

Anterior cruciate ligament injuries in children and adolescents

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Valorisation

The incidence of ACL injuries in adolescents is increasing [1]. Compared to adults, the risk of graft failure or a contralateral ACL injury is higher after ACL reconstruction [2]. An ACL injury can be considered as a permanent injury to the knee. On the long term, there is an increased risk of posttraumatic osteoarthritis of the knee [3]. In case of concomitant meniscus or cartilage injury, posttraumatic osteoarthritis can even be manifest at 30 or 40 years of age [3]. The importance of primary prevention for ACL injuries and secondary prevention for meniscus and cartilage injuries after ACL injury is therefore clear.

Primary prevention is of uttermost importance, as the incidence of ACL injuries among girls aged 13 to 15 years is increasing rapidly [1]. Girl's football (soccer) has the highest ACL injury rate of all sports [4]. In the Netherlands, the participation of girls in football is increasing in recent years [5]. Although no epidemiological data on ACL injuries in children and adolescents are available in the Netherlands, it seems obvious that there should be more attention on the primary prevention of ACL injuries in this vulnerable population. Biomechanical movement patterns are a key modifiable risk factor for injury and injury prevention programs target at movement patterns [6,7]. Injury prevention programs have shown to be effective in reducing the number of primary ACL injuries in skeletally mature patients and secondary ACL injuries after ACL reconstruction. Those injury programs are straightforward to implement as they require little to no equipment and can be performed as regular team training or during physical education programs [6,7]. Given the low costs and ease of implementation, neuromuscular training of all young athletes represents a cost-effective strategy for reducing costs and morbidity from ACL injuries [6,7]. Although primary prevention was not one of the aims of this thesis, I believe that it is important to highlight this topic in this thesis at the impact paragraph. If we are able to prevent ACL injuries among children and adolescent by drawing more attention to this topic and create awareness for the role of primary prevention programs, the impact of this thesis is more relevant.

When a child or adolescent sustains an ACL injury, timely diagnosis is essential to prevent secondary damage to the menisci or cartilage. In **Chapter 3**, the diagnostic values of history taking were evaluated in order to help clinicians to screen for ACL injuries in this population. Timely suspicion may lead to timely referral and timely diagnosis. Timely diagnosis is the start point for management planning and shared decision making [6]. An adequate, physiological age based rehabilitation is furthermore important to prevent damage to the knee. As discussed in **the General discussion**,

a more individualised approach seems to be necessary, because children and adolescents with an ACL injury present in different physiological and developmental stages. Those children and adolescents may also have different underlying risk factors for ACL injuries and may present with concomitant injuries which have to be addressed. This individualised approach makes diagnosis and treating children and adolescents, especially in case of open growth plates, rather complex. Hence, we aimed to develop a practice guideline for adolescent ACL rehabilitation which can be used in day-to-day practice in **Chapter 9**. We believe that this is an important step toward reducing practice inconsistencies, closing the evidence-practice gap, and improving quality of rehabilitation after adolescent ACL injury.

Should any specialised knee (sports) surgeon and physiotherapist treat children and adolescents with open growth plates? As discussed in **Chapter 2**, in the survey among NVA members, it was found that many surgeons are consulted by only a few skeletally immature patients and perform ACL reconstructions on even less patients. These numbers do not specifically include paediatric orthopaedic surgeons, as the survey was conducted among members of the NVA and not among the Werkgroep Kinderorthopedie (WKO). These numbers do also not include the experience of the physiotherapists who are guiding the rehabilitation process. Given the complexity of growth and physiological development, specific expertise in rehabilitation of children and adolescents and the potential complications of ACL reconstruction, should children and adolescents with open growth plates be treated in a rather multidisciplinary, specialised team of knee (sports) surgeons, paediatric orthopaedic surgeons and paediatric sports physiotherapists? ACL reconstructions are often performed by knee (sports) surgeons, however can also be performed by paediatric orthopaedic surgeons [8]. A study among American orthopaedic surgeons showed no significant differences in outcomes between knee sports orthopaedic surgeons or paediatric orthopaedic surgeons [8]. Paediatric orthopaedic surgeons have specific knowledge of musculoskeletal growth and are able to diagnose and treat growth disturbances. In case of growth disturbances, it is essential that a paediatric orthopaedic surgeons can be consulted as knee sports orthopaedic surgeons do not often treat growth disturbances.

Rehabilitation of children and adolescents is depending on the physiological age and specific treatment regimens and criteria should be used, as discussed in **Chapter 9**. In case of severe kinesiophobia or post-traumatic stress disorder symptoms, I argue that a paediatric psychotherapist also be included in a multidisciplinary team [9]. Psychological factors have to be taken in consideration and to be treated when necessary. In order to improve the re-injury outcomes, reduce secondary



meniscal and chondral injuries and to prevent and treat growth disturbances, this multidisciplinary approach might be a valuable step in increasing the quality of care for this vulnerable population. One might consider, regarding the (relatively) low incidence of ACL injuries in skeletally immature patients, to organise several centres of expertise including a multidisciplinary and dedicational team, which also participates in (internationally) scientific research programs. This expertise and data, gathered for example in the PAMI registry, is important to gain more evidence on this topic and to improve care for these patients [10].

With this thesis, I want to draw attention to ACL injuries in children and adolescents in the Netherlands and hopefully to start multidisciplinary collaborations and discussions, in order to centralise and optimise care. At this point, the incidence of ACL injuries in adolescents is increasing, treatment protocols and surgical techniques are becoming more complex and there are high risks of re-injuries with – probably – poor long term knee health. As the evidence in general is still low however, this takes us back to the primary aim of this thesis: to gain insight in the current state of care in the Netherlands, to gain evidence on basic topics within diagnostics and predictors and to create outcome measures and rehabilitation protocols for future clinical and scientific use. The impact of this thesis can be summarised:

- The current state of care for children and adolescents with ACL injuries in the Netherlands are known, which is necessary for organising, and centralising, care for these patients
- Diagnostic values of history taking, physical examination and KT-1000 arthrometer are studied and questions for early referral for ACL injuries are formulated
- Hamstring tendon lengths and graft characteristics can be predicted preoperatively and in case of a closed socket technique, hamstring tendons are sufficient to create a graft of ≥ 8 mm
- Lateral tibial slope is a morphological factor to take in consideration before and after ACL reconstruction as a risk factor for re-injuries
- There is an evidence based overview knee specific, paediatric patient reported outcome measures
- A short and simple paediatric activity scale is translated and transculturally validated in Dutch for clinical and scientific use
- There is an evidence based overview of current tests and outcomes regarding return to sports after ACL reconstruction in children and adolescents
- Based on an international expert panel, new (p)rehabilitation guidelines are created for children and adolescents based on physiological age

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