

Is group-based physical therapy superior to individual rehabilitation in elderly adults after total knee arthroplasty? A prospective observational study

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Abstract

Knee osteoarthritis (OA) is the most prevalent joint disease and one of the leading causes of disability, poor physical activity levels (PAL), and quality of life (QoL) of elderly people worldwide. The purpose of this study was to evaluate the superiority of a novel group-based physical therapy (GBPT) intervention compared to a more traditional one-to-one individual physical therapy (IPT) among elderly Bulgarian subjects underwent total knee arthroplasty (TKA). One hundred and thirty elderly TKA recipients of both genders with mean age=72.69±0.44 were randomly assigned to GBPT or to one-to-one IPT. Elderly participants were assessed at baseline and at 3 and 6 months after both rehabilitation interventions, with the use of the following evaluation tools: Physical Activity Scale for the Elderly (PASE), Six-Minute Walk Test (6MWT), and Short Form Health Survey questionnaire (SF-36v2). At 6 months elderly TKA recipients who received GBPT achieved 7.36 points more in the PASE questionnaire when compared with the IPT group. Elderly participants of the GBPT group walked significantly longer distance during the 6MWT than TKA recipients attended IPT, respectively 421.56 m vs. 398.62 m, ($p < 0.001$). Furthermore, significantly greater improvement in health-related quality of life (HRQoL) was obtained from the elderly participants of the GBPT arm compared with the participants of the IPT arm, respectively 70, 7% vs. 60, 8% at 6 months follow up. We conclude that our results suggest the superiority of the GBPT in terms of PAL (PASE score, 6MWT) and HRQoL among elderly TKA recipients across the first 6 months.

Key Words: Total knee arthroplasty; physical activity; six-minute walk test; health-related quality of life; group-based physical therapy.

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Nowadays, the global increase in total numbers of elderly people is astonishing and the World Health Organization (WHO) has estimated that the geriatric population has increased from 8% in 2012 to 8.5% in 2015 and is expected to rise by 22% in 2050.¹ Osteoarthritis (OA) remains the most challenging degenerative joint disease, and a primary cause of pain, disability, and diminished quality of life (QoL) among the older population, resulting in an enormous burden on the

healthcare systems worldwide.² It has been estimated, that 9.6% of men and 18% of women above 65 years suffer from knee OA, and 78 million people will be affected by 2040.³ The knee joint is the most frequent location of OA, and is mainly characterized by pain, reduced muscle strength, cartilage destruction, and abnormal bone metabolism, which limiting in performing activities of daily living (ADL), and compromising physical activity levels (PAL) of patients. Both,

individuals with knee OA and total knee arthroplasty (TKA) recipients demonstrate several functional limitations such as reduced mobility, slower walking speed, prolonged time to climb stairs, and difficulties in transferring into and out of a car compared to people without knee pathology.

So far the effective management of knee OA is one of the main priorities of the World Health Organization (WHO) and includes surgical techniques such as TKA in combination with nonsurgical treatments, such as nonsteroidal anti-inflammatory drugs (NSAIDs) and application of several rehabilitation protocols.⁴ TKA has been documented as the most effective surgical treatment for end-stage knee OA, giving patients restored functional ability, pain relief and consequently improved PAL and QoL.⁵ These benefits led to 25% increased demand of TKAs in Western countries, partly due to the aging of population and increasingly longer life expectancy. It has been estimated that between 2000 and 2014, the annual number of primary TKAs was increased by 148% in the United States, and more than 700,000 Americans annually elect to undergo TKA, projected to reach 3.5 million by 2030.⁶ Osteoarthritis Research Society International (OARSI) guidelines, rehabilitation is considered the "core" non-surgical treatment of OA and is widely promoted after TKA.⁷

Nowadays, various post-TKA rehabilitation protocols are applied. The majority of them are focused on the recovery of knee range-of-motion (ROM) and strengthening of the knee extensor musculature.⁸ While in United Kingdom and Australia, the outpatient post-TKA rehabilitation setting is widely applied, in the United States the inpatient post-TKA rehabilitation interventions are mainly preferred.⁹ The outpatient setting includes various modalities such as (one-to-one) individual physical therapy (IPT), group-based physical therapy (GBPT),⁴ home-based exercise, interventions and more recently telerehabilitation.¹⁰ IPT is widely used

rehabilitation modality in Australia, while the group-based interventions are the predominate treatment in the United Kingdom and Scandinavian countries. Although, the adequate and quick functional recovery of elderly TKA recipients continues to pose a challenge for both patients and physical and rehabilitation medicine (PRM) specialists. Hence, the purpose of this study was to highlight the eventual superiority of the GBPT compared to the IPT, in terms of PAL and QoL, among elderly Bulgarian patients primarily undergoing TKA.

Materials and Methods

Design Overview

This was a prospective single-blinded (assessor-blinded), randomized controlled trial, conducted at Rehabilitation Center Pobeda, Varna, Bulgaria. Recruitment began in April 2013 and was completed in September 2019. This research was conducted in accordance with the Declaration of Helsinki of 1975 (revised in 2000) and was approved by the Bioethics Committee of the Faculty of Public Health "Prof. Dr. Tzecomir Vodenicharov, DSc.", Medical University of Sofia, Bulgaria.

Study Participants

The cohort consisted of patients from the at Clinic of Orthopedics and Traumatology, Military Medical Academy Varna. All study participants were elderly subjects of both genders aged 65-80 years, who underwent primary unilateral or simultaneous bilateral TKA and were willing to perform their post-TKA rehabilitation at Rehabilitation Center Pobeda, Varna-Bulgaria. Elderly TKA recipients were excluded if they were unable to comprehend the study material (originally available in Bulgarian only) or if they were diagnosed with post-surgical joint infection, severe respiratory or cardiac comorbidity, uncontrolled diabetes, neuromuscular impairments, progressive cancer, or if weight-bearing was restricted. Elderly participants were

Table 1. Baseline demographic and clinical characteristics of participants.

Variables	GBPT group (n.= 65)	IPT group (n. = 65)	p value
Age (years)	73.63±5.08	71.81±4.75	>0.05
Gender (men/women)	31/35	32/33	>0.05
Height, meters	171.25±7.57	169.61±8.19	>0.05
Weight, Kilograms	76.76±10.21	78.39±12.97	>0.05
BMI, kg/m2, (mean 95% CI)	29.23±3.62	29.89±5.04	>0.05
Diagnosis of Osteoarthritis, n (%)	2±1	2±1	>0.05
Number of Co-morbidities n (median, IQR)	2±1	2±1	>0.05
PASE	42.79±3.5	41.68±2.2	>0.05
6MWT	338.57±9.88	336.29±9.88	>0.05
SF-36 V2	43.59 ±3.5	43.54±3.5	>0.05

Bulgarian speakers and had adequate hearing and intellectual capacities. Health care professionals from Rehabilitation Center Pobeda, Varna, Bulgaria involved in the study administered, both questionnaires i.e. Physical Activity Scale for the Elderly (PASE),¹¹ Short Form Health Survey (SF-36v2) questionnaire,¹² the six-minute walk test (6MWT),¹³ and supervised both rehabilitation interventions. The baseline sociodemographic and clinical measurements of the elderly subjects are shown at the Table 1. All study participants agreed to participate were informed about the aims, procedures, benefits and potential risks of the trial, and signed written informed consent.¹⁴

Physical Activity Scale for the Elderly (PASE)

The PASE questionnaire is a brief and easily administered tool specifically designed to assess PAL of people aged 65 years and older.¹¹ It assesses intensity, frequency and duration of physical activities of the past 7 days in three life domains: recreational, household and work-related activities. The first domain includes questions concerning weekly frequency of recreational activities (e.g., walking, light sports), sports with great intense (dancing) and exercise for the increase of the muscular system (e.g. weights). The second domain includes questions referring to household activities (inner house activities). The third domain includes questions referring to the duration and the type of the patient's job for the last week. The PASE total score is measured by adding all the subscores and has been found to be moderately correlated with direct methods for assessing PAL (doubly-labeled water and accelerometry), but also with grip strength, static balance, knee muscle strength and 6MWT distance in patients with knee OA. Additionally, the PASE questionnaire demonstrates several advantages such as short time to completion, short recall time frame and it especially considers low-intensity activities which are commonly performed by the elderly individuals. We performed the translation and cross-cultural adaptation of the PASE questionnaire into Bulgarian following the guidelines recommended by the American Association of Orthopedic Surgeons Outcomes Committee.¹⁵ Elderly TKA recipients of our study completed the validated Bulgarian version of the PASE questionnaire one week preoperatively to 3 and 6 months after both rehabilitation interventions.

Six-minute walk test (6MWT)

The 6MWT is the most commonly used metric for measuring changes in mobility and functional recovery after TKA.¹³ It's excellent test-retest reproducibility, even among elderly TKA recipients and people with knee OA has been proven in several studies.¹⁶ Additionally, 6MWT seems to be more representative of ADL, and is an excellent predictor of functional ambulation after TKA.¹³ The minimally clinical important difference (MCID) for the 6MWT in patients recovering from TKA, has been estimated to be 26.0 m.¹⁷ Study participants

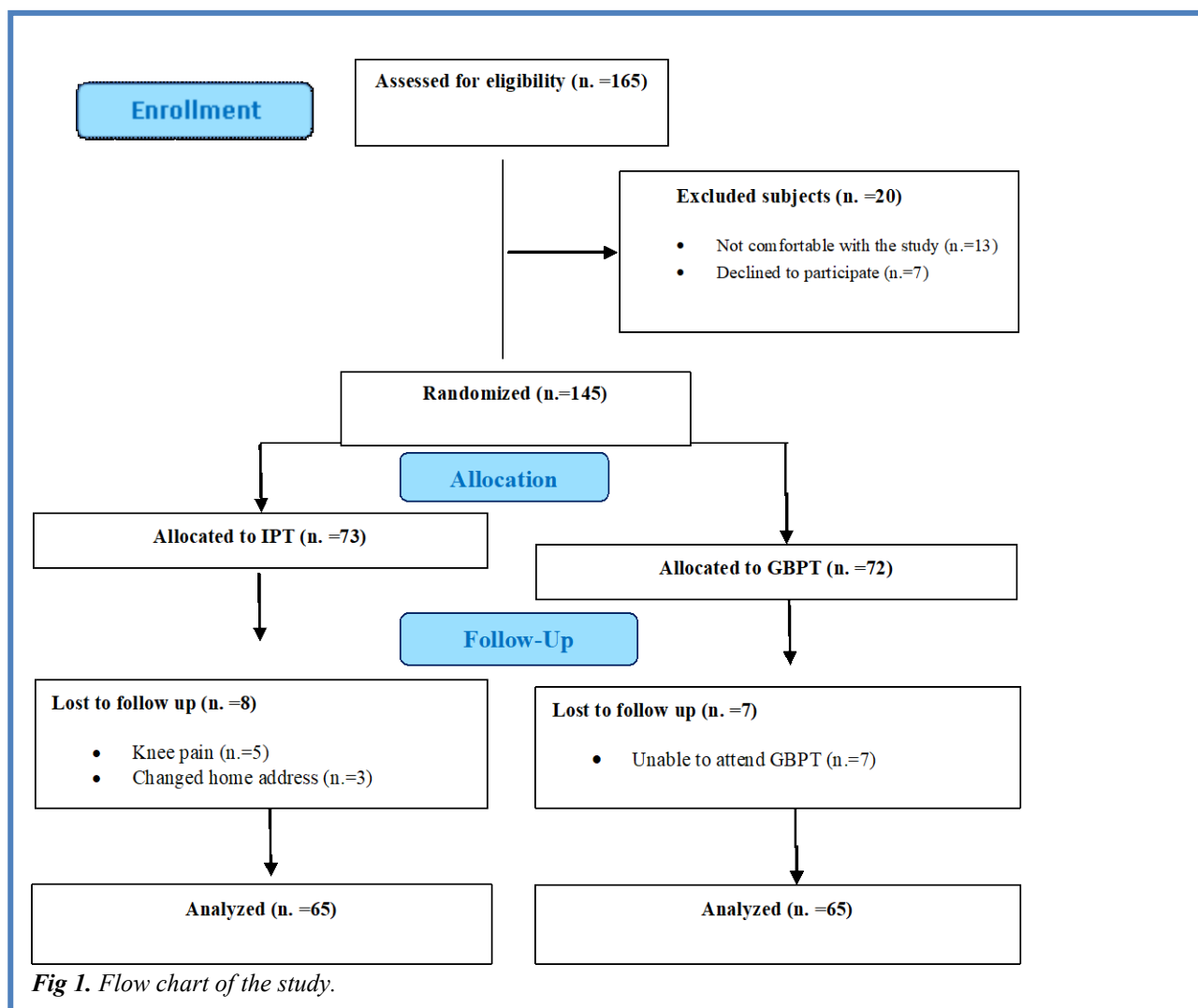
were familiar with the 6MWT guidelines published by the American Thoracic Society¹⁸ and were instructed to walk as much distance on the 35-m marked corridor at Rehabilitation Center Pobeda, Varna, Bulgaria. Standardized encouragement phrases and the time left of the 6MWT were given to the patients at each minute. Rests were permitted but time was not stopped. Elderly TKA recipients of our study performed two tests with 30-m rest times on the same day. The 6MWT with the longest distance covered was selected for analysis. The 6MWT was repeated at 3 and 6 months after both rehabilitation interventions.

Short Form Health Survey SF-36v2 questionnaire

Elderly subjects completed the Bulgarian version of the Short Form Health Survey SF-36v2 questionnaire. The SF-36 v2 is a generic HRQoL instrument, consisting of 36 questions that inquire about the general health status of patients. Its 36 items cover eight domains: physical functioning (PF), role limitations due to physical problems, bodily pain (BP), general health (GH), vitality (VT), social functioning (SF), role limitations due to emotional problems (RE), and mental health (MH).¹² Scoring for each dimension ranges from 0 to 100, with a higher score indicating better health status,¹⁹ and the minimal clinically important difference (MCID) defined as 5 points.²⁰ The SF-36v2 has been widely used to assess health outcomes in several diseased population, and its validity and reliability was established in more than 50 countries as well as in Bulgaria.¹² The SF-36v2 questionnaire was administered by two investigators (HM and KP) blinded to group assignment. Elderly TKA recipients from our study completed the SF-36v2 questionnaire at baseline, as well as at 3 and 6 months after both rehabilitation interventions.

Rehabilitation interventions

One-hundred and thirty elderly TKA recipients of both genders were allocated to perform GBPT and IPT at Rehabilitation Center Pobeda, Varna, Bulgaria over a six-months period. Sixty-five (n=65) elderly subjects from our study were randomized to perform a group-based intervention.⁴ Elderly TKA recipients allocated to GBPT initially performed progressive strengthening and balance exercises, as well as gait training with devices. The GBPT was designed to increase the strength of the flexor and extensor of the knee, reduce the pain, as well as to improve both the knee ROM and general physical activity of the elderly TKA recipients.⁸ Moreover, elderly subjects performed specific muscle group exercises (knee flexion, mini-squats, step-ups, and upper-limb weights) aerobic activities (arm ergometry in standing and stationary cycling) with common warm-up, general aerobic, and cool-down periods, as well as weight-bearing functional tasks. Sixty-five (n=65) elderly TKA recipients were randomized to IPT, and performed specific exercises addressed to vastus medialis oblique retraining or iliotibial band stretches as appropriate.²¹



Additionally, manual therapy techniques such as joint mobilization and soft-tissue therapy were provided. Several physical modalities such as cryotherapy, interferential electrical stimulation, and taping were also applied. Elderly participants of our study were allocated into 18 training groups, consisting of 5 to 8 subjects. Both rehabilitation interventions were supervised by a PRM physician, and the PT-to-patient ratio did not exceed 1:8. The enrollment flow chart according to the CONSORT guidelines²² is presented in Figure 1.

Statistical analysis

All statistical analyses were completed using SPSS Statistics (Version 19, IBM Statistics, SPSS Inc., Chicago, Ill., USA). The independent variables were age, gender, BMI (under and over 30 kg/m²), baseline PASE scores, 6MWT, and SF-36 v2 scores. Participant characteristics were summarized using frequencies, means and standard deviations (SD) or medians as appropriate. We confirmed that our study data were normally distributed using the Kolmogorov-Smirnov test. Chi-square tests were used to compare quantitative and qualitative characteristics in age, gender and BMI of

elderly TKA participants. The effect of each independent variable was analyzed separately for the PASE and SF-36 v2 questionnaires, and the 6MWT, in time (one week before TKA, 3 and 6 months after both rehabilitation interventions) using general linear modeling for repeated measures and post-hoc tests with Bonferroni's correction. We used a mixed-model analysis of variance ANOVA to detect differences in the outcome measures (PASE scores, 6MWT, and SF-36 v2) with time (one week preoperatively, to 3 and 6 months after both rehabilitation interventions) as the within-subject factors, and group (GBPT, IPT) as the within-subject factor. Outcomes at each time point were compared with either Mann-Whitney U or Kruskal-Wallis tests, with Bonferroni corrections performed for post hoc subgroup analyses. The Sidak multiple comparisons test was also used to perform post-hoc analysis. The level of significance was set to $p < 0.05$.

Results

Of the 165 elderly subjects who underwent TKA surgery at Clinic of Orthopedics and Traumatology of Military Medical Hospital in Varna, Bulgaria between March

Table 2. PAL (PASE, 6MWT), HRQoL in GBPT and IPT groups at baseline at 3 and 6 months after both rehabilitation interventions.

Variable	GBPT Baseline	GBPT Follow-up (3m)	GBPT Follow-up (6m)	% Change (95% CI)	p-value	IPT Baseline	IPT Follow-up (3m)	IPT Follow-up (6m)	% Change (95% CI)	p-value
PASE	42.79±3.5	66.35±3.29	84.75±5.00	93.63±3.93	<0.001	41.68±2.2	58.29±7.63	74.39±2.48	78.48±4.10	<0.001
6MWT	338.57±9.8	398.49±1.3	421.56±1.2	24.51±4.1	<0.012	336.29±9.78	375.72±2.4	398.62±3.7	18.53±5.29	<0.013
SF-36 v2	47.50±1.64	65.35±2.31	77.41±6.25	29.79±3.4	<0.010	46.03±0.75	61.12±0.66	72.52±5.3	25.71±1.70	<0.011

Abbreviations: GBPT, group-based physical therapy; HRQoL, health-related quality of life; IPT, individual physical therapy; PASE, physical activity scale for the elderly; questionnaire; 6MWT, six-minute walk test; SF-36 v2, Short Form Health Survey SF-36v2 questionnaire; 95% CI, 95% confidence interval.

Note: p-value from Mann-Whitney test

2013 to September 2019. Finally, 130 participants with mean age: 73, 32 ± 0.40 years were included and were randomly assigned into two groups by 1:1 ratio to GBPT (n.=65) or IRI (n.=65), by using an online randomizer, Research Randomizer (<https://www.randomizer.org>) program.

Fifteen TKA recipients from our study dropped out (rate <20%). Eight of these 15 elderly subjects were allocated to perform IRI; they declined starting treatment mainly because they felt knee pain and 3 subjects changed home address (Figure 1). Elderly subjects of our study were subjected to identical TKA procedures performed by a team of two orthopedic surgeons (J.K., V.O.). In all elderly participants used the medial parapatellar approach and posterior-stabilized knee replacement. At the end of TKA, elderly subjects received identical anesthetic procedures (HB). The median length of hospital stay was six days.

According to the Table 1, there were no significant differences among elderly TKA recipients who attended both rehabilitation interventions, regarding sociodemographic variables and baseline PASE scores,

Physical Activity Levels (PAL)

In the third month after TKA, PASE scores changed significantly among elderly TKA recipients attended both rehabilitation interventions, Table 2.

Our analysis showed statistically superior improvement for the elderly TKA recipients received GBPT achieved 66.35±3.29 points in the PASE questionnaire, while the elderly subjects performed IPT arm reached 58.29±2.48 points in the same questionnaire (Figure 2).

Six months after the TKA, elderly subjects performed GBPT arm achieved 84.75±5.00 points in the PASE questionnaire, which was significantly greater than the improvement achieved by the TKA recipients performed IPT, respectively 74.39±2.48 points (93.06%±3.93 vs. 78.48%±4.10; Table 2).

No statistically significant differences in the baseline were observed during the 6MWT. Three months after TKA, elderly subjects performing IPT arm walked 6MWT and HRQoL. Both questionnaires, PASE and SF-

36 v2 were completed by 130 elderly subjects (100%) one week preoperatively, as well as at 3-d and 6-th month after both rehabilitation interventions. No elderly participant of our study necessitated decreasing training intensity during both rehabilitation interventions, as well as no adverse events were associated with both rehabilitation arms. significantly shorter distances in the 6MWT, respectively 375.72±2.40m, compared, compared to the TKA recipients who attended GBPT arm, respectively 398.49±1.3m; (Figure 3).

Six months after TKA, elderly participants attended GBPT arm walked 23.07 m longer distance during the 6MWT, compared to the distance walked from the elderly TKA recipients performed IPT arm, respectively 421.56±1.2 m, vs. 398.62±3.7m.

The improvement for the elderly subjects performed GBPT arm was significantly greater compared to the improvement achieved for elderly subjects attended IPT arm, respectively 24.51±4.1% vs. 18.53±5.29%; Table 2. Using a mixed ANOVA analysis of variance, a significant group-by-time interaction was found for PAL participants (p=0.02), and 6MWT (p=0.02). Significantly more elderly TKA recipients amongst the IPT cohort required rests during the 6MWT compared to GBPT cohort, respectively 12 vs. 8 participants.

Health-Related Quality of Life (HRQoL)

There were no statistically significant differences in SF-36 v2 domains across age, and BMI, at baseline between the elderly subjects participated in the research (Table 1). Elderly TKA recipients of both rehabilitation arms improved significantly all SF-36 v2 domains, however greater improvement was observed on main physical domains, (RP), physical function (PF), and bodily pain (BP), at each follow-up (3 and 12 months; Table 3).

Smaller, but statistically significant improvements on the general health and mental domains (mental health, social functioning and role emotional) were seen. At 3 months follow-up, we observed significantly greater improvement among elderly participants attended GBPT arm in all SF-36 v2 domains compared to the improvement achieved among elderly subjects received

Group-based or individual rehabilitation after total knee arthroplasty

Eur J Transl Myol 32 (4): 10984, 2022 doi: 10.4081/ejtm.2022.10984

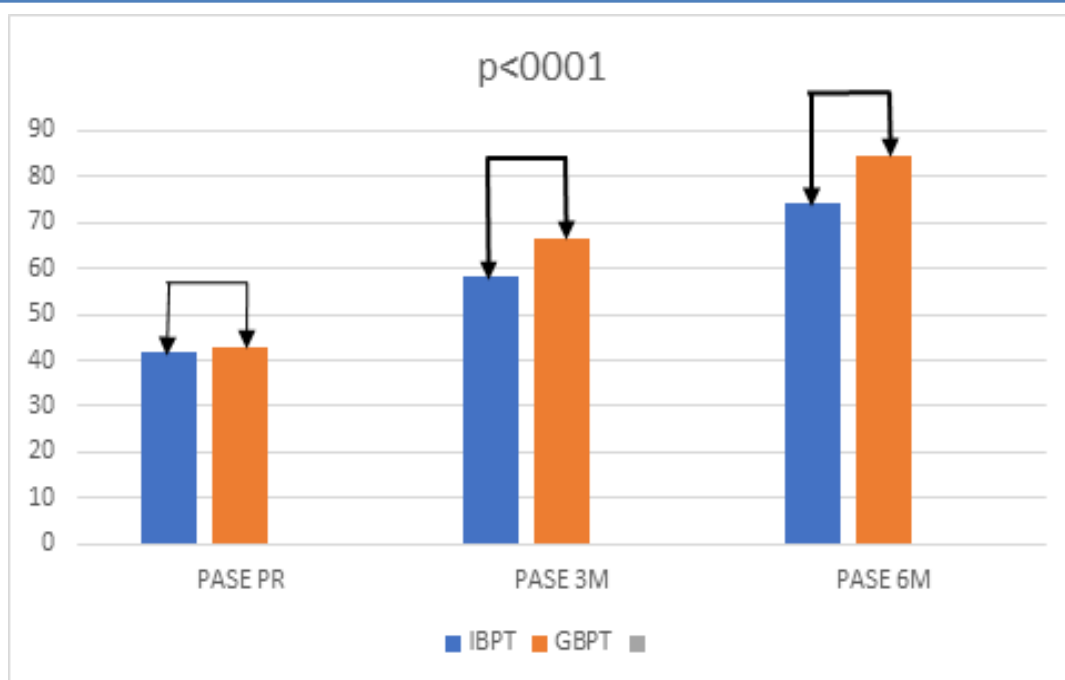


Fig 2. Results of PASE questionnaire at baseline, and at 3 and 6 months after both rehabilitation interventions.

IPT ($P < 0.001$; Table 3). Elderly TKA recipients performed GBPT arm achieved notable improvement in role physical (RP) domain, respectively from 22.86 ± 3.70 units at baseline to a score of 52.10 ± 3.18 units, ($p < 0.001$) 3-month after TKA, while the improvement in this domain achieved from the elderly subjects received IPT was significantly lower, respectively from 23.42 ± 0.9

units at baseline to a score of 49.13 ± 4.24 units, for the same interventional period ($p < 0.001$; Table 3).

Similarly, elderly TKA recipients who attended GBPT improved significantly bodily pain (BP) score of 28.87 ± 2.29 units to a score of 53.05 ± 3.53 units, 3 months after TKA ($p < 0.001$; Table 3). The improvement in this domain achieved for the TKA recipients received IPT was respectively of 27.06 ± 2.09 units to a score of

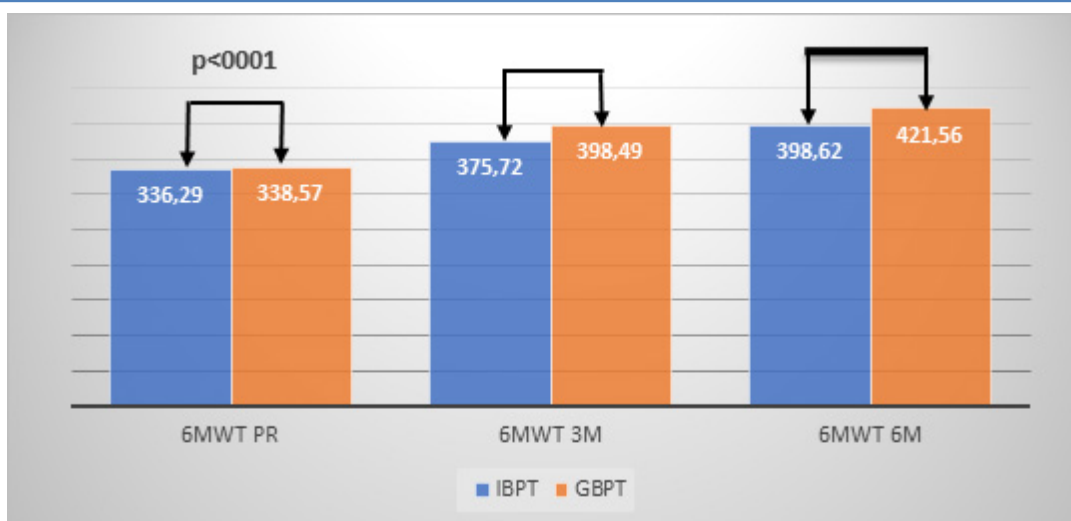


Fig 3. Average distance covered during the 6MWT, at baseline, and at 3 and 6 months of both rehabilitation interventions. Abbreviations: GBPT, group-based physical therapy; IBT, individual physical therapy; 6MWT, six-minute walk test..

Table 3. Comparison of SF-36 v2 total scores and scores for every physical and mental domain at baseline and at 3 and 6 months after both rehabilitation interventions.

SF-36 v2 Domains	GBPT Baseline	GBPT Follow-up (3m)	GBPT Follow-up (6m)	Δ GBPT 6 – 0 (percentage change)%	p-value	IPT Baseline	IPT Follow-up (3m)	IPT Follow-up (6m)	Δ GBRI 6 – 0 (percentage change)%	p-value
(PF)	42.74±3.04	66.77±4.85	74.75±5	74.79	<0.001	41.28±2	64.29±3.65	72.27± 6.12	70.22	<0.001
(RP)	22.86±3.7	52.10±3.18	67.55±3.16	195.49	<0.001	23.42±0.9	49.13±4.24	62.31± 2.24	166.05	<0.001
(BP)	28.87±2.29	53.05±3.53	68.46±3.52	137.13	<0.001	27.06±2.09	51.47±2.73	61.59± 4.23	127.60	<0.001
(GH)	47.13±3.72	60.24±2.89	71.89±2.23	52.53	<0.001	48.12±2.54	57.33±1.58	67.75± 4.52	40.79	<0.001
(VIT)	41.65±5.18	57.12±4.47	72.75±4.76	74.66	<0.001	41.05±3.7	52.35±2.15	68.12± 4.76	65.94	<0.001
(SF)	51.10±8.83	62.86±8.79	74.43±8.91	45.65	<0.001	52.08±5.2	60.34±3.22	71.12± 2.3	40.39	<0.001
(RE)	48.96±3.04	65.87±4.48	80.78±6.47	64.99	<0.001	49.23±1.28	60.45±6.48	75.61± 2.32	53.58	<0.001
(MH)	65.45±5.85	77.85±6.74	84.72±5	29.44	<0.001	66.11±7.56	73.95±3.24	79.42± 6.73	20.13	<0.001
Total SF-36 v2	43.61±4.35	61.98±4.8	74.41±48	70.63	<0.001	43.54±3.15	58.66±3.4	70.02±4.1	60.82	<0.001

Abbreviations: BP, bodily pain; GH, general health; GBPT, group-based physical therapy; IPT, individual physical therapy; MH, mental health; PF, physical functioning; RE, role emotional; RP, role physical; SF, social functioning; VIT, vitality. Note: p-value from Mann-Whitney test

51.47±2.73 units, and was significantly lower than the improvement achieved by the TKA recipients of GBPT arm.

The physical functioning (PF) score was also significantly improved by the elderly TKA recipients performing GBPT 3-months after TKA. From 42.74±3.04 units at baseline to 66.77±4.85 units 3-month after TKA, (p <0.001; Table 3). Similar, but significantly lower gains in this domain were achieved by the elderly TKA recipients received IPT, compared with the elderly participants performed GBPT arm, respectively from 41.28±2.00 units at baseline to 64.29±3.65 units 3-month after the intervention (p <0.001; Table 3).

At 6-month follow-up, total SF-36 v2 scores were 4.39 points higher in GBPT arm vs. IPT arm (95% CI-4.6, 2.0; p=0.04; Table 3), indicating meaningful difference between both rehabilitation arms. According to the multiple comparison Sidak test significant differences between the baseline scores in all domains 6 months after TKA were found (p<0.05), while there were also significant differences between the results at three and six months after both rehabilitation arms (p<0.05, Table 2). Results of the mixed ANOVA indicated significant group-by-time interaction for role physical (F 2,142 =35.87; p<0.001).

Furthermore, there was a significant interaction between both factors (F2, 142=69, 08, p<0.001). The Sidak tests revealed significant differences to the results before the TKA and 3 (p<0.001) and 6 months (p<0.001) after both rehabilitation interventions. Additionally, we observed a significant difference to the measures between 3 and 6

months after the GBPT (p<0.001; Table 3). As far as all 4 domains of the level are concerned, we wrote down a significant affection of the factor „measure”; physical function (F 2, 256 =76.16, p<0.001), role physical (F2,142=42.87, p<0.001, bodily pain (F2,256=48.27, p<0.001) and role emotional (F 2,205=42.20, p<0.001).

Discussion

As the number of elderly TKA recipients in Bulgaria continues to rise, designing novel rehabilitation strategies that effectively improve PAL, QoL and decrease the burden on our health care system should be prioritized. To date, this is the first study conducted in Bulgaria aimed to evaluate the superiority of GBPT compared to a more traditional one-to-one IPT among elderly TKA cohort. Moreover, unlike previous studies found similar effects between GBPT and IPT,²³ Ko et al.,²⁴ have demonstrated the lack of superiority of one-to-one IPT when compared to home-based interventions including telerehabilitation in terms of PAL and HRQoL.^{6,13} The results of our study indicate an overall increase in PAL from baseline to 3 and 6 months follow-up in both rehabilitation arms. Although, the GBPT cohort of our study demonstrated much higher PASE scores compared to those referred in the study of Tsonga et al., in which elderly females underwent IPT were evaluated.²⁵ Our explanation for the significantly higher PASE scores obtained by the GBPT group may be associated with the early-onset of the elderly TKA recipients, the type and the intensity of the exercises included in GBPT, as well as with the significant advantages of group-based

interventions in the context of chronic conditions such OA.^{4,17} Evidence for the benefits of GBPT for elderly TKA recipients has been accumulating and includes greater exercise motivation,²⁶ advanced class instruction, and peer support.⁸ Furthermore, GBPT seems to be a cost-effective rehabilitation intervention, when compared to IPT, as well as it has a positive impact on physical function in community-dwelling elderly adults and individuals after TKA.²⁷

Since 6MWT is a widely used tool in assessment of various rehabilitative interventions,^{16,17} we observed a notable increase in distance walked during 6MWT, from the TKA cohort of both rehabilitation arms, at 3- and 6-months follow-up. This was unexpected, given the poor baseline values recorded on the 6MWT by the elderly TKA cohort of our study. Previous RCTs have highlighted the functional limitations of elderly TKA recipients during 6MWT, as well as the poorest performance at 6 months follow-up.^{8,11,16}

Although, at 6 months follow-up there was a statistically significant improvement in the distance walked during 6MWT in favor of GBPT cohort respectively 24, 5%, while the improvement obtained from the participants performed IPT arm, was respectively 18, 5% ($p < 0.001$; Table 2). The findings of our study are consistent with the results reported in the study of Allen et al.,²⁵ as well with other studies applied high-intensive rehabilitation interventions after TKA.²⁴ However, using the reference equations published by Enright et al.,²⁸ the performance of our TKA cohort attended GBPT arm was still inferior, with the predicted distance for TKA recipients of 464 m.¹³

While Naylor et al.,¹⁷ used an anchor-based approach for the calculation of MCID value for the 6MWT 26.0 m, at 6-months follow-up, we have measured significantly greater change in the 6MWT distance from the elderly TKA cohort performed GBPT, compared to the change observed by the elderly subjects attended IPT arm, respectively 82.99 m vs. 62.2 m ($p < 0.001$; Figure 3).

Furthermore, we have identified meaningful values in the SF-36v2 dimensions and total scores between the elderly TKA cohorts of both rehabilitation arms. Usually, the improvement in the SF-36v2 scores referred among elderly TKA recipients is lower, due to multiple comorbidities, the presence of another lower-limb joint disease,²⁰ and the lack of appropriate rehabilitation.^{4,8,12,24} As can be seen in Table 3, at 6-month follow-up, the elderly participants of the GBPT arm improved significantly the SF-36v2 scores, and the improvement achieved was significantly greater compared with the improvement obtained from the elderly participants of the IPT arm, respectively 70, 7% vs. 60, 8%. Thus, the significantly higher postoperative SF-36v2 scores obtained by the GBPT group may be explained with the group-based support, which facilitates greater number of contacts per participant, consequently the higher participation of elderly adults, in rehabilitation programs. On the other hand, the significantly higher

postoperative SF-36v2 scores obtained by the GBPT group may be associated with the length of our intervention, which was longer than that reported in previous RCTs with similar design.^{4,21} It has been proven that even efficacious rehabilitation interventions, lose their impact if they cannot be sustained long term.^{4,17} Therefore, long-term group-based rehabilitation interventions may guarantee better adherence to physical activity and more opportunities for social interaction for elderly adults.⁸ We consider that MCID is a dynamic and context-specific entity that ranges for each of the SF-36v2 dimensions, and may help clinicians to assess detectable improvements after rehabilitation care is likely to be large enough to be important.²⁹ At 6 months follow-up, the MCID was significantly greater for the GBPT cohort, respectively from 44.69 points for RP to 19.27 points for MH, while for BP and VT, it ranges from 39.59 to 33.01 points (Table 3). The identified meaningful MCID was significantly higher among participants of the GBPT arm compared with MCID achieved from the participants from the IPT arm, and it could be attributable to the above-mentioned advantages of the GBPT, the type and the intensity of the exercises included in both rehabilitation interventions, as well as with Hawthorne or placebo effects.³⁰ Both, placebo and Hawthorne effects continue to represent an intriguing topic from theoretical and practical perspectives in PRM. Finally, we suggest that the superiority of GBPT, could be larger, if more training sessions had been provided.

Strengths and limitations

The strengths of our study are its prospective design, the several outcomes assessed of the first application of GBPT intervention among elderly Bulgarian TKA cohort, as well as the high rate of participants return to follow-up (89,6% at 6 months). However, our findings should be interpreted within some important limitations. First, the current sample is from Varna region and from a single center, which limited our ability for generalization of the results, thus multicenter research is needed. Furthermore, we used only one HRQoL questionnaire, i.e. the Short Form Health Survey SF-36v2 questionnaire to evaluate HRQoL of the elderly TKA recipients. A longer follow-up period would help us to evaluate the long-term effects of the novel GBPT intervention among elderly TKA cohort.

In conclusion, this prospective observational study present evidence for the superiority of GBPT compared to IPT interventions in terms of PAL and HRQoL. Given the significantly better outcomes for the elderly TKA recipients, as well as the growing number of TKAs in Bulgaria, it may encourage PRM physicians and rehabilitation providers in our country to offer GBPT in many health care settings. However, future research should investigate the optimal intensity, duration, cost-utility, and cost-effectiveness of the GBPT as a novel approach of post TKA rehabilitation in Bulgarian practice.

List of acronyms

6MWT - six-minute walk test
ADL - activities of daily living
BMI – body mass index
BP - bodily pain
GBPT - group-based physical therapy
GH - general health
HRQoL - health-related quality of life
IPT- individual physical therapy
MCID - minimally clinical important difference
MH - mental health
NSAIDs - nonsteroidal anti-inflammatory drugs
OA - osteoarthritis
OARSI - osteoarthritis research society international
PAL - physical activity levels
PASE - Physical Activity Scale for the Elderly
PF - physical functioning
PRM - physical and rehabilitation medicine
QoL – quality of life
RE - role limitations due to emotional problems
ROM - range-of-motion
SD - standard deviations
SF - social functioning
SF-36v2 - Short Form Health Survey
TKA - total knee arthroplasty
VT - vitality
WHO - World Health Organization

Contributions of Authors

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Conflict of Interest

The authors declare no financial, personal, or other conflicts of interest.

Ethical Publication Statement

We confirm that we have read the Journal's position on issues involved in ethical publication and affirm that this article is consistent with those guidelines.

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Group-based or individual rehabilitation after total knee arthroplasty

Eur J Transl Myol 32 (4): 10984, 2022 doi: 10.4081/ejtm.2022.10984

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Group-based or individual rehabilitation after total knee arthroplasty

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