©Journal of Sports Science and Medicine (2016) **15,** 633-638
http://www.jssm.org

Research article

The Value of Visa-Score and Colour Flow Imaging in the Follow-Up of Non-Athletes Operated for Jumpers Knee

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Abstract
The objective of this study was to assess if the Victorian Institute of Sport Assessment (VISA) questionnaire was suitable in the evaluation of patients from a mixed population with normal levels of sports activity, and if neovascularization of the patellar tendon demonstrated by color flow imaging (CFI) was more frequent in patients with lasting symptoms after surgical treatment for jumpers knee (JK). This study was conducted at St. Olavs Hospital, University Hospital of Trondheim, Norway, and included 21 men and 18 women who were operated for JK. Symptoms were assessed using the Knee Injury and Osteoarthritis Outcome Score (KOOS) and VISA questionnaires. Clinical and ultrasonographic examinations of the knees, including CFI, were done at a mean follow-up duration of 82 (range, 16–136) months after surgery. Patients with positive CFI also had significantly lower KOOS scores, whereas the total VISA-P (Victorian Institute of Sport Assessment - Patella) score showed no association. Patients with a positive clinical examination had significantly more frequent positive CFI findings than did patients with negative examinations. The operated patellar tendon was significantly thicker and had more frequent hypoechoic signal in the proximal part than the contralateral unoperated tendon. The post-operative VISA-P score seems less valuable in the evaluation of patients from a mixed population with normal levels of sports activity. CFI may be a valuable diagnostic tool in the evaluation of patients operated for JK.

Key words: Orthopedic surgery, patellar tendinopathy, Ultrasonography.

Introduction

Patellar tendinopathy or Jumpers knee (JK) is a clinical condition of activity-related knee pain and distinct tenderness on palpation of the proximal part of the patellar tendon (Gisslén and Alfredson, 2005; Lian, 2007). Ultrasound can be of some value for the diagnosis (Gemignani et al., 2008; Gisslén et al., 2007; Warden et al., 2007; Weinberg et al., 1998), and Doppler ultrasound may increase diagnostic accuracy (Warden et al., 2007).

The etiology of JK is not fully understood, but it is assumed that repeated and strenuous workload on the extensor apparatus is an important contributor (Ferretti et al., 2002; Gisslén and Alfredson, 2005; Lorbach et al., 2008). The pain may be due to ingrowth of pathological blood vessels in the patellar tendon (Andres and Murrell, 2008; Danielson et al., 2008; Gisslén and Alfredson, 2005). This neovascularization process allows nerve fibers to follow the microvessels, and these nerve fibers may generate pain when stressed (Danielson et al., 2008; Gisslén et al., 2007; Knobloch, 2008; Lian et al., 2006). Alfredson and Öhberg (2005) have shown that neovascularization is common in patients with JK. Other studies have shown that patients with neovascularization often have more pain than patients without such findings (Gisslén and Alfredson, 2005; Gisslén et al., 2007), and neovascularization has been accepted as a major pathophysiological aspect of tendinosis (Knobloch, 2008). Based on previous studies, we hypothesized that the presence of continuous neovascularization could play an important role for lasting pain in patients operated for JK.

If conservative treatment is insufficient, surgery is one of the treatment strategies (Cucurulo et al., 2009). Some surgical techniques aim to remove degenerated and damaged parts of the tendon. Open patellar tendon surgery includes a longitudinal incision made distally from the inferior patellar pole, where pathological tissue is removed (Bahr et al., 2006), with or without resection or drilling of the inferior patellar pole (Ferretti et al., 2002; Pascarella A et al., 2011).

Arthroscopical procedures may include shaving of the dorsal side of the proximal tendon and tendon debridement (Rodriguez-Merchan, 2013). Newer surgical techniques that aim to remove the infrapatellar fat pad and hypertrophic synovium without any tendon resection are being developed (Maier et al., 2013).

Surgery is successful in around 60%–70% cases (Bahr and Mæhlum, 2006). Still higher success rates are described for both open surgery and arthroscopical procedures (Brockmeyer et al., 2015; Maier et al., 2013). Long-term follow-up studies of patients operated for JK are sparse, and especially little is known about the relationship between self-reported symptoms from questionnaires and clinical and sonographic findings in the operated knee in a group of patients that are not performing athletes. With this background, we focused on well-known questionnaires such as the Victorian Institute of Sport Assessment for Patella (VISA-P) and Knee Injury and Osteoarthritis Outcome Score (KOOS) to see if they were reliable in such a study population.

We aimed to specifically assess the long-term results of surgical treatment of JK with a focus on possible associations between self-reported symptom scores from questionnaires such as KOOS and VISA-P, clinical examinations, and ultrasound findings. We also wanted to study if neovascularization of the patellar tendon was visible with color flow imaging (CFI) in patients with lasting symptoms after surgical treatment.

Received: 27 April 2016 / Accepted: 20 September 2016 / Published (online): 01 December 2016

Methods

Between 1999 and 2009, 55 patients were operated for JK at the Department of Orthopedic Surgery, St. Olav's Hospital, Norway. Two patients underwent bilateral knee surgery and hence, the total number of knees was 57. The study population included 32 men and 23 women, with a mean age of 29 (range, 12–54) years at the time of surgery. All patients were diagnosed with JK by traditional clinical examination and a magnetic resonance imaging (MRI) scan. After diagnosis, conservative treatment with an eccentric training protocol was tried for six months in all patients. In case of lasting symptoms, surgery was recommended. The use of ultrasonography preoperatively was sparse, and not standardized. Any sonographical tendon measurements before surgery were not recorded.

Most patients were operated with open patellar surgery, meaning a longitudinal incision of the patellar tendon and removal of abnormal tissue. Six patients and seven knees were operated with arthroscopical tendon debridement. Diagnostic arthroscopy was performed at the same time to exclude any concomitant findings.

All patients were instructed in eccentric exercises postoperatively, and referred to a physiotherapist for rehabilitation. At follow-up, 7 of 39 patients reported no participation in a rehabilitation program. Two patients hadn`t been offered rehabilitation, 3 patients gave no reason for not participating and 2 patients didn`t answer the questions on rehabilitation.

All patients received the KOOS and VISA-P questionnaires to evaluate clinical outcomes and current symptoms (Roos et al., 1998; Visentini et al., 1998). The VISA-P questionnaire is specially designed to assess JK-related symptoms. In addition, a third questionnaire included information on height, weight, occupation, sport activities, and questions for self-assessment of degree of knee pain.

A standardized clinical examination was done for all patients, including what we call the "apicitis test". This test involves applying a pinpoint pressure at the insertion of the patellar tendon at the distal pole of the patella; focused pain at palpation is considered a positive test. The quadriceps muscle was relaxed, and the knee held in a straight position. The operated knee was compared with the contralateral knee.

The ultrasound examination was performed in a supine position with a pillow under the knee and knee flexion around 10–20 degrees in order to straighten out the patellar tendon. We used a GE Vingmed Logiq E9 (GE Vingmed Ultrasound AS, Trondheim, Norway) with a 6–15 MHz linear multi-frequency probe for all patients. The sonography was performed after the clinical examination. The right knee was always examined first. All scans were done by the same well-trained examiner (KJH). The pathological changes were registered on a standard form. The patients were requested to meet in their usual condition and instructed not to participate in hard physical exercise on the same day as the examination. First, a standard longitudinal scan was performed, measuring the length and thickness of the proximal and distal parts of the tendon (Figure 1). Proximal and distal transverse scans were also performed (Figure 2), measuring the width and thickness of the tendon in both positions. Hypo- and hyperechoic areas were registered. Finally, the tendon was examined with CFI, as described by Hoksrud et al. (2008). For this part of the examination, the knee was further extended, now only in slight flexion, since the knee position might affect the blood flow (Warden et al., 2007). Neovascularization was classified semi-quantitatively. CFI was classified as positive if one or more microvessels were found inside the tendon substance and the findings could be reproduced by a second scan (Hoksrud et al., 2008). Figure 3 shows a positive CFI test.

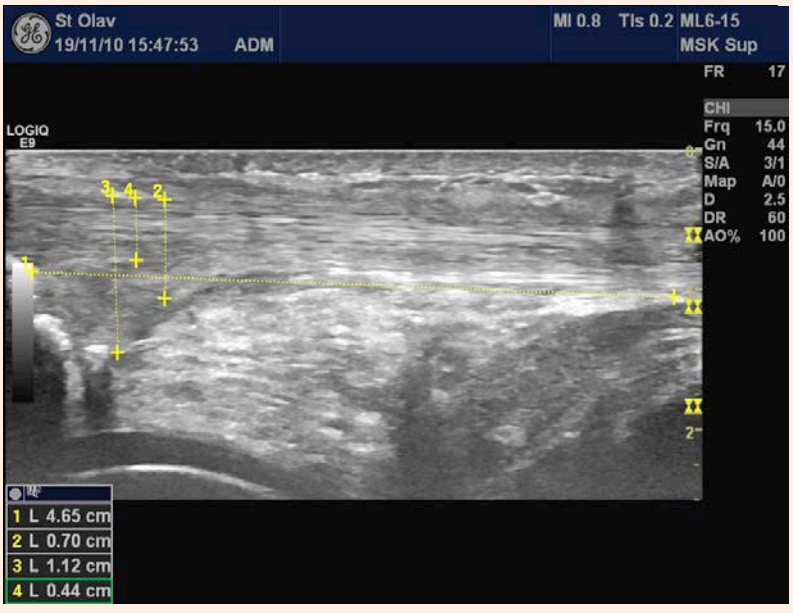

Figure 1. Measurements of (proximal) thickness and length, patellar tendon, greyscale ultrasound – longitudinal scan. (Photo by Salvesen ES)

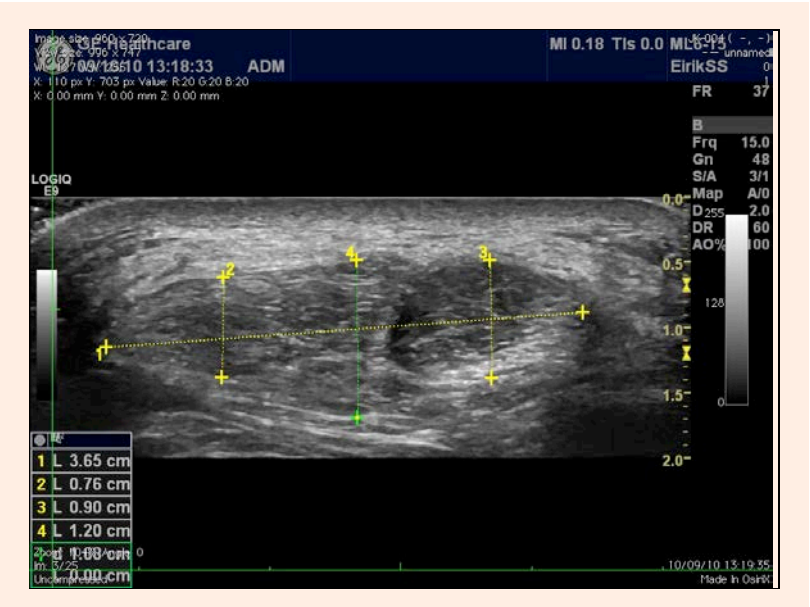

Figure 2. **Measurements of width and thickness in the proximal part of patellar tendon, grey-scale ultrasound – transverse scan. (Photo by Salvesen ES).**

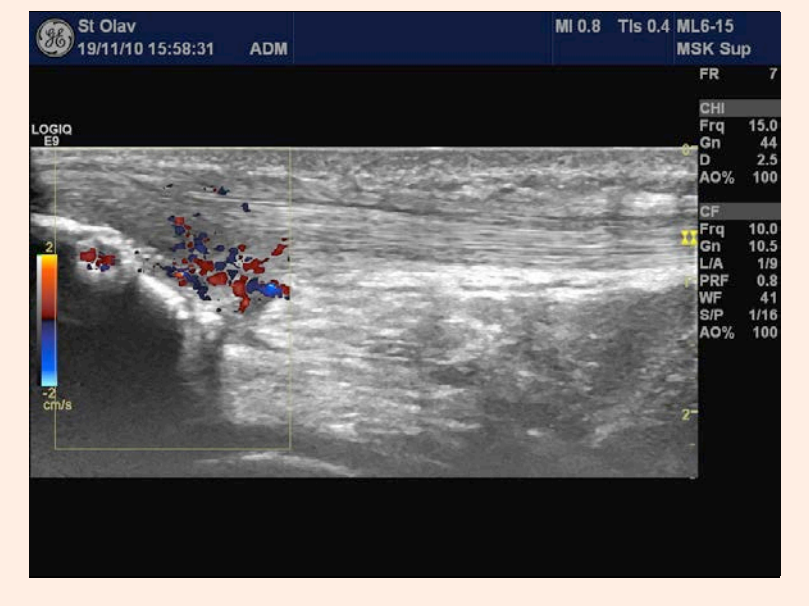

Figure 3. **Neovascularization in the proximal part of the patellar tendon visualized with colour flow imaging (Photo by Salvesen ES).**

Statistical analysis

Data were analyzed using PASW Statistics 18.0. Chi-square test or Fischer exact test were used to analyze categorical variables, and *t*-test or Mann–Whitney U test were used for continuous variables. Wilcoxon signed rank test was used to compare operated vs. unoperated knees. $P < 0.05$ was considered statistically significant.

Results

In all, 39 (71%) of 55 eligible patients answered the postal questionnaires, and 34 (62%) were assessed with clinical and ultrasound examinations. Of 16 non-participants, 5 did not want to participate, 2 had moved to unknown addresses, 2 studied abroad, and 7 did not respond. Among the 39 included patients, 21 were men and 18 women. Mean age at follow-up was 37 (range, 13–63) years, and mean BMI was 26.5 (range, 17.9–38.8) $kg \cdot m^{-2}$. Mean observation time was 82 (range, 16–136) months. Details of the study population are given in Table 1.

Thirty-seven patients completed the KOOS and VISA questionnaires. Table 2 shows the mean score for each of the five subcategories of the KOOS score and the mean VISA-P score. Interestingly, we found statistically significant differences between CFI in the operated knee and KOOS scores, but not for VISA-P scores (Table 3). We also found significant differences between calcifications on ultrasound and KOOS-pain ($p = 0.03$), KOOS-activities of daily living ($p = 0.03$), and VISA-P scores ($p = 0.04$). There were no other significant associations

between ultrasound and symptom scores. However, we found lower VISA-P scores in patients with other surgical interventions in the operated knee after primary surgery for JK (Table 4).

Table 1. Patient characteristics (n = 39) at follow-up. Data means (±SD).

	Mean	Range
Age, years	37.0 (11.9)	13 – 63
Months since operation	82 (40)	16 – 136
Age at operation, years	30.0 (11.2)	12 – 54
BMI, kg·m^{-2}	26.5 (5.1)	17.9 – 38.8
Hours of training/week at time of follow-up	2.2 (1.0)	0 – 10
No (%) male	21 (54)	
No (%) active in sport before surgery	31 (84)	
No (%) active in sport at time of follow-up	13 (35)	

Table 2. Total KOOS-scores and VISA-scores for the operated knee (n = 37).

	Mean (±SD)
KOOS - pain[1]	64 (±24)
KOOS - symptoms	67 (±18)
KOOS - activities of daily living	77 (±20)
KOOS - sport and recreation[1]	46 (±27)
KOOS - knee related quality of life	50 (±26)
VISA score	51 (±21)

[1] 1 patient missing. Patients operated on both knees count as one individual.

Table 3. Colour flow imaging (CFI) versus KOOS- and VISA-scores for operated knee (n = 32). Data are means (±SD).

	CFI positive	CFI negative	p ≤
KOOS - pain	53 (26)	73 (17)	.02
KOOS - symptoms	59 (20)	72 (10)	.03
KOOS – activities of daily living	67 (22)	85 (10)	.02
KOOS - sport and recreation	34 (27)	55 (19)	.01
KOOS – knee related quality of life	42 (26)	61 (19)	.03
VISA score	47 (19)	55 (22)	.47

Table 4. VISA-scores and knee-operations (Knee Op.) for operated knee (N = 35). Two patients missing. Two patients operated in both knees were excluded.

	Knee Op.>1	Knee Op.=1
N (%)	12 (35%)	23 (65%)
VISA total (±SD)	40 (±13)	56 (±22) *

* p = 0.049

We found statistically significant differences (p = 0.001) between proximal tendon thickness in the operated knee and the contralateral knee (Table 5). We also found more hypoechoic regions in the operated knee. There were no other statistically significant differences between the operated and contralateral knees (Table 5).

We also found statistically significant differences (p = 0.002) between a positive apicitis test and CFI of the operated knee (Table 6). There were no other statistically significant differences between clinical examination and ultrasound findings (Table 6).

In a self-evaluation test, 21 (66%) patients felt that the operation was successful (good or excellent result) at a mean follow-up of 82 months. All these patients had a negative apicitis test, negative CFI, and VISA-P score > 60 in the operated knee. This was our quantitative definition of success after surgery.

There was no statistical difference in outcome between patients with arthroscopical and open surgery.

Table 5. Clinical examination (apicititis test) and sonographical findings in the operated knee versus contralateral knee. N = 32 (64 knees). Two patients operated in both knees were excluded.

	Operated knee (N = 32)		Contralateral knee (N=32)		
	Mean	**SD**	**Mean**	**SD**	**p≤**
Proximal thickness longitudinal, cm	.51	.15	.43	.14	.001
Proximal thickness transverse, cm	.59	.17	.45	.21	.001
	N	**%**	**N**	**%**	
Edema					
Positive	20	62	7	22	.006
Negative	12	38	25	78	
Hyperechoic changes					
Positive	10	31	3	10	1.00
Negative	22	69	29	90	
Colour flow imaging					
Positive	18	56	8	25	.7
Negative	14	44	24	75	
Apicitt test					
Positive	15	53	9	28	.44
Negative	17	47	23	72	

Table 6. Clinical examination (apicitis test) versus ultrasound of the operated knee. N = 32 (patients and knees). Two patients operated in both knees were excluded.

Ultrasound findings	Apicitis test positive		Apicitis test negative		
	Mean	**SD**	**Mean**	**SD**	**p≤**
Proximal thickness longitudinal, cm	.49	.12	.54	.17	.67
Proximal thickness transverse, cm	.59	.17	.57	.16	.64
	N	**%**	**N**	**%**	
Edema					
Positive	11	73	9	53	.29
Negative	4	27	8	47	
Calcifications					
Positive	6	40	4	24	.45
Negative	9	60	13	76	
Colour flow imaging					
Positive	13	87	5	29	.002
Negative	2	13	12	71	

Discussion

We found statistically significant associations between CFI and clinical examination (apicitis test) and symptom scores from the KOOS questionnaire at follow-up around 7 years after surgery for JK. Although there were differences between the operated and contralateral knee on grey-scale ultrasound, we found no associations between grey-scale ultrasound and CFI.

We found no correlation between grey-scale ultrasound findings, such as thicker tendon and more frequent hypoechoic areas, and the KOOS and VISA-P scores for the operated knee (Table 6). This is in accordance with Khan et al., who found no correlation between grey-scale ultrasound after surgery and the VISA-P score (Khan et al., 1999). Coleman et al. (2000) found that 70% of patients operated for JK had an abnormal tendon by grey-scale ultrasound 4 years after surgery, and concluded that grey-scale ultrasound was not particularly helpful in the follow-up of patients operated for JK.

We found an association between CFI and positive apicitis test at the follow-up examination. In our study, the clinical tests were done before the ultrasonographic examinations, and for some patients, the same examiner did both examinations. Since no blinding technique was used, we cannot rule out the possibility of operator bias. However, CFI was also associated with the scores of the KOOS questionnaire. This questionnaire was filled in at home before the examination, and the examiner was not aware of the KOOS scores at the time of examination. Because there was an association between CFI and KOOS scores (Table 3), we believe that the association between positive apicitis test and CFI was actual, and not due to bias.

The association between CFI and KOOS scores is in accordance with other studies on pre-surgery patients (Cook et al., 2004; Gisslén et al., 2007; Hoksrud et al., 2008). We were unable to find similar studies on these associations many years after the operation. The reason for lasting pain could be that the surgeon did not sufficiently remove the vessels during surgery. Hoksrud et al. (2008) found this to be the case for some of the patients who received sclerosing injection treatment. Another possible reason for lasting pain may be that a re-neovascularization has occurred after surgery.

The validity of color and power Doppler findings in the patellar tendon is debatable. Several studies have confirmed that neovascularization can exist in tendons without any clinical symptoms (Gisslén and Alfredson, 2005; Gisslén et al., 2007), and that microvessels are not a consistent finding among patients with clinical symptoms (Hoksrud et al., 2008). Another problem is that the examination is dependent on the knee position and on the scan operator (Alfredson and Öhberg, 2005; James et al., 2007). However, Warden et al. (2007) conclude that grey-scale ultrasound combined with CFI is the best sonographical examination for finding pathology in the patellar tendon with the tendon relaxed. In our study, we did the examination with the knee slightly flexed, and still found CFI-based pathology. It is however difficult to say whether more pathological microvessels would have been found if the knee had been completely straight. In the future, other and newer ultrasonographic methods like ultrasound tissue characterization (UTC) and sonoelastogram might also be of value concerning diagnosis and treatment of tendinopathies (Docking et al., 2015).

Our study population had a lower total VISA-P score (mean, 51) than other studies. Visentini et al. found a mean VISA-P score of 95 in asymptomatic control subjects and a mean VISA-P score ranging from 55 to 22 in patients with JK; 12 months after surgery, they found a mean total VISA-P score of 75 (Visentini et al., 1998). Bahr et al. found a mean total VISA-P score of 70 in their study (Bahr et al., 2006). A possible explanation for our low mean VISA-P score could be that our study population was heterogeneous with respect to gender, age, and activity level. Only 13% were active in sports at the time of follow-up, and only one participated in sports at high level. Professional athletes usually achieve higher scores on questionnaires like VISA (Bahr et al., 2006). Although Visentini et al. described the VISA-P score as a reliable and valid scale for assessing JK, it was not an effective diagnostic test. Other knee injuries or problems with doing the tests might negatively influence the total score (Visentini et al., 1998). In our population, we found a lower VISA-P score in patients with other surgical interventions in the operated knee after primary surgery for JK. This, however, was not truly statistically significant ($p = 0.049$).

Overall, 66% of the participating patients with JK were satisfied with the postoperative results—a result we find acceptable, as it is in accordance with other studies (Ferretti et al., 2002; Khan et al., 1999). There were no differences between patients with open and arthroscopical surgery in our study. Other studies have shown better results with arthroscopic surgery (Brockmeyer et al., 2015, Lorbach et al., 2008; Maier et al., 2013; Santander et al., 2012). The lack of difference between open and arthroscopical surgery in our study might be explained by our low number of patients having arthroscopic surgery.

Conclusion

Doppler ultrasound can be a valuable tool in the follow-up examination of patients operated for jumpers knee. We found the VISA-P score to be of little value in assessing a mixed population with normal sport activity level after surgery.

Acknowledgments

This study was conducted at the University in Trondheim, NTNU. It was part of a student assignment and managed without funding.

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Key points

- Overall, 66% of the participating patients with jumpers knee (JK) were satisfied with the post-surgical results.
- The VISA-P score seems less valuable in the evaluation of patients with JK with normal levels of sports activity.
- CFI may be a valuable tool in the evaluation of patients operated for JK.

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