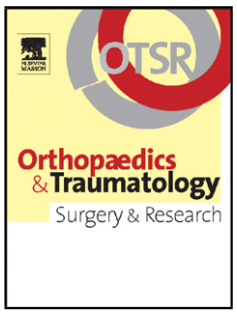

Title: Complications following harvesting of patellar tendon or hamstring tendon grafts for anterior cruciate ligament reconstruction: Systematic review of literature

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Review article

Complications following harvesting of patellar tendon or hamstring tendon grafts for anterior cruciate ligament reconstruction: Systematic review of literature

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Conflict of interest: None

ABSTRACT

Introduction Anterior cruciate ligament (ACL) reconstruction can be performed with an autograft, which is most often harvested from the patient's hamstring tendon (HT) or patellar tendon (PT). However, autograft harvesting leads to morbidity that is by no means insignificant.A systematic review of literature was performed to define the incidence of complications related to graft harvesting and the methods to prevent these complications.

Materials and methods

In March 2017, a systemic review of literature was performed using the keywords“harvesting”, “harvest”, “morbidity”, “complication”, “cruciate ligament”. No time limit was applied. The studies had to be written in French or English with their abstract available online. This initial search based on the title and abstract identified 133 articles. Two independent observers analyzed each article entirely, including the references.

Results

In all, 36 articles were retained. The main complication of HT harvesting was sensory deficit because of damage to the infrapatellar branches of the saphenous nerve. This complication occurred in 39.7% to 88% of patients. This risk can be reduced by using a horizontal or oblique incision. The main complication following PT harvesting is anterior knee pain, reported in up to 46% of patients.

Discussion

There are substantial numbers of short-, medium- and long-term complications related to the harvesting of the two main ACL autografts. Effective means of prevention exist to reduce the risk of these complications.

Keywords – *Hamstring, patellar tendon, patellar ligament, nerve complication, harvesting site, prevention*

Level of evidence: II Systematic review of literature

INTRODUCTION

Reconstruction of the anterior cruciate ligament (ACL) is a common procedure [1, 2] with good functional outcomes; however only 25% of operated patients have a subjective IKDC (International Knee Documentation Committee) grade of A [3, 4]. Reconstruction is performed with an autograft in most cases in France [5]. Allograftsare used in the United States andin a limited number of casesin France [6, 7]. Although using an allograft removes the morbidity related to harvesting, its cost, contamination risk and high rupture rate are drawbacks [8-10].

The most commonly used grafts are taken from the patellar tendon (PT), hamstring tendons (HT), fascia lata (FL) and quadriceps tendon (QT). The functional outcomes are similar for the various types of grafts, although some differences in the retear rate have been reported [11-13]. Each type of autograft has specific complications related to the harvesting site. These complications may have short-term, medium-term or long-term clinical effects.

The primary objective was to analyze the complications related to harvesting of autografts commonly used for ACL reconstruction; the secondary objective was to describe the main preventative measures that can be used to reduce the iatrogeny of the harvesting. We hypothesized that a systematic review of literature would allow us to define the complications related to harvesting of the main types of autografts used for ACL reconstruction.

MATERIALS AND METHODS

Search strategy:

The structure of this review followed the recommendations [14] on systematic reviews of literature and meta-analyses [15]. The objectives, analysis methods, and inclusion and exclusion criteria were determined before the data were collected. In March 2017, a literature search was performed of the PubMed, Medline, CINAHL, Cochrane and Embase databases. The MeSH headings used were "harvesting" AND "morbidity" AND "cruciate ligament" (query 1 – Q1) then "harvesting" AND "complication" AND "cruciate ligament" (query 2 – Q2) then "harvest" AND "complication" AND "cruciate ligament" (query 3 – Q3) and lastly, "harvest" AND "morbidity" AND "cruciate ligament" (query 4 – Q4).

The initial selection of articles based on the title and abstract was carried out by two co-authors (TN, AH) separately. If there was disagreement about the status of an article, the two co-authors discussed it to come to a consensus. A second filtering step was applied by reading the entire article and reviewing the reference list of each selected article to make sure that no key article on this topic had been overlooked. The following data were extracted from the articles: complication type and complication rate related to the harvesting site and proposed preventative measures. The selected studies:(1) had no time limit on the publication date, (2) were written in either English or French, (3) had an abstract available online.

Selection criteria: Inclusion criteria consisted of all articles that reported unusual intercurrent events during the postoperative course of ACL reconstruction attributed to autograft harvesting. The other inclusion criteria for the articles were: (1) adult patients, (2) indication for ACL reconstruction with an autograft, (3) use of an autograft. The following exclusion criteria were used: (1) high-energy trauma with vascular and nerve damage, (2) injury to the posterior cruciate ligament, multiple ligaments or bone, (3) bone procedure along with ligament surgery, (4) surgical revisions, (5) allograft, (6) article featuring only QT or FL grafts. Articles featuring the harvesting of QT or FL grafts were excluded because the small number of cases in these studies did not provide interpretable results. Thus our study

87 focused on articles featuring the harvesting of HT and PT grafts. We also attempted to
88 differentiate between anterior knee pain and loss of sensibility.

RESULTS

Bibliometrics

The keyword searches identified 133 articles among the four queries (44+17+13+59). Three articles were added after reviewing the reference list of the selected articles [16-18]. In all, 36 articles were included (Fig 1) that brought together 5526 ligament reconstruction cases, of which 4142 were performed with a PT graft. The publication date of these articles ranged from 1994 to 2016. Nine of these articles (25%) had a level I evidence, 13 articles (36%) had level II, 0 were level III, and 14 articles (39%) were level IV.

HT Complications

Surgical complications related to harvesting of the HT occurred in 8.3% of cases [19]. Anterior knee pain was reported specifically in 38% of cases in a single article [20]. Sensory deficits due to lesions of the infrapatellar branches of the saphenous nerve were reported in 39.7% [21, 22] to 88% [23] of patients. Sanders et al. [24] found a 74% prevalence of sensory deficits after HT harvesting due to damage to the infrapatellar and sartorial branches of the saphenous nerve (medial crural cutaneous branches), which is located close to the gracilis. Flexion strength deficits [25] and internal rotation strength [26] deficits were reported in patients who had two HTs harvested (gracilis and semitendinosus) up to 1 year postoperative [27]. Various studies [28-30] have found these deficits to be transient (up to 3 months' postoperative). Harvesting of the HT does not alter the neuromuscular, biomechanical or endurance characteristics in the medium term [31].

Prevention of HT complications

A horizontal incision reduces the rate of infrapatellar branch lesions from 39.7% to 14.9% according to Papastergiou et al.[21] and from 59% to 43% according to Portland et al. [16]. This observation has been reported by other authors whether a horizontal [32] or oblique incision is used [22]. Conversely, Kjaergaard et al. [23] found no differences between a vertical and oblique incision. Minimally invasive [33] and posterior [34] approaches have been described that can theoretically reduce the risk of nerve damage. Harvesting the semitendinosus only avoids flexion and internal rotation strength deficits [25, 26].

PT Complications

The rate of surgical complications related to PT harvesting in various studies ranged from 0.2% [35] to 1.21% [19, 36]. The incidence of patellar fracture during the harvesting ranged from 0.42% [37] to 1.3% [18]. Rupture of the remaining PT has been reported 10 months to 6 years after surgery due to changes in the tendon's properties and devascularization[38]. The frequency of anterior knee pain was 46% according to Breitfuss et al.[39]. Tsuda et al. found a correlation between anterior knee pain and sensory disorders after PT harvesting, which was present in 13% of cases after the graft was harvested through a double incision [40].

127

128 ***Discussion***

129 Despite the low number of studies reporting harvesting-related complications, 25% of these
130 articles were level I studies, making this analysis relevant. This review is novel because it was
131 conducted according to the principles of systemic reviews of literature by two independent
132 authors and used strict selection criteria. It confirms that the complication rate following ACL
133 reconstruction is not insignificant, no matter which type of autograft is used. Effective
134 means for eliminating these complications have been described.

135 In the context of HT harvesting, the reported rate of saphenous nerve damage is up to 88%
136 [23], making it the principal complication. This incidence can be reduced theoretically to
137 14.9% by changing the graft harvesting approach [41]. A recent systematic review of
138 literature showed that an oblique incision was slightly better than a vertical incision [42].
139 Other authors prefer using a minimally-invasive technique [33] or a posterior approach [41,
140 43] to attempt to preserve the infrapatellar branches of the saphenous nerve or the
141 saphenous nerve itself. Harvesting the HT through a posterior approach is more esthetic [44]
142 and allows better early muscle recovery[45].

143 The main complication related to PT harvesting is anterior knee pain reported in up to 46%
144 of cases [39, 46]. To reduce the incidence of anterior pain, some authors have proposed
145 using a minimally invasive approach for graft harvesting [47] or a double transverse incision
146 [17, 40]. A double incision helps to reduce the incidence of anterior knee pain to 13% [48,
147 49]. Moreover, a double incision does not compromise the healing of the patellar tendon as
148 there are no benefits to closing the PT after harvesting of the graft[50] and its healing is
149 gradual according to an MRI study [11]. The addition of platelet-rich plasma at the harvest
150 site has led to promising results in terms of limiting anterior knee pain [51, 52]. Lastly, bone
151 grafting of the tibial defect has no demonstrated benefit on morbidity at the harvest site
152 [53]. According to Shelbourne et al. [54], attaining full hyperextension during the
153 postoperative recovery phase will help reduce the incidence of anterior knee pain.

154 Patellar fracture occurs in more than 1% of cases [18]. This is a rare but serious complication
155 of PT graft harvesting. There is no advantage to using a guided technique versus free-hand

harvesting [55]. The risk of transverse patellar fracture is reduced when using the Mac InJones technique [56] where one-third of the PT is harvested; the shape of the harvested bone blocks has no effect on the fracture risk [57].

Another problem with autograft harvesting is the resulting muscle strength deficit and its impact on rehabilitation. In the Xergia meta-analysis, a persistent flexion strength deficit inthe HT group and an extension strength deficit in the PT group was found at 12 months' postoperative [58].Use of a short hamstring graft (single tendon harvested) does not appear to significantly improve strength recovery [59]. Harvesting the graft from the contralateral leg allows optimal quadriceps strength recovery in certain studies [54], with the quadriceps strength being 69% of the initial strength after 6 weeks in a knee where only the graft was harvested [60].

The type of graft harvested often depends on the surgeon's preferences.Morbidity of the harvesting site must be taken into account when selecting a graft and the patient must be informed fully of this possibility before the surgery. One alternative is using an allograft, which reduces the surgery time, morbidity of the harvest side and postoperative pain [61, 62]. Nevertheless, patients who receive an allograft appear to have a higher retear rate [63]. There are also challenges related to the availability of allografts, given the common nature of this surgical procedure.

This systematic review of literature has some limitations. Our analysis revealed that anterior knee pain was a different symptom than loss of sensitivity. The term "anterior knee pain" did not have the same meaning in all the analyzed studies.Some authors included pain related to patellar femoral syndrome or tendinopathy-related pain after PT harvesting under the umbrella term "anterior knee pain". Another limitation of this study is that we identified few studies focused on the complications related to harvesting of the QT or FL.

CONCLUSION

Each type of autograft harvesting procedure has specific complications. HT harvesting leads to more nerve-related complications and sensory deficits while PT harvesting leads to more

184 cases of anterior knee pain and extensor mechanism deficits. The incidence of these
185 complications can be reduced by following certain harvesting rules.

186

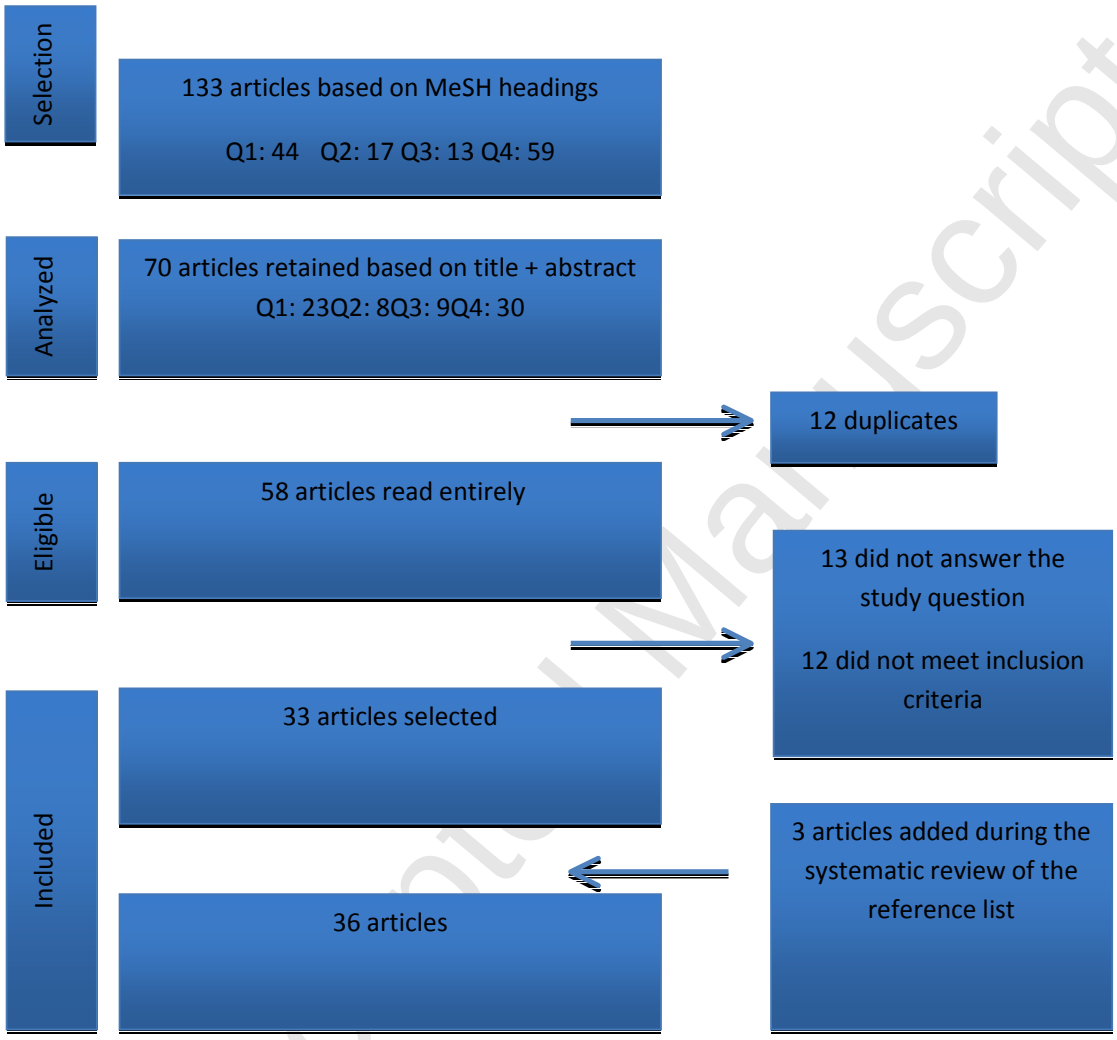

Fig 1:Flow chart for systematic review of literature: identification, selection and inclusion of analyzed articles

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