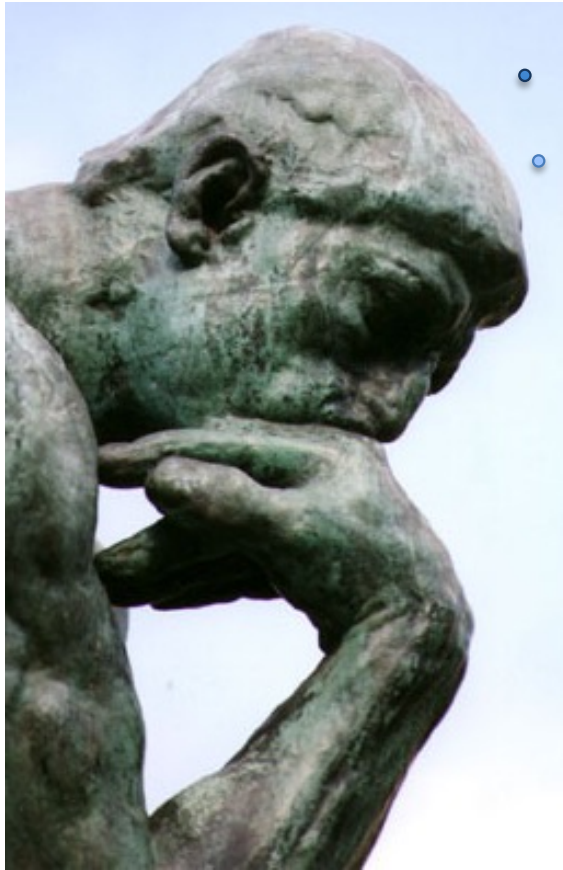
TL-PJ Two leg polymetric jump

OL-SY One leg speedy jump

TL-QFT Two leg quick feet test

Return to Sport

Surgical related
unhappyness



General emotional
and mental status

- Return to sport
- Quality of life
- Expectation

Return to Sport



N = 2100 patients

RTS + (2175 Pat)

- 64% RTS at the same level
- Interval of 17 months

RTS - (795 Pat.)

- 64% Psychological reasons
- Fear 76%
 - Lack of self confidence 14%
 - Depression 5.6%
 - Lack of motivation 2.5%

Return to Sport



N = 2100 patients

RTS + (2175 Pat)

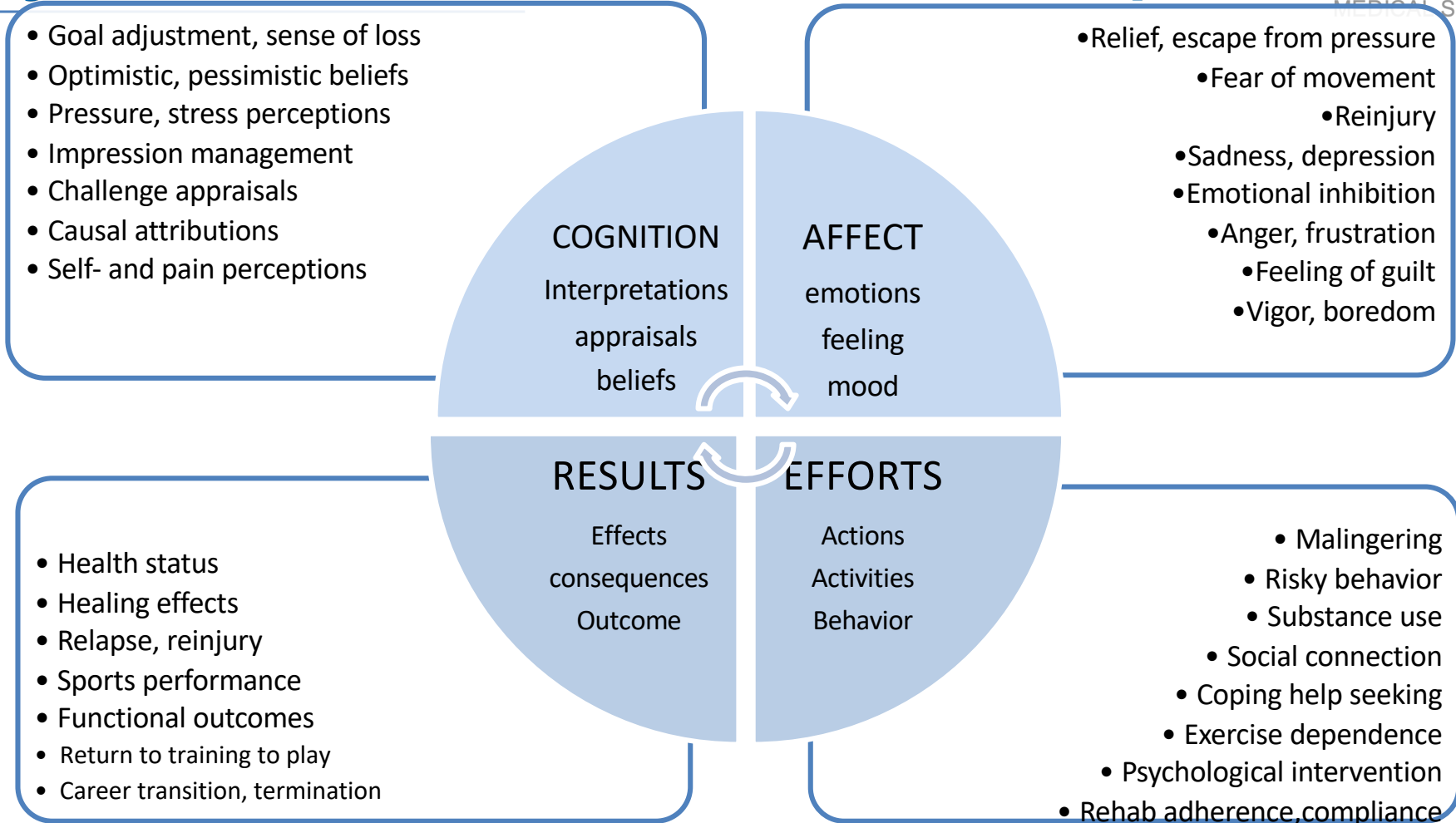
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Psychological assessment (HADS, ACL-RSI, KSES, TSK)

Psychosocial factors for return to sport



SUMMARY



- High percentage of patients do not return to the same level of sports
- Bilateral persistent quadriceps muscle deficit after ACL reconstruction
- Psychosocial factors play an important role in RTS
- Predictive factors show significant impact on outcome
- Surgical precision is essential to regain full range of motion