

1 Development and test of a decision aid for shared decision making in 2 patients with anterior cruciate ligament injury

4 Abstract

5 Rationale, aims and objectives

6 Patients with anterior crucial ligament injury are faced with a choice between surgery or non-
7 surgical treatment with intensive rehabilitation. Evidence shows that surgical treatment is not
8 superior to non-surgical treatment. To offer patients a treatment meeting their individual values,
9 lifestyle and conditions, patients must be involved in the decision-making. The aim of the study
10 was to develop and evaluate a patient decision aid to support shared decision-making.

11 Method

12 Development of the patient decision aid was based on international criteria, current literature,
13 and former patients' experiences and suggestions on how to optimize the decision-making
14 process. The patient decision aid was evaluated by the SDM-Q9 questionnaire and semi-structured
15 interviews with patients and doctors.

16 Results

17 A patient decision aid for patients with and an anterior crucial ligament injury was developed. On a
18 scale from 0-5, patients experienced a high degree of shared decision-making in their treatment
19 decision both before (score 4.3) and after (score 4.3) implementation of the patient decision aid.
20 No statically significant difference was found ($p=0.72$). From interviews, patients expressed that
21 they found the patient decision aid very useful. Especially, reflection time was important for some
22 patients. Doctors reported that the patient decision aid improved shared decision-making by
23 supporting the dialogue clarifying patients' values concerning issues important for treatment
24 choices.

25 Conclusion

26 No statically significant difference in the SDM Q9 -score was found between patients' perceptions
27 of shared decision-making before and after implementation of a patient decision aid. However,
28 patients experienced the decision aid as very useful when making treatment decisions, and
29 doctors reported that it improved the dialogue clarifying patients' values important for the
30 treatment options.

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32 **Keywords:** Patient-centered care, Evaluation, Person-centered medicine

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Introduction

To achieve the best treatment results for patients with an anterior cruciate ligament (ACL) injury, it is important to involve patients in the decision-making about treatment options to provide the treatment that matches values, lifestyle and conditions of the individual patient.

More people are physically active as a part of a healthy lifestyle, leading to an increase in the incidence of joint injuries ¹. In Denmark, with a population of 5.5 million people, 5000 patients annually are expected to contact the hospital with a ACL injury ². The aim of this study was to develop a method to ensure that patients with an ACL injury choose the treatment option that matches their individual wishes and needs.

ACL injuries are especially common among athletes, typically resulting from a valgus-internal rotation injury to the knee. The injury leads to joint instability and thus decreased activity, unsatisfactory knee function, and poor knee-related quality of life ³⁻⁵. Historically, ACL injuries have usually been treated surgically and generally accomplished arthroscopically by use of a patellar tendon or hamstring tendon autograft ⁶. Rehabilitation alone has more recently been advocated as an alternative treatment to surgery even for people with high demands on their knee function ⁷⁻⁹. The highly profiled randomized clinical trial by Frobell et al. ¹⁰ demonstrated that structured rehabilitation as initial treatment for an ACL lesion led to a satisfactory outcome in half of the patients. These results have led to a worldwide shift in the treatment strategy for ACL injury, and more patients are offered non-operative treatment. Surgical and non-surgical treatment are more often being considered of equal value, which has led to a need for better tools for patient information and support when deciding about treatment options after ACL lesion.

A patient decision aid (PDA) can be used when there is more than one medically suitable treatment option. Treatments have different advantages and disadvantages for individual patients. To make a proper decision on treatment choice, an expert on the facts about the treatment (the health professional) and an expert on what matters the most (the patient) are needed. The presence of both types of expert information constitutes the concept of shared decision-making (SDM) ¹¹.

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65 SDM is a key component of patient-centred care and has been defined as: “an approach where
66 clinicians and patients share the best available evidence when faced with the task of making
67 decisions, and where patients are supported to consider options, to achieve informed
68 preferences”¹². SDM supports patients to consider options, when one option does not have a
69 clear advantage and when the possible benefits and harms of each option affect individual
70 patients differently. PDAs are often used during the process of SDM to involve patients in the
71 decision about health care options¹². Some PDAs can be used generally for all health care
72 decisions while others are designed specifically to provide balanced information about risks and
73 expected outcomes for a defined health care decision.

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75 Overall, SDM and PDAs help patients to make informed, values-based decisions in collaboration
76 with the health professionals by assisting the patients to construct, clarify, and communicate the
77 personal values they associate with the different features of the options¹¹⁻¹³. A systematic
78 literature review from 2017 on the use of a PDA in SDM showed a positive effect on patient–
79 clinician communication, and patients were more satisfied with their decision¹³. Compared to
80 usual care, people involved in decision aids feel more knowledgeable, better informed, and are
81 clearer about their values¹³. There is growing evidence that PDA may improve value-based
82 choices across a wide variety of decision contexts. In this study we described the development of a
83 PDA for treatment of patients with an ACL injury¹¹⁻¹³.

84

85 With the purpose of improving the quality of treatment, this study aimed to develop, test and
86 evaluate a PDA for SDM in patients with an ACL injury to support patients to choose the best
87 treatment option in accordance with their individual values, lifestyle and conditions.

88

89 **Methods**

90 The study was conducted at Aarhus University Hospital in Denmark from 2015 to 2019 and
91 included a stepwise method¹⁴. A subsequent evaluation was based on the questionnaire: "Shared
92 Decision Making 9 questions" SQM9^{15,16} and a thematic analysis of semi-structured interviews
93 with patients and doctors¹⁷.

94

95 **Setting**

96 The Clinic of Sports Traumatology is a section of Department of Orthopaedic Surgery at Aarhus
97 University Hospital. The section has a highly specialized function and is organized as a close
98 interdisciplinary collaboration between doctors, nurses and physiotherapists, who are all
99 experienced specialists in ACL treatment. The department annually treats approximately 400
100 children and adult patients with cruciate ligament injury. They are offered conservative treatment,
101 primary cruciate ligament surgery or revision reconstruction surgery.

103 **Design**

104 The design included six phases: Preparation, Reality check, Developing a prototype, Repeated
105 testing, Quality assessment and Implementing the new practice (Figure 1) ¹⁴. In the following, each
106 phase will be presented in detail.

108 **Preparation**

109 The study was a part of a large-scale project at Aarhus University Hospital about patient
110 involvement of different patient groups with mandatory implementation of methods for SDM and
111 user-led health care ¹⁴. In the Department of Orthopaedic Surgery, we decided to focus on patients
112 with an ACL injury and set up an interdisciplinary project team of doctors, nurses and
113 physiotherapists.

115 **Reality check**

116 A reality check was conducted to explore the patients' perspectives on the existing care trajectory.
117 Qualitative interviews were conducted to gain an understanding of the wishes, experiences, and
118 perceptions of patients' needs for information and support. A focus group interview of six patients
119 was conducted before, during, and after the treatment. Further, individual in-depth interviews
120 were performed with 20 patients at different time points in the care pathway. Using a semi-
121 structured interview guide, patients were asked to tell about their ideas, experiences, wishes, and
122 needs. Interviews were recorded and subsequently transcribed verbatim. In the thematic analysis,
123 the interview data was categorized into themes based on the aspects mentioned in the interview
124 to improve the care pathway. This study focuses exclusively on the patients' suggestions for

125 improvement concerning the treatment decision. When undertaking thematic analysis of the
126 interview data, the patients' experiences and wishes could be outlined in the following five points:
127 1. Most patients had difficulties to choose between treatment options on the same day they were
128 diagnosed, and they wished to have time to consider the options.
129 2. Patients wanted a timeline for both treatment options describing the expected functional status
130 and recommendation on when to resume different activities.
131 3. Patients suggested an overview with short- and long-term advantages and disadvantages of the
132 treatment options.
133 4. Several patients felt that it might be helpful to hear stories from other patients faced with a
134 similar choice.
135 5. Patients wanted to have the possibility to further discuss treatment options with a
136 nurse/physiotherapist/doctor.

137

138 **Development of prototype**

139 To meet the patients' needs for an overview of the two treatment options, a prototype of a PDA
140 was created based on the current literature as well as experiences and suggestions from patients
141 with an ACL injury on how to optimize the decision-making process. A systematic development
142 process was carried out inspired by the 12 criteria from the International Patient Decision Aid
143 Standards (IPDAS) described by the Ottawa Hospital Research Institute ¹¹. The 12 broad criteria
144 include: systematic development process, information on options, presenting probabilities,
145 clarifying values, patient stories, disclosing conflicts of interest, delivering decision aids on the
146 Internet, balanced presentation of options, use of plain language, information based on scientific
147 evidence and established effectiveness ¹¹.

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149 To clarify key issues enabling a treatment decision, each health care professional in the Clinic of
150 Sports Traumatology was asked to list all possible issues that influence a patient's treatment
151 decision. This resulted in 39 different issues, which subsequently were categorized into 10 issues:
152 Return to Sports, Complications, Work possibilities, Cosmetic concerns, Knee function,
153 Rehabilitation, Stability of knee, Prognosis, Graft selection, and Sick leave. Then, 35 random
154 patients were asked to prioritize these 10 issues and comment on any missing issues. Finally, the
155 top eight prioritized issues important for the treatment decision were identified: Knee stability,

156 Possible activities of daily living, Sports ability, Workability, Clinical results, Risks, Rehabilitation,
157 and Sick leave (Fig 2).

158

159 For each of the eight issues, the advantages and disadvantages of surgery vs. non-surgery were
160 described based on a literature review. When no scientific evidence was available, best practice
161 was described. To help patients to consider and clarify which features were the most important,
162 the two treatment options were presented in a table with the prioritized issues expressed as
163 questions and answers in a balanced way (Fig 2). When the literature supported probabilities of
164 outcome for both treatments, these were presented.

165

166 **Repeated testing**

167 The prototype of the decision aid was sent to the hospital's communication department to
168 improve readability and graphic layout. The improved version was evaluated by seven patients,
169 and minor corrections were made.

170

171 The process of SDM and the associated PDA was introduced to all health professionals in the Clinic
172 of Sports Traumatology. To assess whether both the patient and the doctor were actively involved
173 in decision-making, sharing knowledge and preferences, a member of the project team attended a
174 minimum of two consultations per doctor. After the consultation, the doctor and the team
175 member evaluated the use of SDM and the PDA. Following these evaluations, the use of the PDA
176 was adjusted to a feasible, standardized procedure for patient involvement.

177

178 To meet patients' wish for reflection time before making a decision about treatment, practice was
179 changed in our clinic facilitating that the patient's decision on treatment should not be taken
180 before at least one day after the patient had been diagnosed. Together with the PDA, a guide was
181 made for the patients on how to contact the clinic about their decision. Patients could also book
182 an appointment to get additional information from a nurse, physiotherapist or doctor. The PDA
183 was available both in a paper version given to the patients after they had reviewed it together
184 with the doctor and an electronic version located on the clinic's website. Along with the website
185 version, a video showed how the PDA would be used in the clinic to prepare the patients before
186 their consultation. Furthermore, video recordings of four former patients (two patients who had

187 undergone surgery and two patients with non-surgical treatment) telling their stories about their
188 injury, treatment, and rehabilitation were available on the website.

189

190 **Quality assessment**

191 To assess the perceived benefits and effects on patient involvement, the new procedure and the
192 associated PDA were tested quantitatively by the SDM-Q9 questionnaire ^{15,16} and evaluated
193 qualitatively by patients and doctors. The SDM-Q9 questionnaire was chosen to measure whether
194 patients experienced SDM and had formerly been used at the Clinic of Sports Traumatology where
195 some patients with an ACL injury had participated in the validation process of a Danish translation
196 of the questionnaire ¹⁸. The scale consists of nine questions with six response categories, ranging
197 from 0 (completely disagree) to 5 (completely agree). A high score indicates a high patient
198 perception of SDM with the doctor ¹⁶. Two months before and two months after implementation of
199 the PDA, all patients with an ACL injury were asked to fill in the questionnaires after a consultation
200 with a doctor. Data were analysed in Stata using a t-test for comparing the mean scores for each
201 question and the total score from all patients, who had consultations before and after
202 implementation of the PDA.

203

204 In addition to the quantitative study, semi-structured interviews were conducted with five
205 randomly selected patients with an ACL injury consulting different doctors to identify the patients'
206 experiences of SDM after the implementation of the PDA. Patients were invited to participate at
207 their first appointment at the clinic; all patients accepted to participate. After the consultation and
208 a brief break to reflect on the PDA and the consultation, patients were interviewed individually
209 (lasting 20 minutes on average). The interviews were subsequently transcribed, analysed and
210 thematically summarized.

211

212 After evaluation of the SDM process and the patients' experiences, the doctors' experiences of
213 using the decision aid was examined. In a focus group interview, the doctors from the Clinic of
214 Sports Traumatology were encouraged to discuss their experiences with SDM and the use of the
215 PDA. The interview was transcribed and analysed to identify the perceived advantages and
216 disadvantages with the new practice.

217

218 **Implementation of the new practices**

219 In 2020, the PDA has been used in clinical practice for two years and is well implemented. The
220 project team has just reviewed the PDA according to the update procedure. This included a
221 clarification of some of the areas and a new literature search. The reviewed PDA is shown in Figure
222 2 in the Supporting information.

223

224 **Ethical considerations**

225 Participants were informed orally and in writing about the study, voluntary participation,
226 confidentiality, and anonymity; participants provided written informed consent. The study was
227 conducted in accordance with the ethical principles of the Helsinki Declaration (ref). All data were
228 stored securely in accordance with the regulations by the Danish Data Protection Agency. The
229 User-involving Hospital project, including the data collection procedure for the evaluation, was
230 approved by the Danish Data Protection Agency (J.no.1-16-02-621-14).

231

232 **Results**

233 As a result of a systematic process, a PDA for patients with an ACL injury was developed and
234 implemented in Clinic of Sports Traumatology at Aarhus University Hospital. The SDM using the
235 PDA was tested quantitatively by the SDM-Q9 questionnaire and evaluated qualitatively by
236 patients and doctors.

237

238 **SDM-Q9 questionnaires**

239 The questionnaire was fulfilled by 39 patients before and 50 patients after implementation the
240 PDA. All adult patients with an ACL injury were invited to attend, and none declined. The patients
241 were generally young (26 years on average) with an equal gender distribution. About one third of
242 patients had undergone previous surgery, and nearly all patients were doing sports activities 5-6
243 hours a week prior to the ACL injury. No statistically significant differences were found on these
244 demographic factors between the two groups of patients included before and after
245 implementation of the PDA (Table 1).

246

247 On a scale from 0 to 5, patients reported a high degree of SDM about their treatment both before
248 (score 4.3) and after (score 4.3) implementation of the PDA (Table 2). No statically significant

249 difference was found ($p=0.72$) and the same applied to the nine sub questions. Most patients
250 highly agreed that *the doctor told that there were different options for the treatment* (Q3 score 4.6
251 before and 4.7 after), whereas the lowest, though still high, scores were found in the question: *My*
252 *doctor and I thoroughly weighted the different treatment options* (Q7 score 4.1 before and 4.1
253 after). The two largest differences between before and after implementation of the PDA
254 concerned the questions: *My doctor made clear that a decision needs to be made* (Q1 score 4.1
255 before and 4.5 after) and *My doctor and I selected a treatment option together* (Q8 score 4.2
256 before and 3.8 after). However, the differences were not statistically significant.

257

258 **Patient interviews**

259 The five interviewed patients evaluating the PDA were 28 years on average; 2 female and 3 males.
260 They were all sports active and had a strong desire to continue with their sports. Two patients
261 were unaware of the extent of their injury before the consultation. None of the five patients were
262 prepared for a treatment decision to be made at the consultation. However, the interviews
263 revealed that the patients perceived the PDA as a supportive and useful tool as illustrated by these
264 quotes from the interviews: *"The PDA gives a very good overview of the two options, so it is easier*
265 *to decide what to do"*. *"It [the PDA] showed what the pluses and minuses were for the two*
266 *treatments"*. *"If only the doctor had informed me, then I think I would have forgotten most of it.*
267 *So, it was really nice to take the tool home and read it again"*. Furthermore, a patient expressed:
268 *"What the doctor said was also part of the decision aid. It is all very well connected"*. The patients
269 experienced that both treatment options were presented equally, also if the patient had already
270 decided on the choice of treatment. *"It was clear to me that I wanted to have surgery, I was*
271 *explained about the options, but I was listened to, and I was not pressured to do just*
272 *rehabilitation"*.

273

274 The principles of SDM were practiced. The patients' individual preferences of importance for the
275 decision were discussed, and the patients felt they were involved in the decision. One patient
276 stated: *"I thought I was given some good information, and the doctor was very interested in me,*
277 *what I am doing and what sport I practice"*. Another patient said: *"The doctor asked me a lot. He*
278 *asked what I wanted to be, whether I wanted to be a craftsman or something"*. *"The doctor*
279 *explained very well what the decision aid was about. After our discussion, it became clear what*

280 *was best for me now*". Patients felt their preferences and needs were heard: *"I was very much*
281 *listened to, and was asked about what I was doing, my work and my physical activity. Also, how my*
282 *knee function is now, what I can and can't do, and how loose it [the knee] is. It was a good*
283 *dialogue"*.

284

285 **Doctor interview**

286 Overall, the doctors in the focus group interview expressed satisfaction with use of the PDA. They
287 found it well implemented in the clinic and as an integral part of their consultation. The PDA was
288 perceived as a tool that was deliberately used to guide the dialogue, clarifying the patient's
289 preferences, desires, and needs. *"Apart from the fact that the dialogue is more systematically*
290 *structured, the patient's involvement and focus are extra clear when sitting together going through*
291 *the PDA"*.

292

293 Doctors reported that they used the PDA as a tool for SDM: *"The decision aid is a helpful tool in the*
294 *conversation. When using it, the patients are more engaged, and they are encouraged to be*
295 *involved "*. To guide the patient to make a decision, an introduction to the PDA was important: *"An*
296 *intro is needed to use the decision aid, but after this, the patient will automatically be involved in*
297 *sharing information"*. Reflection time was viewed as a new positive approach by the doctors;
298 hence the patient's decision was made on an informed basis. *"Some patients are almost shocked,*
299 *when they are diagnosed, and then they do not remember much from the conversation"*.

300

301 The doctors found it challenging if the choice of treatment was obvious both for the patient and
302 the doctor - for example surgery. In these cases, some of the doctors felt that they informed too
303 much about an apparently irrelevant treatment. However, another doctor said:

304 *"I have seen patients who have changed their attitude about treatment, because they have gone*
305 *through all the information again at home, and have become aware of some advantages or*
306 *disadvantages, they did not know about"*. One concern in the beginning was whether the
307 consultation would take longer and cause a delay. However, this was not the case. One doctor
308 expressed it like this: *"I do not see there is a time problem, but rather an advantage of the*
309 *systematic dialogue"*.

310

311 Discussion

312 Using a stepwise approach, a PDA for SDM in patients with an ACL injury was developed
313 systematically based on the IPDAS criteria. The results on patients' perceptions of SDM by the
314 SDM-Q 9 questionnaire showed a high, though not statistically significant, level of SDM both
315 before and after implementation of the PDA. Interview data showed that patients experienced the
316 PDA as a very useful tool to assist SDM. The doctors reported that the PDA improved SDM by
317 supporting the dialogue to clarify the patients' values concerning issues relevant for choice of
318 treatment.

319
320 In the interviews, patients expressed they were very satisfied with the PDA to support SDM;
321 however, statistically significant difference in the SDM-Q9 score before and after implementation
322 of the PDA was not detected. There may be several reasons for this finding. Looking into the sub-
323 questions in the SDM-Q9 for the two largest (though not statically significant) differences between
324 before and after implementation of the PDA, it seems that the doctors are more aware of
325 explaining to the patients that a decision needs to be made (Q1 score 4.1 before and 4.5 after
326 implementation). On the other hand, after the PDA implementation, patients scored lower in the
327 question of whether they decided the treatment together with the doctor (Q5 score 4.2 before
328 and 3.8 after implementation). This may be explained by the introduction of reflection time. After
329 the consultation, patients were told to contact the clinic about their treatment decision, which
330 may have made some patients feel, they made the decision themselves and not together with the
331 doctor. PDA scores after implementation for Q5 would thus have been higher if the reflection time
332 had not been implemented together with the PDA. Also, the limited sample size of 39 and 50
333 patients before and after PDA implementation, respectively could explain the lack of a significant
334 difference between scores before and after PDA implementation. The most likely explanation is
335 that the patients before the implementation of the PDA generally already agreed they were
336 involved in the decision about treatment showed by the high score of 4.3.

337
338 The maximum score of 5 was seen in 452 answers (57%). This distribution gives a considerable
339 ceiling effect without much variance, which reduces the possibility to study differences. Ceiling
340 effect is a known problem in SDM self-reported instruments ^{18,19}. To adjust for a high ceiling effect,
341 the response categories in the SDM-Q9 questionnaire was in 2010 changed from a 4-point to a 6-

342 point rating scale with more extreme categories ("completely disagree" to "completely agree")¹⁶.
343 However, ceiling effect might still be a problem. In a systematic review of studies published
344 between 2010 and October 2015 evaluating interventions to facilitate SDM, no significant changes
345 were detected between intervention and control groups in four of the five included studies; the
346 detected difference in the fifth study was "small in size"²⁰. As mentioned in this review, this could
347 mean that SDMQ9 has deficiencies of the sensitivity to measure changes.

348
349 The process demonstrated the importance of involving patients and colleagues to promote the
350 implementation of new tools into routine clinical practice; patients were involved throughout the
351 process. The patients identified the problems they experienced concerning treatment decisions,
352 they suggested improvements, evaluated all new initiatives, and tested all tools before use.
353 Patients were very committed and willing to participate when invited. From information posters in
354 the waiting room, they were prepared to be asked for participation by the staff. No one declined
355 participation, which may also be explained by the relatively young and not seriously ill population.
356 All health professionals in the clinic were engaged during the process by disseminating and
357 evaluating methods and accompanying tools for SDM.

358
359 The newly developed PDA for patients with an ACL injury may positively impact on the patient-
360 doctor interaction and individual treatment decisions. The use of PDA will improve patients'
361 responsibility for the treatment and outcome of their knee condition. The PDA can be
362 disseminated nationally and internationally for a broader approach to increase SDM. With the
363 successful development of a PDA for a knee condition with more than one relevant treatment
364 option, a similar process could be conducted for other knee or joint conditions. Future research is
365 needed investigating the impact of a PDA in patients with an ACL injury regarding treatment
366 choices and whether PDA improves clinical outcome at follow-up.

367
368 This study had several limitations. First of all, the interviews were conducted by the project team
369 in their own department. This may result in interviewees being more positive and that the analysis
370 did not sufficiently include negative aspects. Although the interviewers were committed to focus
371 on what could be improved, patients were generally very satisfied.

372

373 Further, it could be discussed whether the five interviewed patients were representative.
374 However, they were randomly selected and corresponded to the mean age and gender
375 distribution in the SDMQ9 study. It was not the same patients who were interviewed before and
376 after development and implementation of PDA, which could support that patients' suggestion for
377 improvements regarding treatment decisions were expressions of the general wishes of patients
378 with an ACL injury as it was evaluated positively by other patients in the same situation.

379
380 It was regarded as a strength that the patients were interviewed immediately after the
381 consultation following a short period of reflection and that different doctors were involved.
382 However, the study only reflects patients' short-term experiences, and not what increased
383 involvement in decision-making means on a long-term basis.

384

385 **Conclusion**

386 A PDA for SDM in patients with an ACL injury was developed based on the IPDAS criteria. Using the
387 SDM-Q 9 questionnaire to investigate patients' perception of SDM showed no difference in the
388 score from before to after implementation of the PDA. This was presumably caused by the ceiling
389 effect with scores at 4.3 on a scale from 0 to 5 both before and after implementation of the PDA.
390 However, the patients expressed in interviews that they found the PDA very supportive and useful,
391 when they had to make a treatment decision. Especially, reflection time was important. The
392 doctors found that the PDA improved SDM by supporting the dialogue to clarify the patients'
393 values concerning issues important for the treatment options. Future studies are needed to
394 investigate whether implementation of the PDA has an impact on ACL patients' treatment choices
395 and outcome.

396

397 **Conflict of interest**

398 No conflicts to declare

399

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402 University, Denmark.

403

404 References

- 405 1. Eime RM, Harvey JT, Charity MJ, Payne WR. Population levels of sport participation:
406 implications for sport policy. *BMC Public Health*. 2016;16:752-752.
- 407 2. Lind M, Menhert F, Pedersen A. The first results from the Danish ACL reconstruction
408 registry: epidemiologic and 2 year follow-up results from 5,818 knee ligament
409 reconstructions. *Knee Surgery, Sports Traumatology, Arthroscopy*. 2009;17(2):117-124.
- 410 3. Spindler KP, Warren TA, Callison JC, Jr., Secic M, Fleisch SB, Wright RW. Clinical Outcome at
411 a Minimum of Five Years After Reconstruction of the Anterior Cruciate Ligament. *JBJS*.
412 2005;87(8).
- 413 4. Spindler KP, Wright RW. Clinical practice. Anterior cruciate ligament tear. *N Engl J Med*.
414 2008;359(20):2135-2142.
- 415 5. Musahl V, Karlsson J. Anterior Cruciate Ligament Tear. *New England Journal of Medicine*.
416 2019;380(24):2341-2348.
- 417 6. Lohmander LS, Englund PM, Dahl LL, Roos EM. The Long-term Consequence of Anterior
418 Cruciate Ligament and Meniscus Injuries: Osteoarthritis. *The American Journal of Sports*
419 *Medicine*. 2007;35(10):1756-1769.
- 420 7. Moksnes H, Risberg MA. Performance-based functional evaluation of non-operative and
421 operative treatment after anterior cruciate ligament injury. *Scand J Med Sci Sports*.
422 2009;19(3):345-355.
- 423 8. Frobell RB, Roos HP, Roos EM, Roemer FW, Ranstam J, Lohmander LS. Treatment for acute
424 anterior cruciate ligament tear: five year outcome of randomised trial. *Bmj*. 2013;346:f232.
- 425 9. Grindem H, Eitzen I, Engebretsen L, Snyder-Mackler L, Risberg MA. Nonsurgical or Surgical
426 Treatment of ACL Injuries: Knee Function, Sports Participation, and Knee Reinjury: The
427 Delaware-Oslo ACL Cohort Study. *J Bone Joint Surg Am*. 2014;96(15):1233-1241.
- 428 10. Frobell RB, Roos EM, Roos HP, Ranstam J, Lohmander LS. A Randomized Trial of Treatment
429 for Acute Anterior Cruciate Ligament Tears. *New England Journal of Medicine*.
430 2010;363(4):331-342.
- 431 11. O'Connor A EGea. International Patient Decision Aid Standards (IPDAS) Collaboration.
432 IPDAS 2005: Criteria for judging the Quality of Patient Decision Aid. 2005.
433 http://ipdasohrica/IPDAS_checklistpdf. Assesed August 25, 2020

- 434 12. Elwyn G, Laitner S, Coulter A, Walker E, Watson P, Thomson R. Implementing shared
435 decision making in the NHS. *Bmj*. 2010;341:c5146.
- 436 13. Stacey D, Légaré F, Lewis K, et al. Decision aids for people facing health treatment or
437 screening decisions. *Cochrane Database of Systematic Reviews*. 2017(4).
- 438 14. Jørgensen MJ, Pedersen CG, Martin HM, Lomborg K. Implementation of patient
439 involvement methods in the clinical setting: A qualitative study exploring the health
440 professional perspective. *Journal of Evaluation in Clinical Practice*. 2020;26(3):765-776.
- 441 15. Simon D, Schorr G, Wirtz M, et al. Development and first validation of the shared decision-
442 making questionnaire (SDM-Q). *Patient Education and Counseling*. 2006;63(3):319-327.
- 443 16. Kriston L, Scholl I, Hölzel L, Simon D, Loh A, Härter M. The 9-item Shared Decision Making
444 Questionnaire (SDM-Q-9). Development and psychometric properties in a primary care
445 sample. *Patient Educ Couns*. 2010;80(1):94-99.
- 446 17. Braun V, Clarke V. Using thematic analysis in psychology. *Qualitative Research in*
447 *Psychology*. 2006;3(2):77-101.
- 448 18. Hulbæk M, Jørgensen MJ, Mainz H, et al. Danish Translation, Cultural Adaptation and
449 Validation of the Shared Decision Making Questionnaire - Patient Version (SDM-Q-9-Pat).
450 *European Journal for Person Centered Healthcare*. 2018;6(3):438.
- 451 19. Kunneman M, LaVecchia CM, Singh Ospina N, et al. Reflecting on shared decision making: A
452 reflection-quantification study. *Health Expectations*. 2019;22(5):1165-1172.
- 453 20. Doherr H, Christalle E, Kriston L, Härter M, Scholl I. Use of the 9-item Shared Decision
454 Making Questionnaire (SDM-Q-9 and SDM-Q-Doc) in intervention studies-A systematic
455 review. *PLoS One*. 2017;12(3).

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458 **Figures**

459
460 **Figure 1.** *The six phases included in the design.*

461 (Jørgensen et al. Journal of Evaluation in Clinical Practice. 2020; 26(3):765-76.)

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Tables

Table 1. Demographic data on patients with an ACL injury before and after implementation of the patient decision aid (PDA)

	Before PDA (n=39)	After PDA (n=50)	p-value for the difference
Age (years)	25.3 (21.8-28.8)	27.6 (24.6-30.8)	p=0.34
Gender (% female)	50% (34-66)	47% (33-61)	P=0.78
Had previous surgery (%)	31% (14-48)	45% (31-59)	P=0.22
Doing sports (%)	97% (97-100)	90% (82-98)	P=0.24
Weekly hours doing sports (hours)	6.3 (5.0-7.6)	5.1 (4.2-6.0)	P=0.11

Table 2. SDM-Q9 scores of patients with an ACL injury before and after implementation of the patient decision aid (PDA)

SDMQ9	Before PDA (n=39)	After PDA (n=50)	p-value for the difference
Q1. My doctor made clear that a decision needs to be made	4.1 (3.7-4.6)	4.5 (4.2-4.8)	P=0.13
Q2. My doctor wanted to know exactly how I wanted to be involved in making the decision	4.0 (3.7-4.3)	4.2 (3.9-4.5)	P=0.41
Q3. My doctor told me that there are different options for treating my medical condition	4.6 (4.3-4.8)	4.7 (4.4-5.0)	P=0.55
Q4. My doctor precisely explained the advantages and disadvantages of the treatment	4.4 (4.1-4.8)	4.3 (4.0-4.6)	P=0.48
Q5. My doctor helped me understand all the information	4.5 (4.3-4.8)	4.2 (4.0-4.5)	P=0.08
Q6. My doctor asked me which treatment option I prefer	4.3 (3.9-4.7)	4.2 (3.8-4.6)	P=0.78
Q7. My doctor and I thoroughly weighted the different treatment options	4.1 (3.8-4.5)	4.1 (3.8-4.4)	P=0.96
Q8. My doctor and I selected a treatment option together	4.2 (3.9-4.6)	3.8 (3.4-4.2)	P=0.17
Q9. My doctor and I reached an agreement on how to proceed	4.6 (4.4-4.9)	4.3 (4.1-4.6)	P=0.09
Mean score	4.3 (4.1-4.6)	4.3 (4.0-4.5)	P=0.72