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SHORT REPORT

Do self-reported knee instability, difficulty twisting, and knee confidence change after exercise and education in patients with knee osteoarthritis?

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KEYWORDS

education, exercise, osteoarthritis, patient

1 | INTRODUCTION

Knee instability, often assessed as self-reported buckling or giving way (Assar et al., 2020; Fitzgerald et al., 2011; Knoop et al., 2013), is an important challenge in knee osteoarthritis (OA) with a prevalence of 60%–80% (Selçuk et al., 2023; van der Esch, van der Leeden, Roorda, Lems, & Dekker, 2016), which can increase the risk of development and progression of OA and lead to worse physical function (Blalock et al., 2015).

Previous studies have reported that self-reported knee instability did not improve after 2 years in 88% of patients undergoing some type of exercise programme (van der Esch et al., 2016) and that 32% still experienced knee instability 6 months after total knee arthroplasty (Fleeton et al., 2016). Furthermore, knee instability is associated with lower knee confidence (S. T. Skou et al., 2014) and linked with worse long-term physical function (Sharma et al., 2015) and quality of life (Leichtenberg et al., 2018). This confirms the persistent nature of knee

instability and underpins the need to target knee instability in the treatment of knee OA.

Still, surprisingly little is known about the effects of different types of exercise on knee instability as well as other related self-perceived measures such as difficulty experienced while twisting the knee, and patients' overall confidence in their knee. Only three previous randomised trials have specifically investigated changes in self-reported knee instability (Assar et al., 2020; Fitzgerald et al., 2011; Knoop et al., 2013). These studies observed that muscle strengthening combined with functional exercises seemed to improve self-reported knee instability (Assar et al., 2020; Knoop et al., 2013), on the other hand, standard lower extremity strengthening did not (Fitzgerald et al., 2011). There was no additional benefit from adding knee joint stabilisation therapy or agility and perturbation training (Fitzgerald et al., 2011; Knoop et al., 2013). Thus, further studies are warranted.

Neuromuscular control exercise has previously been recommended for knee OA patients with self-reported knee instability as it

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targets functional knee instability (Ageberg & Roos, 2015), but it remains unclear the extent to which it affects knee instability and other related self-perceived measures in patients with knee OA. Therefore, this study aimed to examine changes in self-reported knee instability, difficulty with twisting/pivoting, and lack of knee confidence (the patient's perception of inability to rely on their knees) after supervised neuromuscular exercise and patient education in patients with knee OA.

2 | METHODS

2.1 | Design

We conducted a registry-based retrospective cohort study using the Good Life with osteoArthritis in Denmark (GLA:D) registry to examine changes in self-reported knee instability, difficulty with twisting/pivoting, and knee confidence after an 8-week supervised exercise therapy and patient education programme (approximately 3 months from baseline to follow-up). The study was reported in accordance with the STROBE statement's recommendations for reporting observational studies (15). According to the local ethics committee of the North Denmark Region, ethics approval was not required for GLA:D. According to the Danish Data Protection Act, patient consent is not required, as personal data are processed exclusively for research and statistical purposes. GLA:D was approved by the Danish Data Protection Agency (SDU: 10.084).

All participants in the study followed the GLA:D programme, which is a nationwide programme in Denmark led by certified physical therapists with the aim of implementing clinical guidelines on knee and hip OA into practice. The GLA:D programme included 2 patient education sessions and 12 sessions of 60 min supervised neuromuscular exercises. Patient education consists of two interactive sessions led by a certified physiotherapist and one optional third session led by a prior participant in the programme. During sessions, patients are educated on OA and various treatment methods, including exercise, its benefits, how to handle pain during exercise, and practical advice. The third session aims to give the participants the opportunity to discuss challenges and solutions living with OA. Details of the programme can be found elsewhere (Skou & Roos, 2017). Participants with knee joint problems who did not have other symptoms that were more severe than the OA problems (such as chronic, generalised pain or fibromyalgia) or another cause for the problems than OA (e.g., tumour, inflammatory joint disease, or sequelae after hip fracture) were eligible for inclusion.

2.2 | Participants

Participants with knee OA from the GLA:D study that enrolled after 1 January 2019 (introduction of the self-reported knee instability question), completed the 3 month follow-up before 11 March 2020 (onset of lockdown due to the COVID-19 pandemic in Denmark), and answered the baseline and 3 month follow-up questions on self-

reported knee instability, difficulty with twisting/pivoting, and lack of knee confidence were included in the analyses. Participants who had total knee replacement surgery on the most affected knee before the intervention were excluded.

2.3 | Outcomes

We investigated changes in the proportions of patients experiencing different levels of self-reported knee instability, difficulty with twisting/pivoting the knee, and knee confidence in the last week from baseline to the 3-month follow-up. Participants responded to the following questions on a 5-points Likert scale; "Have you felt your knee give way or let you down within the last week?" (0 = Never, 1 = Rarely, 2 = Sometimes, 3 = Most of the time, 4 = All the time) for knee instability, "The degree of difficulty you have experienced in the last week due to twisting/pivoting on your injured knee?" (0 = None, 1 = Mild, 2 = Moderate, 3 = Severe, 4 = Extreme) for difficulty with twisting/pivoting, and "How much are you troubled with lack of confidence in your knee?" (0 = Not at all, 1 = Mildly, 2 = Moderately, 3 = Severely, 4 = Extremely) for lack of knee confidence (Skou et al., 2015).

2.4 | Statistical analyses

The data are presented as mean (SD) or frequency (*n*, %), as appropriate. The McNemar-Bowker test was used to compare self-reported knee instability, difficulty with twisting/pivoting, and lack of knee confidence variables at baseline and 3 month follow-up. Alluvial diagrams were used to visualise changes in all outcomes from baseline to the 3 month follow-up. Statistical significance was set at $p < 0.05$. All analyses were performed using SPSS 22.0 (SPSS Inc., Chicago, IL, USA).

3 | RESULTS

A flow chart of the participants included in the study is presented in Figure S1. A total of 3633 patients (69% females) with a mean age of 66.1 ± 9.2 years (SD) were included in the study. More than 80% of the patients attended at least two education sessions and at least 10 of the 12 exercise sessions. The baseline characteristics of the patients are summarised in Table 1.

At 3 months, we found a significant decrease in the frequency of knee instability, with an increase in the number of patients reporting never or rarely experiencing it, and a decrease in the number of patients reporting sometimes, most of the time, and all the time ($p < 0.001$). Additionally, more patients reported no or mild difficulty with twisting and pivoting, while fewer patients reported moderate, severe, and extreme difficulty ($p < 0.001$). Moreover, a higher proportion of patients reported no or mild lack of knee confidence, with a decrease in the number of patients reporting moderate, severe, and extreme lack of knee confidence ($p < 0.001$) (Table 2).

The alluvial diagram shows that the participants trends for shift in self-reported knee instability categories from baseline to 3 month

TABLE 1 Baseline characteristics of participants.

	Total (n = 3633)
Age (years, mean ± SD)	66.1 ± 9.2
Female (n (%))	2511 (69%)
BMI ^a (mean ± SD)	28.8 ± 5.5
Education (n (%))	
Primary school	626 (17%)
Secondary school	407 (11%)
Short-term education (under 3 years after secondary school)	751 (21%)
Middle-term education (3–4 years after secondary school)	1446 (40%)
Long-term education (at least 5 years after secondary school)	403 (11%)
Baseline pain (VAS, mm, mean ± SD)	47.2 ± 21.9
Number of comorbidities ^b (n (%))	
0	1353 (37%)
1	1337 (37%)
2	629 (17%)
≥3	314 (9%)
Number of attended exercise sessions ^c (n (%))	
0	54 (2%)
1–6	145 (5%)
7–9	300 (11%)
10–12	1014 (38%)
>12	1152 (43%)
Attended education sessions ^c (n (%))	
Patient education 1 (yes)	2266 (85%)
Patient education 2 (yes)	2149 (80%)
Session with a former GLA:D participant (yes)	558 (21%)
Instructions to individualised exercise programme (yes)	2535 (95%)

Abbreviations: BMI, Body Mass Index; GLA:D, Good Life with osteoArthritis in Denmark; VAS, Visual Analog Scale.

^aData missing from 23 participants.

^bSelected from a list of 12 possible comorbidities (Hypertension, cardiovascular diseases, lung diseases, diabetes, stomach diseases, kidney/liver diseases, blood diseases, cancer, depression, rheumatoid arthritis, neurological disorders, other medical diseases).

^cData missing from 968 participants.

follow-up (Figure 1.). The alluvial diagrams for shift in difficulty with twisting/pivoting and lack of knee confidence from baseline to 3 month follow-up are shown in Figure S2 and S3. The shift in categories was mainly towards one degree lower, with a larger trend for participants rarely feeling instability at baseline shifting to never feeling instability at 3 month follow-up and those feeling instability sometimes at baseline shifted to feeling instability rarely at the 3 month follow-up.

TABLE 2 Self-reported knee instability, difficulty with twisting/pivoting, knee confidence at baseline and 3 months follow-up.

	Baseline	Follow-up	<i>p</i>
Knee instability			
Never	791 (22%)	1108 (31%)	<i>p</i> < 0.001 ^a
Rarely	905 (25%)	1191 (33%)	
Sometimes	1401 (39%)	1039 (29%)	
Most of the time	464 (13%)	248 (7%)	
All the time	72 (2%)	47 (1%)	
Lack of knee confidence			
Not at all	289 (8%)	464 (13%)	<i>p</i> < 0.001 ^a
Mildly	1046 (29%)	1373 (38%)	
Moderately	1224 (34%)	1002 (28%)	
Severely	949 (26%)	710 (20%)	
Extremely	125 (3%)	84 (2%)	
Difficulty with twisting and pivoting			
None	110 (3%)	309 (9%)	<i>p</i> < 0.001 ^a
Mild	661 (18%)	1092 (30%)	
Moderate	1310 (36%)	1217 (34%)	
Severe	1273 (35%)	814 (22%)	
Extreme	279 (8%)	201 (6%)	

^aSignificant; McNemar-Bowker test. Numbers may not add up to 100% due to rounding.

4 | DISCUSSION

This is the first study to examine changes in self-reported knee instability and other related self-perceived measures after neuromuscular exercise and education. We found that there were significantly more patients with knee OA experiencing no or rare knee instability, no or mild difficulty with twisting and pivoting, and no or mild lack of knee confidence after an 8-week supervised neuromuscular exercise therapy and patient education programme. The participants trends for shift in categories of the self-reported measures corresponded roughly to one category of improvement on the 5-points scale.

In a recent systematic review that focused on the effects of exercise therapy on self-reported knee instability in patients with knee OA, Kawabata et al. reported that only three randomised controlled trials investigated the effect of exercise therapy on self-reported knee instability (Kawabata et al., 2020). Knoop et al. found that patients with knee OA showed similar significant improvements in self-reported knee instability from baseline to 12 weeks follow-up for both knee stabilisation therapy in addition to functional exercises based on daily activities and functional exercise alone groups (Knoop et al., 2013). Fitzgerald et al. showed no improvement in self-reported knee instability from baseline to 2 months follow-up after agility and perturbation training in addition to standard exercises consisting of stretching and strengthening of the lower extremity muscles or standard exercises alone in patients

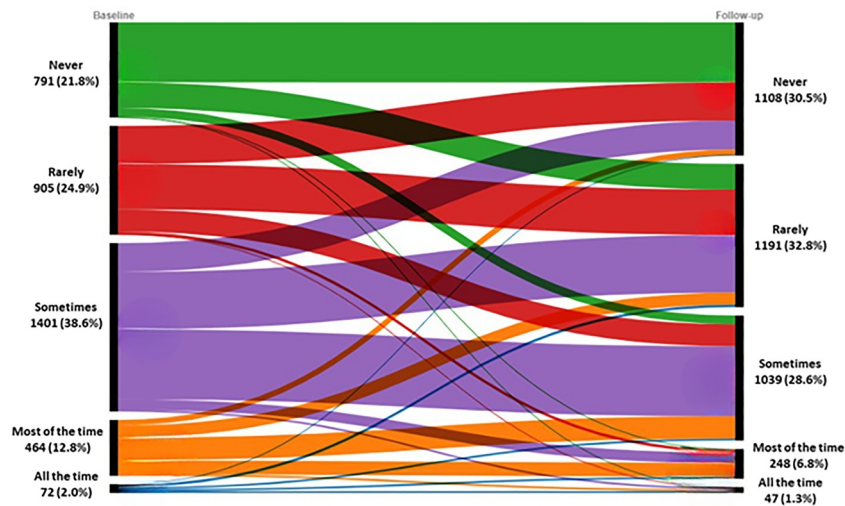


FIGURE 1 Alluvial diagram of knee instability levels at baseline and 3 months of follow-up (measured by the question “Have you felt your knee give way or let you down within the last week?”).

with knee OA (Fitzgerald et al., 2011). Lastly, Assar et al. showed statistically significant improvements in self-reported knee instability following both an 8-week land-based programme including functional exercises with a resistance cord and weighted bar, and an aquatic programme including exercises focused on improving function and balance and reducing pain (Assar et al., 2020). Even though there were similarities to the content of the GLA:D programme focusing on improving proprioceptive accuracy and neuromuscular control of the knee by tailored functional exercises, the existing studies on self-reported knee instability are mixed in terms of content and time of interventions. Also, these studies differed in terms of outcome measures used to assess self-reported knee instability from our study and therefore were not directly comparable to our results. In our study, which is the first to examine the influence of neuromuscular exercise on self-reported knee instability and other related self-perceived measures, we observed significant reductions in the proportion of patients with self-reported knee instability and knee OA after an 8-week supervised exercise therapy and patient education programme. Knee confidence is suggested to be associated with various factors including walking pain, self-reported knee instability, muscle strength, and dynamic varus–valgus joint motion (S. T. Skou et al., 2014). Twisting/pivoting on the knee is an essential functional activity of knee joints during frequent daily activities (Glaister et al., 2007) and previous longitudinal findings have also reported an association between knee confidence and functional outcomes (Colbert et al., 2012). It has been suggested that neuromuscular exercise programs may have positive effects on knee confidence and functional outcomes through their impact on related factors (Sharma et al., 2015; S. T. Skou et al., 2014), but our study is the first to suggest this in patients with knee OA.

Despite the large sample size and use of real-world data collected in routine physiotherapy care, this study has limitations. First, we were unable to draw any conclusions on the degree of improvement that could be attributed to the GLA:D programme or regression towards the mean because of the absence of a control group. Secondly, as we used self-perceived knee instability as the outcome, the results cannot be generalised to mechanical joint stability.

In conclusion, we found that larger proportions of patients with knee OA had no or rarely self-reported knee instability, no or mild difficulty with twisting/pivoting, and lack of knee confidence after an 8-week supervised exercise therapy and patient education programme as compared to before the programme. Randomised trials confirming the effects of specific exercise interventions on knee instability, difficulty with twisting/pivoting the knee and knee confidence in patients with knee OA are needed.

AUTHOR CONTRIBUTIONS

All authors contributed to the study conception and design. Data collection was performed by Ewa M. Roos, Dorte T. Grønne, and Søren T. Skou. Analysis and interpretation of data were performed by Halit Selçuk, Ewa M. Roos, Dorte T. Grønne, Jonas B. Thorlund, and Søren T. Skou. All authors were involved in drafting the article or revising it critically for important intellectual content, and all authors approved the final version to be submitted for publication.

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CONFLICT OF INTEREST STATEMENT

Dr. Roos is on the Editorial Board of Osteoarthritis and Cartilage, the developer of the Knee injury and Osteoarthritis Outcome Score (KOOS) and several other freely available patient-reported outcome measures and co-founder of GLA:D®, a not-for profit initiative hosted

at University of Southern Denmark aimed at implementing clinical guidelines for osteoarthritis in clinical practice. Dr. Skou has received personal fees from Munksgaard, TrustMe-Ed, and Nestlé Health Science, outside the submitted work, and is co-founder of GLA:D®.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on reasonable request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

ETHICS STATEMENT

According to the local ethics committee of the North Denmark Region, ethics approval was not required for GLA:D. According to the Danish Data Protection Act, patient consent is not required, as personal data are processed exclusively for research and statistical purposes. GLA:D was approved by the Danish Data Protection Agency (SDU: 10.084).

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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