Journal of Telemedicine and Telecare
0(0) 1–6

DOI: 10.1177/1357633X17723368
journals.sagepub.com/home/jtt
SAGE

Efficacy of tele-rehabilitation compared with office-based physical therapy in patients with knee osteoarthritis: A randomized clinical trial

Kamran Azma[1,2], Zahra RezaSoltani[2], Farid Rezaeimoghaddam[2], Afsaneh Dadarkhah[2] and Sarasadat Mohsenolhosseini[2]

Abstract

Introduction: Knee osteoarthritis is a major cause of disability among the middle to senior age groups. Despite being effective, office-based physical therapy (OBPT) needs professional human resources and is both costly and time-consuming. We aimed to compare the efficacy of tele-rehabilitation (tele-rehab) compared with OBPT in patients with knee osteoarthritis.

Methods: In this randomized clinical trial, patients with symptomatic osteoarthritis of the knee were assigned to participate in either a 6-week home-based tele-rehab or an OBPT program between 2015 and 2016. Our primary outcome was the mean change from the baseline until 1 and 6 month's post-intervention in scores of the Knee injury and Osteoarthritis Outcome Score (KOOS) and the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC). We used analysis of variance for the repeated measure statistical test.

Results: A total of 54 patients entered the final analysis, with 27 in each group. The mean age of the patients was 58.2 ± 7.41 years and 60.2% were female. In the tele-rehab and OBPT group, KOOS scores increased from baseline to 6 months post-intervention (50.6 to 83.1 and 49.8 to 81.8) respectively. There was no significant difference between tele-rehab and OBPT groups in any of the studied scales.

Discussion: The tele-rehab program is as effective as OBPT in improving the function of patients with knee osteoarthritis. Considering the much lower time and cost consumed by tele-rehab, it is the recommended program for the older population living in remote sites.

Keywords
Tele-rehabilitation, efficacy, middle-aged, knee, osteoarthritis, pain measurement, Iran

Date received: 5 June 2017; Date accepted: 2 July 2017

Introduction

Osteoarthritis (OA) is the most common synovial joint disease[1] and is the leading cause of disability among the elderly.[2] Its prevalence reaches nearly half of the middle-aged Iranian population in some areas.[3] Among the joints throughout the body, the knee is the most common joint affected.[4] OA presents itself with progressive mechanical pain and morning stiffness that lasts less than 30 minutes. By disease progression, these symptoms make patients debilitated and limits their function.[5,6] The treatment goal is to improve the quality of life by controlling pain, increasing function, and maintaining joint motion.[7] To reach this goal, different treatment modalities have been proposed so far including medical (analgesics and intraarticular medicines),[8] surgical (lavage, arthroplasty), and physical therapy (exercise, lifestyle modification, hydrotherapy, hot pack and ultrasonography).[8–10] These modalities are most helpful and effective when they are combined together. The simplest and earliest options are to avoid pain-aggravating activities, losing weight, and consumption of acetaminophen as an analgesic of choice in OA.[10] Surgical approaches are costly and not the first-line treatment; however, they are recommended at advanced stages.

[1]Research Centre of Clinical Biomechanics and Ergonomics, Emam Reza Hospital, Aja University of Medical Sciences, Iran
[2]Physical Medicine and Rehabilitation Department, Emam Reza Hospital, Aja University of Medical Sciences, Iran

Corresponding author:
Sarasadat Mohsenolhosseini, Emam Reza Hospital, Etemadzade Street, Tehran, Iran.
Email: saramah22@gmail.com

The last decade has witnessed several studies on the efficacy of non-medical and non-surgical treatment modalities. These studies provided strong evidence for efficient exercises to reduce pain and increase function.[11,12] These exercises require that patients with OA visit specialized clinics for many sessions in order to yield maximized effect. Unfortunately, for most of the patients who are mainly middle-aged to elderly, it would not be easy to visit physical therapy clinics regularly for several times and weeks especially if they live in remote locations. This issue needs a lot of time, money, and transportation services.[13–15]

Tele-rehabilitation (tele-rehab) involves the use of information and communication technology to deliver services to people outside the rehab clinics which is potentially associated with less transportation and consequently reduced treatment expenses and time-savings. A number of studies have examined the efficacy of tele-rehab services in OA and there are a number of clinical trials underway.[16,17] Almost all published studies claimed the equal effectiveness of tele-rehab with face-to-face daily sessions of physical therapy at least in the short term.[18–20] It seems that this technique is preferable by healthcare providers (in this case, physical therapists) and is associated with high patient satisfaction.[21–23] However, generally the most cited source of concern was the lack of physical contact.

Considering the above benefits of telemedicine and especially tele-rehab, and also the scarcity of specialized rehabilitation services in remote locations outside clinics and high prevalence of OA in Iran, we aimed to evaluate the efficacy of tele-rehab using phone calls in improving pain and function of patients with knee OA in comparison with office-base physical therapy (OBPT). We tested the efficacy of tele-rehab services under supervision of a physical medicine and rehabilitation specialist instead of a physical therapist and continued our follow up for 6 months post-intervention to assess long-term outcomes between groups.

Methods

This controlled randomized clinical trial (RCT) was carried out in 2016 in a university medical centre. The design and protocol of this RCT was reviewed and approved by the institutional review board and then registered in the Iranian registry of clinical trials (www.irct.ir) as a world health organization regulatory representative for clinical trials in Iran [IRCT2017013032251N2]. This study was supervised by the institutional ethics committee to be in agreement with the Declaration of Helsinki.

Patient selection

We recruited 50–60-year-old patients with knee OA based on American College of Rheumatology criteria. The patients were recruited from individuals attending the physical medicine and rehabilitation clinic who complained of knee pain in most days of the past month. Patients had to have crepitation in active joint motions and swelling in examination. Our *exclusion criteria* consisted of severe (Kellgren–Lawrence grade 4) OA and morning stiffness longer than 30 minutes.

Sampling and randomization

We used the convenient sampling method based on previous studies;[13] an appropriate formula for comparison of two proportions. Our final estimated sample size with 10% dropout was equal to 27 individuals in each group ($\alpha = 0.05$, $\beta = 0.2$). Eligible patients were randomized into two groups after providing written informed consent. The first received tele-rehab and the second underwent OBPT.

Interventions. The patients in the tele-rehab group learned strengthening, endurance, flexibility, and active range of motion exercises. Then, they received a pamphlet containing descriptions and pictures detailing the above exercises and also a logbook to record their activities. Patients were asked to continue these exercises for three times a week for 6 weeks (total of 18 sessions). They were told to place a hot pack on their knees for 20 minutes before every session. A medical doctor, a specialist in physical therapy and rehabilitation (one of the authors named SM), was responsible for making contact with patients via a phone call on a weekly basis. In this manner, the specialist remotely monitored the progress of exercises, maintaining principles of daily activities, and symptom improvements. The specialist asked patients to match their exercises as instructed by the pamphlet and logbook they received.

In the OBPT group, patients visited the physical therapy clinic three times a week for 6 weeks (total of 18 sessions) and underwent treatment with various passive physiotherapeutic modalities including a 20-minute hot pack, 20-minute 50 Hz transcutaneous electrical nerve stimulation, and ultrasonography (US) with 1 MHz frequency and 1 watt/cm^2 intensity for 10 minutes. The same exercises as the first group were instructed by a physiotherapist for patients to do at home between sessions.

The patients were not allowed to consume any analgesics except diclofenac 50 mg once a day in the 48 hours prior to the first session of treatment.

Pre- and post-treatment evaluations. In both groups, after acquiring demographic data, the intensity of knee pain was assessed with the aid of Visual Analogue Scale (VAS) before the first session of treatments. Then, the Persian version of Knee injury and Osteoarthritis Outcome Score (KOOS)[24] was filled out by an expert in physical medicine and rehabilitation to measure knee pain, symptoms, and physical function during daily, recreational, and sport activities and also overall quality of life. The patients were also provided with Western Ontario and Macmaster Universities Osteoarthritis Index (WOMAC) for evaluation of physical function.[25] The scores of KOOS and WOMAC were normalized [(acquired score/total possible score) $\times$ 100]. In accordance with previous studies,[13,26] participants were re-evaluated using the same scales at the

end of 6 weeks, 1 and 6 months post-treatment time-points to assess short and long-term effects of each treatment.

Outcome measures

Our main outcome to measure was changes in patients' pain and function within each group and between study groups. We estimated the percent of changes from baseline to 6 months post-treatment with this formula [(6 months post-treatment score − baseline score / baseline score) × 100].

Statistical analysis

Final data before and after the treatment were imported and analysed by SPSS v.23. An independent samples *t*-test and appropriate non-parametric (Wilcoxon signed rank,

Table 1. Baseline characteristics of study groups.

	Tele-rehabilitation	Office physiotherapy	*p*-value	Statistical test
Age	55 ± 5.2	56 ± 5.1	0.938	*t*-test
BMI	30.6 ± 3.75	29.8 ± 2.95	0.371	*t*-test
VAS	7 ± 1.2	7 ± 1.4	0.838	Kruskal–Wallis
KOOS	44 ± 9.6	44 ± 11.2	0.598	Kruskal–Wallis
WOMAC	47.7 ± 9.5	47.7 ± 11.4	0.616	Kruskal–Wallis
Pain subscale	50 ± 11.9	44 ± 12.5	0.526	Kruskal–Wallis
ADL subscale	45.6 ± 8.5	45.6 ± 12.5	0.466	Kruskal–Wallis
Symptom subscale	57.1 ± 15.09	50 ± 14.31	0.175	Kruskal–Wallis
Sport subscale	25 ± 8.7	25 ± 11.75	0.656	Kruskal–Wallis
QoL subscale	37.5 ± 14.1	37.5 ± 14.6	0.753	Kruskal–Wallis

ADL: activities of daily life; BMI: body mass index; KOOS: Knee injury and Osteoarthritis Outcome Score; QoL: quality of life; VAS: Visual Analogue Scale; WOMAC: Western Ontario and McMaster Universities Osteoarthritis Index.

Table 2. Mean and median scores in different time-points.

	Tele-rehabilitation				Office physiotherapy				Total			
	Baseline	6th week	1 month	6 months	Baseline	6th week	1 month	6 months	Baseline	6th week	1 month	6 months
VAS	6.93[a]	2.74	2.67	2.48	6.85	2.59	2.52	2.41	6.89	2.67	2.59	2.44
	7.00[b]	3.00	3.00	3.00	7.00	2.00	2.00	3.00	7.00	3.00	3.00	3.00
KOOS	46.91	80.27	81.59	81.99	46.34	79.10	79.65	79.67	46.62	79.68	80.62	80.83
	44.05	81.55	83.33	83.33	44.05	79.17	80.95	80.95	44.04	81.54	82.14	82.14
Pain	50.21	78.81	79.53	79.94	49.18	79.01	80.45	80.56	49.69	78.90	79.98	80.24
	50.00	80.56	77.78	83.33	44.44	80.56	83.33	83.33	48.61	80.55	80.55	83.33
ADL	48.37	83.12	83.82	84.04	48.64	82.46	82.84	82.90	48.50	82.78	83.33	83.46
	45.59	85.29	85.29	85.29	45.59	83.82	83.82	85.29	45.58	85.29	85.29	85.29
Symptom	56.35	84.79	84.79	85.05	52.78	81.61	82.80	83.20	54.56	83.20	83.79	84.12
	57.14	85.71	85.71	85.71	50.00	85.71	85.71	85.71	55.35	85.71	85.71	85.71
WOMAC	50.56	82.35	82.86	83.11	49.80	81.34	82.18	81.82	50.18	81.84	82.51	82.46
	47.73	84.09	84.85	84.85	47.73	82.58	83.33	83.33	47.72	83.71	83.71	84.46
Sport	30.74	67.41	67.59	67.59	31.48	66.11	67.59	67.59	31.11	66.75	67.59	67.59
	25.00	70.00	70.00	70.00	25.00	70.00	70.00	70.00	25.00	70.00	70.00	70.00
QoL	37.50	78.94	79.17	80.09	36.34	76.85	80.32	80.32	36.92	77.89	79.74	80.20
	37.50	81.25	81.25	87.50	37.50	81.25	87.50	87.50	37.50	81.25	81.25	87.50

[a]Mean.
[b]Median.
ADL: activities of daily life; KOOS: Knee injury and Osteoarthritis Outcome Score; QoL: quality of life; VAS: Visual Analogue Scale; WOMAC: Western Ontario and McMaster Universities Osteoarthritis Index.

Mann–Whitney, and Kruskal–Wallis) tests were performed to compare means or medians across two groups. To assess changes within and between groups, we conducted an analysis of variance (ANOVA) for repeated measures. The level of significance was considered <0.05.

Results

Patient characteristics

From October 2015 to October 2016, after primary evaluation of 110 individuals seeking therapeutic interventions for knee OA, after providing informed consent, 76 patients were randomized into two treatment groups. Finally, 54 patients completed the study protocol and were qualified for intention-to-treat analysis, including 27 in each group. Among all participants, the mean age was 58.25 ± 7.41 years (45–60), 60.2% were female and the mean body mass index was 30.2. The baseline characteristics of study patients are depicted in Table 1. As evident, participants were matched statistically between both groups.

Outcomes

The mean and median values of VAS, WOMAC, and KOOS acquired by patients at baseline, immediately, and 1 and 6 months after treatment are shown in Table 2 and Figures 1–3. Based on an ANOVA, for repeated measures, the crescendo pattern observed in WOMAC and KOOS was statistically significant within each group over time (within patients $p < 0.001$ for both) but the difference between the two study groups was not significant (between patients $p = 0.860$ and 0.619, respectively). In the same manner, the decline in VAS scores was statistically significant within both groups (within patients $p < 0.001$ for both) but the difference was not significant between groups (between patients $p = 0.859$).

We estimated the percent of changes from baseline to 6 months post-treatment scores and show the results in Table 3. As shown, among different components of KOOS, the greatest change occurred in the quality of

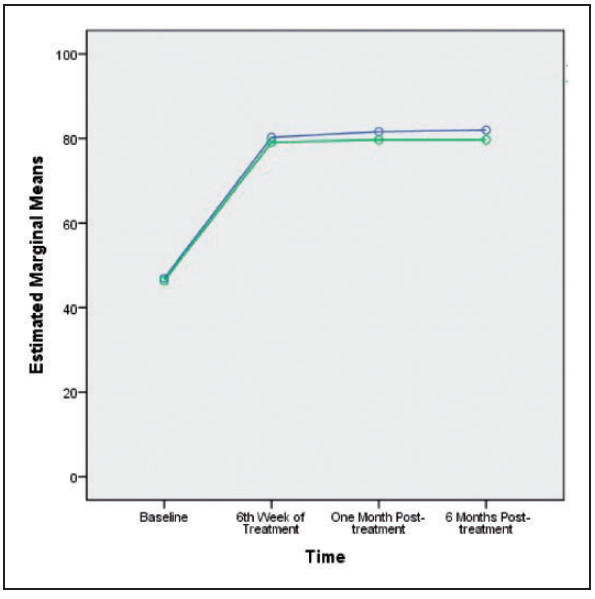

Figure 1. Estimated marginal means for KOOS scores; Darker line represent tele-rehab and lighter line represent office physiotherapy.
KOOS: knee osteoarthritis scale

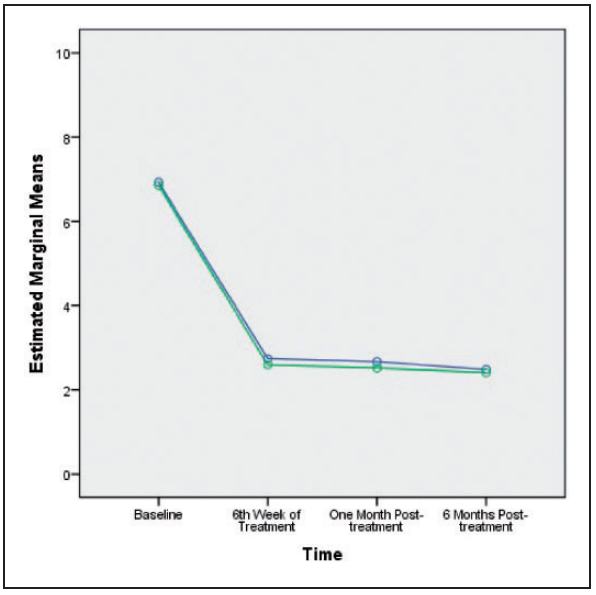

Figure 2. Estimated marginal means for VAS scores; Darker line represent tele-rehab and lighter line represent office physiotherapy.
VAS: Visual Analogue Scale

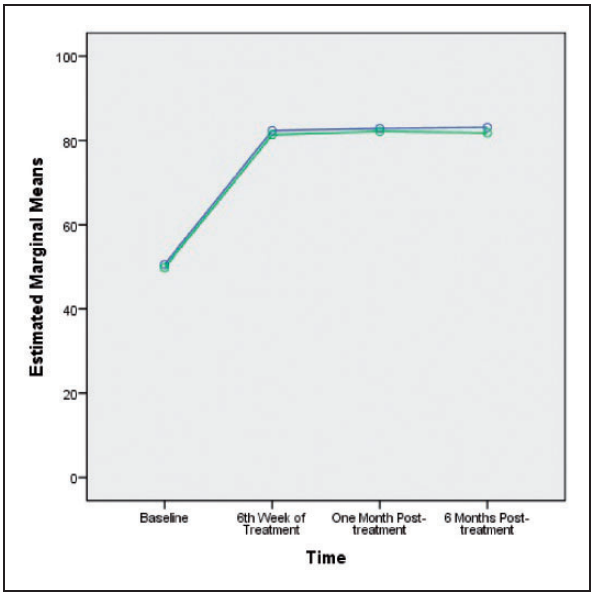

Figure 3. Estimated marginal means for WOMAC scores; Darker line represent tele-rehab and lighter line represent office physiotherapy.
WOMAC: Western Ontario and McMaster Universities' Osteoarthritis Index

Table 3. Mean changes of studied scales scores from baseline to 6 months post-treatment.

	VAS	KOOS	Pain	ADL	Sport	QoL	Symptom	WOMAC
Tele-rehabilitation	62.5 ± 8.8	75.6 ± 31.5	62.5 ± 26.3	76 ± 25.9	133.3 ± 52.5	133.3 ± 88.9	50 ± 42.9	67.1 ± 22.6
Office physiotherapy	62.5 ± 9.5	81.6 ± 30.7	73.3 ± 31.0	81.2 ± 30.8	140 ± 58.6	133.3 ± 90.1	53.8 ± 26.5	75 ± 24.1
p-value	0.867	0.842	0.528	0.931	0.917	0.716	0.328	0.959
Total	62.5 ± 9.1	79.4 ± 28.3	67.5 ± 28.7	79.4 ± 28.2	140 ± 55.1	133.3 ± 88.8	51.9 ± 35.3	72.5 ± 23.2

ADL: activities of daily life; KOOS: Knee injury and Osteoarthritis Outcome Score; QoL: quality of life; VAS: Visual Analogue Scale; WOMAC: Western Ontario and McMaster Universities Osteoarthritis Index.

life and sport activities subscales in both groups, which were over 130%. In addition, the smallest change occurred in symptom subscale which was about 51%.

Discussion

In this study, we evaluated the efficacy of a phone-assisted tele-rehab program compared with OBPT on symptoms and physical function of patients with knee OA. In all participants, we observed a significant improvement in pain intensity, function, quality of life, and sport activities from baseline to 6 months post-treatment according to KOOS, WOMAC and VAS indices. Nevertheless, there was no significant difference between tele-rehab and OBPT groups. Interestingly, there was no difference between the last week of treatment and further evaluations at 1 month and 6 months post-treatment. We could say that the treatment effect was durable for as long as 6 months. Our study indicates that tele-rehab is as effective as OBPT with less transportation, fewer costs, and less time consumption. Especially debilitated patients who cannot be admitted to physiotherapy clinics may benefit from such tele-rehab programs with the same efficacy as long as they follow the recommended exercises and accept the supervision of a specialist over the phone. The specialist monitors the quality of exercises, reminds the principles of healthy knee movement during daily activities, and warns against harmful movements affecting the knee.

Another useful influence of specialist supervision is to maintain the motivation and self-confidence to progress through regular phone contacts. A lesser need for in-person admittance to clinics consequently leads to time and cost savings, reduced work absence hours, reduced car traffic, and maybe even reduced air pollution. The above benefits may be associated with better patient compliance and lower probability of treatment intervals.

In Iran, this is the first study of its kind so we cannot compare our results with national works. However, there are somehow similar studies around the world. Scherr et al. showed the efficacy of tele-care using mobile phones in reducing the hospital admission of patients with heart failure due to decompensations.[27] Russell et al. showed the equivalence of a 6-week rehab program in clinic or tele-rehab using internet applications among patients with knee arthroplasty.[28] In addition to knee OA, the efficacy of tele-rehab programs have also been verified in other musculoskeletal problems. In a study by Multani et al. a 4-week tele-rehab program resulted in significant improvements in pain, muscular strength, and functional capacity of patients with lower back pain.[29]

One of the limitations of our study was our tele-communication device. In different studies investigators used various methods for tele-communications including phone, videoconference, email, video films, and compact disc. It is obvious that by increasing attractiveness of home-based programs (e.g. attractive user friendly web-based applications) we can facilitate patients' adherence to tele-rehabilitation.[30] However, use of these methods is highly correlated to the national communication infrastructure and the compliance of patients to use them. Due to this reason, we picked phone calls as our tele-communication method to attract most of our elderly patients' participation.

One of the strengths of our study was the relatively long-term follow up, until 6 months after treatment. This way we managed to observe the durability of treatments. This issue has rarely been taken into consideration in previous investigations and most of the other authors have only done during and immediately post-treatment measurements. Another was the similarity between our participants' characteristics and other studies. This may help other investigators to achieve a common conclusion by reviewing these study results.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

References

1. Peat G, McCarney R and Croft P. Knee pain and osteoarthritis in older adults: a review of community burden and current use of primary health care. *Ann Rheum Dis* 2001; 60: 91–97.
2. Felson D. Osteoarthritis. In: Fauci A, Kasper D, Braunwald E, et al. (eds) *Harrison's Principles of Internal Medicine*. Washington: McGraw-Hill, 2008, pp.2158–2165.

3. Tehrani-Banihashemi A, Davatchi F, Jamshidi A-R, et al. Prevalence of osteoarthritis in rural areas of Iran: a WHO-ILAR COPCORD study. *Int J Rheum Dis* 2014; 17: 384–388.
4. Simms R. Osteoarthritis. In: Andreoli T, Carpenter C and Cecil R (eds) *Andreoli and Carpenter's Cecil essentials of medicine*. Philadelphia: Saunders Company, 2007, pp.845–847.
5. Jamtvedt G, Dahm KT, Christie A, et al. Physical therapy interventions for patients with osteoarthritis of the knee: an overview of systematic reviews. *Phys Ther* 2008; 88: 123.
6. Jordan KM, Arden NK, Doherty M, et al. EULAR Recommendations 2003: an evidence based approach to the management of knee osteoarthritis: Report of a Task Force of the Standing Committee for International Clinical Studies Including Therapeutic Trials (ESCISIT). *Ann Rheum Dis* 2003; 62: 1145–1155.
7. Sharma L and Kapoor D. Epidemiology of osteoarthritis. In: Moskowitz R, Altman R, Buckwalter J, et al. (eds) *Osteoarthritis: Diagnosis and Medical/Surgical Management*. Philadelphia: Lippincott Williams & Wilkins, 2007, pp.1–26.
8. Rezasoltani Z, Taheri M, Kazempour MM, et al. Periarticular dextrose prolotherapy instead of intra-articular injection for pain and functional improvement in knee osteoarthritis. *J Pain Res* 2017; 10: 1179–1187.
9. Fransen M, Crosbie J and Edmonds J. Physical therapy is effective for patients with osteoarthritis of the knee: a randomized controlled clinical trial. *J Rheumatol* 2001; 28: 156–164.
10. Felson DT and Nevitt MC. Epidemiologic studies for osteoarthritis: new versus conventional study design approaches. *Rheum Dis Clin North Am* 2004; 30: 783–797.
11. Cheing GLY and Hui-Chan CWY. The motor dysfunction of patients with knee osteoarthritis in a Chinese population. *Arthritis Care Res (Hoboken)* 2001; 45: 62–68.
12. Itoh K, Hirota S, Katsumi Y, et al. Trigger point acupuncture for treatment of knee osteoarthritis–a preliminary RCT for a pragmatic trial. *Acupunct Med* 2008; 26: 17–26.
13. Odole AC and Ojo OD. A telephone-based physiotherapy intervention for patients with osteoarthritis of the knee. *Int J telerehabilitation* 2013; 5: 11.
14. Krawczak K, Glinkowski W, Cabaj D, et al. Musculoskeletal telerehabilitation user satisfaction – preliminary report. In: *Med-e-Tel: Electronic proceedings of the international e-Health, telemedicine and health, ICT forum for educational, networking and business*, 18–20 April 2012, pp.333–334.
15. Keerthi R, Chandra I and Deepak A. Can telerehabilitation add a new dimension in the treatment of osteoarthritis knee? *J Pain Reli* 2013; 2: 1–3.
16. Bennell KL, Rini C, Keefe F, et al. Effects of adding an internet-based pain coping skills training protocol to a standardized education and exercise program for people with persistent hip pain (HOPE Trial): Randomized controlled trial protocol. *Phys Ther* 2015; 95: 1408–1422.
17. O'Brien KM, Wiggers J, Williams A, et al. Randomised controlled trial of referral to a telephone-based weight management and healthy lifestyle programme for patients with knee osteoarthritis who are overweight or obese: a study protocol. *BMJ Open* 2016; 6: e010203.
18. Maisiak R, Austin J and Heck L. Health outcomes of two telephone interventions for patients with rheumatoid arthritis or osteoarthritis. *Arthritis Rheum* 1996; 39: 1391–1399.
19. Allen KD, Oddone EZ, Coffman CJ, et al. Telephone-based self-management of osteoarthritis. *Ann Intern Med* 2010; 153: 570.
20. Jansen-Kosterink S, in 't Veld RH, Hermens H, et al. A telemedicine service as partial replacement of face-to-face physical rehabilitation: The relevance of use. *Telemed E-Health* 2015; 21: 808–813.
21. Lawford BJ, Bennell KL, Kasza J, et al. Physical therapists' perceptions of telephone- and internet video-mediated service models for exercise management of people with osteoarthritis. *Arthritis Care Res (Hoboken)*. Epub ahead of print 1 April 2017. DOI: 10.1002/acr.23260.
22. Lawford BJ, Bennell KL and Hinman RS. Consumer perceptions of and willingness to use remotely delivered service models for exercise management of knee and hip osteoarthritis: A cross-sectional survey. *Arthritis Care Res (Hoboken)* 2017; 69: 667–676.
23. Kairy D, Lehoux P, Vincent C, et al. A systematic review of clinical outcomes, clinical process, healthcare utilization and costs associated with telerehabilitation. *Disabil Rehabil* 2009; 31: 427–447.
24. Saraiepour S, Salavati M, Akhbari B, et al. Translation and localization of Knee injury and Osteoarthritis Outcome Score (KOOS) and evaluation of reliability of Persian version among Iranian patients with knee osteoarthritis. *J Rehabil* 2007; 8: 42–46.
25. Nadrian H, Moghimi N, Nadrian E, et al. Validity and reliability of the Persian versions of WOMAC Osteoarthritis Index and Lequesne Algofunctional Index. *Clin Rheumatol* 2012; 31: 1097–1102.
26. Szöts K, Konradsen H, Solgaard S, et al. Telephone follow-up by nurse following total knee arthroplasty–protocol for a randomized clinical trial (NCT 01771315). *BMC Nurs* 2014; 13: 14.
27. Scherr D, Kastner P, Kollmann A, et al. Effect of home-based telemonitoring using mobile phone technology on the outcome of heart failure patients after an episode of acute decompensation: randomized controlled trial. *J Med Internet Res* 2009; 11: e34.
28. Russell T. Tele-rehabilitation as successful as out-patient physiotherapy post total knee replacement. *J Bone Jt Surg* 2011; 93: 113–120.
29. Multani NK, Singh B and Garg S. Effectiveness of telemedicine services integrated into physiotherapeutic health care system. *J Exerc Sci Physiother* 2006; 2: 87.
30. Palazzo C, Klinger E, Dorner V, et al. Barriers to home-based exercise program adherence with chronic low back pain: Patient expectations regarding new technologies. *Ann Phys Rehabil Med* 2016; 59: 107–113.