REVIEW

Rehabilitation effects in patients with total hip replacement: a systematic review and meta-analysis

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ABSTRACT

INTRODUCTION: Assess effectiveness and times of total hip replacement rehabilitation treatment through a systematic review with meta-analysis
EVIDENCE ACQUISITION: Bibliographical research has been made with the following search engines: PubMed, Pedro and Cinalh. For pool analysis evaluation, it has been used the standardized mean difference (SMD). Heterogeneity between studies had been controlled through the I² test.
EVIDENCE SYNTHESIS: Fourteen of those studies have met the inclusion criteria. These have been divided into three different groups to assess different aspects of THR patient rehabilitation program: a rehabilitation path — entirely made and supervised by a physiotherapist — has been compared with an unsupervised one; an intensive rehabilitation path has been compared with a standard one and the early beginning of the treatment has been compared with a standard one.
CONCLUSIONS: considering the great rise of THR surgeries, is important to minimize costs and logistic efforts for the postoperative rehabilitation program ensuring identical or better outcomes.
Thinking of that and of RCTs data it seems evident that, while recognizing physiotherapist as a key element of the rehabilitation program, postoperative treatment should focus on an unsupervised rehabilitation program after a first period of a supervised intensive rehabilitation program.

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KEY WORDS: Rehabilitation; Arthroplasty, replacement, hip; Systematic reviews as topic.

Introduction

In Italy, as well as in the US and in most of the Western countries,[1, 2] osteoarthritis (OA) is the most common articular disease.[3] OA affects hips less frequently compared to knees and hands, but when hips are involved, they strongly influence quality of life.[4]

Most common OA symptoms are pain,[5-7] restrictions on physical functions,[8-10] difficulties in activities of daily life[6, 9] and weakening of the peri-articular musculature.[11] The American College of Rheumatology warns to treat these symptoms conservatively (drugs and physiotherapy); just when this approach fails, it will be suggested a THR surgery.[12]

After THR, patients' expect a significant reduction of pain and the ability to undertake normal tasks involved in daily living.[13, 14] A variety of studies show the THR positive effects: in fact the majority of patients undergoing THR experience a relevant pain relief[15-17] and a better gait after three months from the surgery.[18-20]

During the last fifteen years in many European

countries, it has been noticed a steady increase in THR application, either because of an increase in life expectancy or because of THR, when clinically indicated, is able to improve quality of life.[13, 14] Despite that, long term outcomes show muscular weakness and physical functions deficit[21-24] very often, years after THR surgery, gait analysis is still not comparable to that of healthy same age peers.[24-26]

The rehabilitation program is usually adapted according to patient needs, empirical based practice and best EBMs. Despite lots of THR rehabilitation studies regarding outcomes- related to different quality and/or quantity of treatment- EBMs does not configure a gold standard for muscle strength, physical functions, quality of life's recovery. This fact implies that rehabilitation strategies and choices are sometimes based just on empirical based practice.[27] The so called "standard" postsurgery rehabilitation treatment is based on isometric exercises of hip abductors and quadriceps muscles, articular ROM exercises, muscle stretching exercises, postural movements, gait training and general suggestions for daily life activities.[28, 29] In Italy, as well in lots of Western countries, after hospital resignation it is possible to keep following the rehabilitation program either in an outpatient or in a home-based regime, with or without any physiotherapist supervision.

The aim of this study was to evaluate, whether there are evidences to identify the best post-THR rehabilitation program, through a systematic review of RCTs, and metanalysis, taking into consideration the quantitative, qualitative and intensity treatment aspects. This rehabilitation program can be created according to the daily activities, quality of life and length of stay (LOS), outcomes.

Evidence acquisition

Search strategy for identification of studies

Led by the PRISMA checklist[30] on the 31st of January 2016 we made a simultaneous research on three different search engines: PubMed (since 1949), PEDro physiotherapy evidence database and CINAHL (since 1982) to select relevant RCTs (Table I).

Eligibility criteria

It has been selected: 1) randomized clinical trials that took into account physiotherapy treatments for THR patients who underwent surgery for OA; 2) studies where at least the 85% of the sample pa-

TABLE I.—*Search strategy.*

Search engine	Search terms
PUBMED	"Arthroplasty, Replacement, Hip/rehabilitation"[Mesh] Article types: Clinical Trial
PUBMED	(("Arthroplasties, Replacement, Hip" or "Arthroplasty, Hip Replacement" or "Hip Prosthesis Implantation" or "Hip Prosthesis Implantations" or "Implantation, Hip Prosthesis" or "Implantations, Hip Prosthesis" or "Prosthesis Implantation, Hip" or "Prosthesis Implantations, Hip" or "Hip Replacement Arthroplasty" or "Replacement Arthroplasties, Hip" or "Replacement Arthroplasty, Hip" or "Arthroplasties, Hip Replacement" or "Hip Replacement Arthroplasties" or "Hip Replacement, Total" or "Replacement, Total Hip" or "Hip Replacements, Total" or "Replacements, Total Hip" or "Total Hip Replacements" or "Total Hip Replacement")) AND ("rehab" or "rehabilitation" or "excercises" or "physiotherapy" or "Physical therapy" or "therapy")) Article types: Clinical Trial
PEDro physiotherapy evidence database	Hip Replacement* AND Body Part: Thigh or Hip AND Subdiscipline: Orthopaedics Method: Clinical Trial
PEDro physiotherapy evidence database	Hip Arthroplast* AND Body Part: Thigh or Hip AND Subdiscipline: Orthopaedics Method: Clinical Trial
PEDro physiotherapy evidence database	Hip Prosthes* AND Body Part: Thigh or Hip AND Subdiscipline: Orthopaedics Method: Clinical Trial
PEDro physiotherapy evidence database	Hip Endoprothes* AND Body Part: Thigh or Hip AND Subdiscipline: Orthopaedics Method: Clinical Trial
CINAHL	Hip Replacement or Hip Arthroplasty or Hip Prosthesis (ABriassunto) Clinical Trial, Physical Therapy, English.

tients underwent surgery for OA; 3) articles either in English or Italian; 4) studies where the analyzed sample of patients were older than sixty years; 5) RTCTs that evaluate a "particular" rehabilitation program compared to a "standard" one, or compared two or more types or intensity of treatment; 6) articles in which treatments were well described, as good as to let them possible to be reproduced.

It has been excluded: 1) studies where the treatment was purely finalized to prevent deep vein thrombosis; 2) studies where one or more patients underwent a resurface or partial hip replacement; 3) studies where the rehabilitation program required any electromedical device (*e.g.* muscular electrostimulation, kinetec, ergometer…); 4) studies in which were included a preoperative treatment; 5) studies where were not assessed either the length of stay (LOS), or one or more quality life outcomes.

Risk of bias assessment

Methodical quality of the studies has been assessed through the Jadad Scale, with a score between 0 and 5. Two Authors have independently assessed bias risk of the included articles; every disagreement, whether present, was solved with the introduction of a third opinion.

Statistical analysis

To evaluate treatment effects, whether possible, has been used the SMD. All the results have been compared by applying the random effects model with a confidence interval at 95% (CI).

We planned to test heterogeneity between comparable evidences using a heterogeneity test (I^2) considered statistically significant with a P value <0.05.

It has been interpreted as follows: 0% to 40%, low heterogeneity; 30% to 60%, mid heterogeneity; 50% to 75%, reasonable heterogeneity; 75% to 100%, excellent heterogeneity. Whether I^2 test was not significant (P> 0.05), we would have conduct sensibility analysis to evaluate potential heterogeneity sources. All statistical analyses have been done with the RevMan 5.3 program.

Data items of included studies

For each included study we have analyzed the following items: sample size, average age of the participants, type of treatment, type and dose of treatment of all groups, follow-up, outcome and Jadad Score (Oxford Quality Scoring System).

Evidence synthesis

From the research made on the above mentioned three search engines we have obtained 1211 articles: 226 have been excluded as duplicates and 826 have been excluded as not inherent to this study. Out of the 158 promoted articles the full-text has been read, 144 of these have been excluded since did not match the inclusion criteria (Figure 1).

Included articles description

The fourteen articles included in this systematic review (Table I) are multilayered as follows: six articles compare a rehabilitation path entirely performed and supervised by a physiotherapist, with one just partially or non-supervised;[31-36] five articles compare an intensive rehabilitation program with a "standard" one;[37-41] three articles compare an early start of the rehabilitation program with a standard one.[42-44]
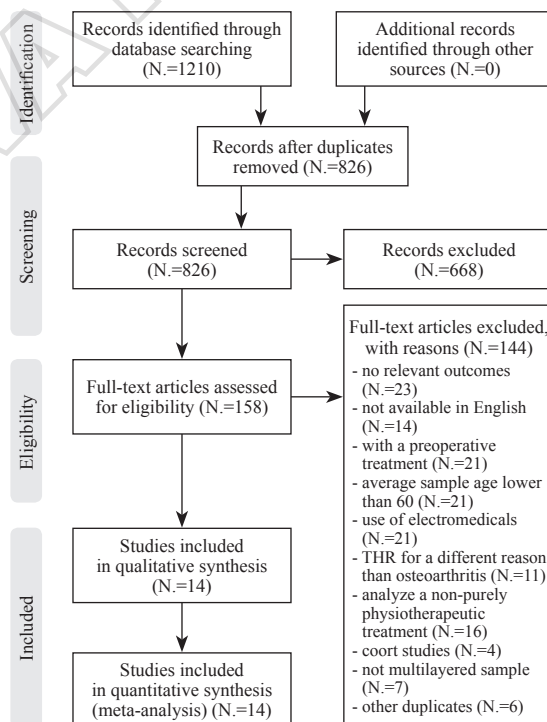

Figure 1.—Flow-chart of the study.

Bias risk

To assess bias risk has been used the Jadad Scale. Among the six studies included in the first stratification, two of them have reported a score of 3, two have reported a score of two and other two a score of one. Related to the second stratification, two studies have reported a score of three, one has reported a score of two and other two a score of one. Among the third stratification studies, two have reported a score of three and one a score of one (Table II).

Summary results

Outcomes evaluation

SUPERVISED REHABILITATION PROGRAM VS. UNSUPERVISED ONE.

The analyzed studies compare a supervised rehabilitation program with one that — studies by Smith et al.[34, 35] excluded — does not provide any physiotherapy supervision.

Galea et al.[36] and Heiberg et al.[33] studies analyze treatments provided respectively three and one month after surgery, while in the other studies treatments are provided in the right short term after hip replacement. In the study by Mikkelsen et al.,[31] with the same quantity of exercises in both groups HOOS Scale at short, mid and long term, it does not show any statistically significant differences between groups; in the study by Umpierres et al.,[32] with the same quantity of exercises in both groups, 20 days after surgery supervised treatment, it had better effects just about one of the 8 SF-36 sub-scales (Bodily pain),while mid- and long-terms outcomes are not recorded; Smith[34, 35] underlines that adding unsupervised bed exercises made during the stay in hospital, do not influence any patient's outcome. Heiberg et al.[33] said that gait training administered three months after the operatio — in comparison to a single phone recommendation — it leads to better outcomes only with regard to HHS short term follow-up, there are not differences between-group regarding HOOS and long-term HHS follow-up; finally the analysis by Galea et al.[36] analyzes a two months long supervised physio-therapeutic treatment compared to an unsupervised home-based exercise program, both of them initiated one month post-surgery. Therefore, the authors concluded that direct physiotherapy treatment does not provide any better effect with regard to WOMAC and AQoL at three months follow-up.

Concerning mid-term (2/6 and months) HOOS meta-analysis data we have had two studies for a total amount of 130 patients. Pool analysis average shows that supervised treatment has led to not statistically significant better outcomes (-1.91 points, CI -7.92-4.11; P=0.53) (Figure 2). For long-term (>6 months) HOOS meta-analysis
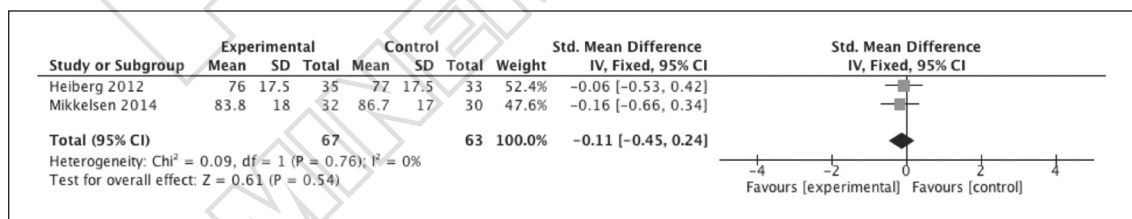
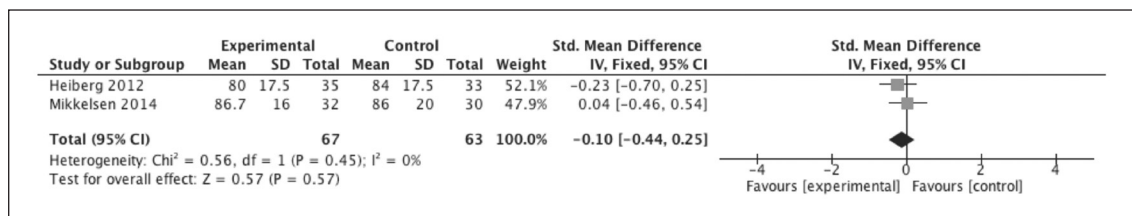

Figure 2.—HOOS analysis; 2-6 months follow-up.

Figure 3.—HOOS analysis; >6 months follow-up.

data we have had the same two studies. Pool analysis average shows that a supervised rehabilitation program has also led to a not statistically significant better outcomes (-1.85 points, CI -7.92–4.28; P=0.55) (Figure 3).

INTENSIFIED REHABILITATION PROGRAM VS STANDARD ONE.

Five studies have been included in this stratification, four of them have used "standard" hospital rehabilitation as control treatment while the remaining one[38] uses an unsupervised home-based program. Suetta[37] added to study group rehabilitation program three unilateral quadriceps strengthening sessions per week. Larsen[40, 41] and Stockton[39] included a redoubling amount of rehabilitation minutes.

Compared to control groups, results show a reduction in LOS of six days in the study by Suetta et al.,[37] a reduction of 2.9 days in Larsen et al.[41] and of 3.1 days in Larsen et al.;[40] in the study by Stockton et al.,[39] no differences are notable. In[40, 41] EQ-5D Scale shows better QoL outcomes following an accelerated program. With regard to Mikkelsen et al.[38] where study group follow a thera-band exercise program added to the standard home based one, EQ-5D and WOMAC data, one and three months after surgery, do not show any statistically significant difference compared to control group.

Three months EQ-5D follow-up data of three

studies with a total of 198 patients have been meta-analyzed. Pool analysis average shows statistically significant better outcomes after an intensified rehabilitation program (0.48 points, CI -0.19-0.76; P=0.0009) (Figure 4).

LOS data meta-analysis has been made on four studies (238 pt). Pool analysis average shows that an intensified rehabilitation program has led to statistically significant shorter LOS (-1.21 points, CI -1.49–0.92; P<0.00001) (Figure 5).

EARLY REHABILITATION PROGRAM VS STANDARD ONE

Analyzed studies compare an early start of the rehabilitation program with a "standard" rehabilitation timing. Munin et al.[43] analyze the early beginning of the hospital rehabilitation path, Liebs[42] study hydrokinesis early beginning and Monticone[44] compares an early total weight bearing with a delayed one.

Munin et al.[43] say that an early beginning of a rehabilitation program after THR could lead to a reduction in LOS but there are not statistically significant difference regarding SF-36 four months after surgery.

Concerning the study by Liebs et al.,[42] hydrotherapy/begun on the 6th day instead of on the 14th day after THR, brings to minor improvements in WOMAC scores at short, mid and long term follow-ups, between group statistically significant there are no differences regarding SF-36.
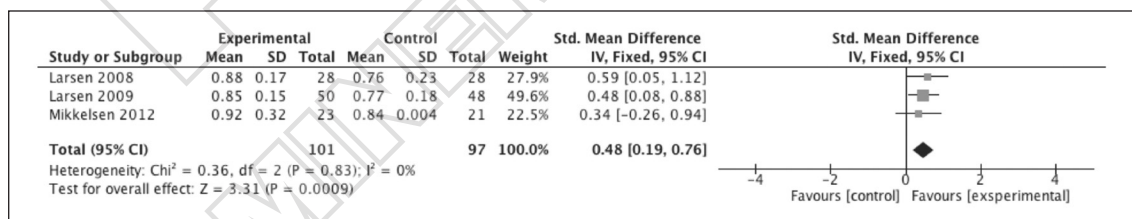

Study or Subgroup	Experimental			Control			Weight	Std. Mean Difference IV, Fixed, 95% CI	Std. Mean Difference IV, Fixed, 95% CI
	Mean	SD	Total	Mean	SD	Total			
Larsen 2008	0.88	0.17	28	0.76	0.23	28	27.9%	0.59 [0.05, 1.12]	
Larsen 2009	0.85	0.15	50	0.77	0.18	48	49.6%	0.48 [0.08, 0.88]	
Mikkelsen 2012	0.92	0.32	23	0.84	0.004	21	22.5%	0.34 [-0.26, 0.94]	
Total (95% CI)			101			97	100.0%	0.48 [0.19, 0.76]	
Heterogeneity: Chi² = 0.36, df = 2 (P = 0.83); I² = 0%									
Test for overall effect: Z = 3.31 (P = 0.0009)									

Favours [control] Favours [exsperimental]

Figure 4.—EQ-5D analysis; 3 months follow-up.

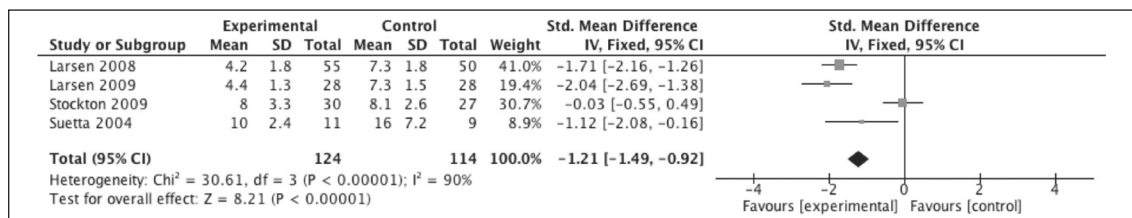| Study or Subgroup	Experimental			Control			Weight	Std. Mean Difference IV, Fixed, 95% CI	Std. Mean Difference IV, Fixed, 95% CI
	Mean	SD	Total	Mean	SD	Total			
Larsen 2008	4.2	1.8	55	7.3	1.8	50	41.0%	-1.71 [-2.16, -1.26]	
Larsen 2009	4.4	1.3	28	7.3	1.5	28	19.4%	-2.04 [-2.69, -1.38]	
Stockton 2009	8	3.3	30	8.1	2.6	27	30.7%	-0.03 [-0.55, 0.49]	
Suetta 2004	10	2.4	11	16	7.2	9	8.9%	-1.12 [-2.08, -0.16]	
Total (95% CI)			124			114	100.0%	-1.21 [-1.49, -0.92]	
Heterogeneity: Chi² = 30.61, df = 3 (P < 0.00001); I² = 90%									
Test for overall effect: Z = 8.21 (P < 0.00001)									

Favours [experimental] Favours [control]

Figure 5.—LOS analysis.

Table II.—*Data extraction*

Article	Sample characteristics	Study group (SG) intervention	Control group (CG) intervention
Mikkelsen LR *et al.* 2014[31]	Sample size SG: 32 CG: 30 Average age SG: 64.8 (8) CG: 65.1 (10) (M/W)	2 weekly supervised progressive resistance training (PRT) in combination with 5 weekly sessions of unsupervised home-based exercise (HB).	7 weekly sessions home based exercises without any supervision (HB).
Larsen K *et al.* 2008[41]	Sample size SG: 28 CG: 28 Average age SG: 62 (11.3) CG: 65 (9.5) (M/W)	Intensified rehabilitation program.	Standard rehabilitation program.
Suetta C. *et al.* 2004[37]	Sample size SG: 9 CG[1]: 10 CG[2]: 11 Average age 60-86 (M/W)	Standard supervised rehabilitation program (SR), followed by home based unsupervised training.	CG[1]: SR + Electrical stimulation (excluded from the present review) CG[2]: SR + unilateral progressive strengthening of the operated side quadriceps (QS).
Umpierres CS *et al.* 2014[32]	Sample size SG: 54 CG: 52 Average age SG: 61.8 (15.6) CG: 60.9 (14.5) (M/W)	Supervision provided by a therapy group for THR patients without any physiotherapist: patients perform and learn gluteal, ischiocrural strengthening and gait exercises. Patients are encouraged to keep carrying out these exercises.	They follow the same SG program under the strict supervision of a physiotherapist.
LR Mikkelsen *et al.* 2012[38]	Sample size SG: 23 CG: 21 Average age SG: 67.7 (7) CG: 66.8 (8) (M/W)	This group follows an intensified home-based rehabilitation program. Patients use thera-bands and increase exercises intensity every 4 weeks. Both groups exercise programs provide weight and not weight bearing exercises, periarticular strengthening and hip flexors stretching.	Perform a smaller amount of exercises and without thera-band.
KE Heiberg *et al.* 2012[33]	Sample size SG: 35 CG: 33 Average age SG: 65 (63-68) CG: 66 (63-69) (M/W)	The training gait program is focalized mainly on balance and stretching exercises, everything is performed in weight bearing: Sit to stand, staircases, stance, step, gait training with obstacles and stretching. Everything performed under a physiotherapist supervision.	The patient is exclusively encouraged to keep performing home-based program learned during the hospitalization period without any supervision.
Liebs TR *et al.* 2012[42]	Sample size SG: 138 CG: 142 Average age SG: 66.7 (10.3) CG: 69.1 (9.8) (M/W)	Hydrokinetic rehabilitation from the 6th day after surgery.	Hydrokinetic rehabilitation from the 14th day after surgery.

Timings	Follow-up	Outcome	Results	Jadad Score
SG: beginning 1/3 days after op. 2/W PRT and 5/W HB CG: beginning 1/2 days after op. 7/W HB. Duration of the study: 10 weeks.	2 weeks, 4 weeks, 6 weeks, 10 weeks, 6 months, 12 months.	HOOS	For what concern HOOS: no between-group statistically significant difference.	2
SG: patient mobilization starts the same day of the surgery. Treatment duration raise from 2 hours to 4 hours in the second day post-op. CG: patient mobilization starts the first day after surgery with a standardized intensity. Treatment are provided until discharge day. Length of stay depends on achieving some relevant physical goals.	3 months.	LOS, EQ-5D	Statistically significant between-group differences in both outcomes. In favor of the SG.	3
SG: 1 hour per day CG^2: SR 1 hour per day + QS 3 times per week. Duration of the study: 12 weeks.	-	LOS	Statistically significant between-group difference with a lower LOS for the CG^2.	3
The rehabilitation program starts 1/2 days after surgery. It is performed 1 hour per day for 5.3±1.1 days.	20 days.	SF-36	In both goups, with regards to physical functions, minimally relevant improvements are described. More relevant improvements are recorded concerning general health and social component. The only statistically significant difference recorded is regarding pain parameters that shows better improvements in the CG. SF-36 Bodily pain score: GS: 29.2 (2.2)-53.8 (2.2) [<0.001] GC: 26.1 (2.2)-43.9 (2.2) [<0.001]	2
Early beginning of the home-based program for both groups (77% of patients begin the program after 3 days). 2 daily series of exercises were recommended for 12 weeks. Authors estimate a total of 10.1 actual weekly series for the SG and 11.6 for the CG. [P=0.37]	1 month, 3 months.	EQ-5D, WOMAC	Data does not provide any statistically significant between-group difference. Exercises performed with thera-band don't seem better than exercises without thera-band. A significant improvement of all the outcomes has been recorded in both groups. 4 SG patients report problems with thara-band exercises. No reported problems in the CG.	1
The study is related to the timeframe from the 3rd month to the 5th one after surgery. The SG 70 minutes program is performed twice a week for 6 weeks.	5 months, 12 months.	HOOS, HHS	At 5 months after surgery statistically significant bigger improvements are reported in SG's HHS (P=0,05). For what concern HOOS and the HHS long term follow up statistically significant differences are not reported.	1
Both groups underwent treatments 30 minutes long, 3 times a week till the 5th week after surgery.	3 months, 6 months, 12 months, 24 months.	SF-36 WOMAC	Results lead author to say that an early start of hidrikinetic rehabilitation for THR PTs is inadvisable. All WOMAC subscales, at every follow-up are, although not always in a statistically significant manner, worse for the SG. For what concern SF-36 scores, relevant differences are not collected at every follow-up.	3

(To be continued)

TABLE II.—*Data extraction (continues).*

Article	Sample characteristics	Study group (SG) intervention	Control group (CG) intervention
Stockton KA *et al.* 2009[39]	Sample size SG: 30 CG: 27 Average age SG: 68.3 (9.3) CG: 68.2 (10.6) (M/W)	Standard rehabilitation program: at the beginning focalized on bed exercises and as soon as possible on weight bearing exercises: ankle dorsiflexion, squats, hip flexion, extension and abduction.	Same standardized rhebilitation program
Smith TO *et al.* 2008 e 2009[34, 35]	Sample size SG: 30 CG: 30 Average age SG: 66.2 (11.3) CG: 68.1 (10.5) (M/W)	Standard gait retraining (SGR). From first day after surgery going out of bed experiencing static and dynamic partial weight bearing. Training proceed by reducing walking support, increasing meters and introducing a step and staircase training. To this program are added bed exercises: hip flexion, ankle flexion/extension, isometric gluteal and quadriceps strengthening.	Standard gait retraining (SGR).
Galea MP *et al.* 2008[36]	Sample size SG: 11 CG: 12 Average age SG: 68.6 (9.7) CG: 66.6 (7.9) (M/W)	Home based program without any supervision: sit to stand, active single-leg stance (loading weight with the not operated leg), climbing steps, hip abduction, heel rise, side walking.	Standard rehabilitation program under the direct supervision of a physiotherapist, plus a home-based rehabilitation program.
Munin M *et al.* 1998[43]	Sample size SG: 14 CG: 12 Average age SG: 75.7 (5.4) CG: 74 (5.8) (M/W)	Standard rehabilitation program.	Standard rehabilitation program.
Monticone MA *et al.* 2014[44]	Sample size SG: 47 Cg: 48 Average age SG: 69,5 (7,5) CG: 68,8(8,1) (M/W)	Finalized exercises: stair climbing and descending, gait training with obstacles, balance exercises and ADL related exercises. Patients are encouraged to abandon any walking aid before the end of the hospitalization.	Open chain exercises: hip flexion, extension, abduction and external rotation, isometric and isotonic quadriceps contraction. The patient is encouraged to keep using some walking aid till the end of the third month after surgery.
Larsen KR *et al.* 2009[40]	Sample size SG: 50 CG: 48 Average age SG: 65 (9.6) CG: 67 (9.8) (M/W)	Standard rehabilitation program.	Standard rehabilitation program.

| Timings	Follow-up	Outcome	Results	Jadad Score
GC: once a day. GS: twice a day. Until the resignation.	-	LOS	There is not statistically significant between-group difference regarding LOS. GS: 8±3,3 GC: 8.1±2.6 (7% of PTs was then transferred to a rehabilitation center).	2
In both groups patients perform the gait training at least once per day for the duration of the hospital stay. SG add bed exercises 5 times per day. .	3 days, 6 weeks, 1 year.	SF-12	No between-group statistically significant differences are emerged.	3
After the initial hospitalization period patients have been randomized. SG complete an 8-week targeted exercise program while under the direct supervision of a physiotherapist twice a week for 45 minutes and patients perform home based exercises without any supervision on an average of 2,7 times a week. Patients of the CG perform home based exercises on an average of 5,8 times a week.	3 months.	AQoL WOMAC	No between-group statistically significant differences are emerged	1
Patients from both groups are treated twice a day for 60 minutes, 6 days a week; on Sunday they receive a treatment 30 minutes long. SG begins the rehabilitation path 3 days after surgery while the CG 7 days after surgery.	4 months.	SF-36, LOS	At the 4 months follow-up doesn't emerge any statistically significant difference for what concern SF-36. Regarding LOS is notable the reduction in the SG. SG: 11.7±2.3 days CG: 14.5±1.9 days P<.001	1
The rehabilitation program begins between the 4th the 7th day postsurgery. Treatment duration: 45 minutes. Treatment frequency: 5/week. Rehab. cycle duration: 3 weeks.	3 weeks, 12 months.	SF-36, WOMAC	After treatment, scores regarding WOMAC physical function improve approximately 50% in the SG and 20% in the CG. With a minor between-group difference also WOMAC pain and stiffness improved more in the SG than in the CG. At 12 months follow-up both groups keep improving in a similar proportional way. SF-36 scores are also in favor of SG in a statistically relevant way.	3
SG: patient mobilization starts the same day of the surgery. Treatment duration raise from 2 hours to 4 hours in the second day post-op. CG: patient mobilization starts the first day after surgery with a standardized intensity. Treatment are provided until discharge day. Length of stay depends on achieving some relevant physical goals.	-	LOS	SG: 4.2 (1.8) days CG: 7.3 (1.8) days	1
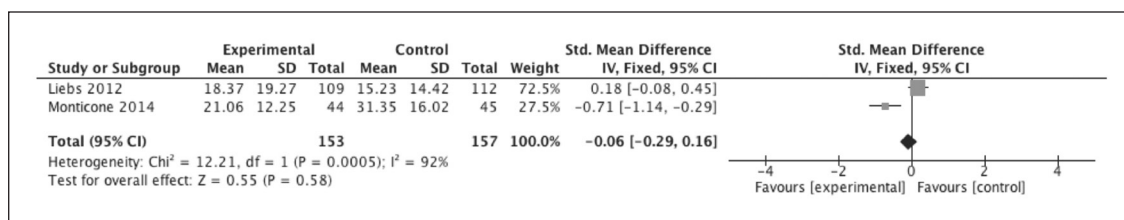
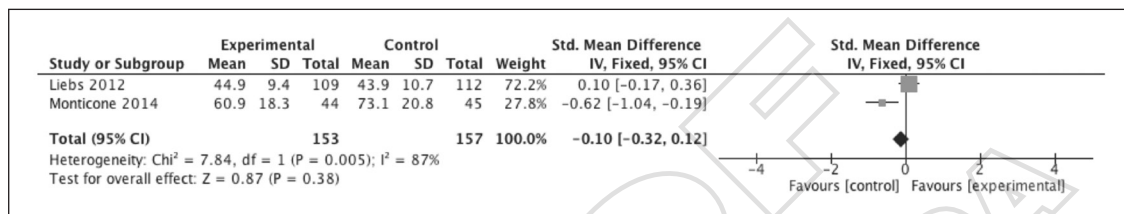Figure 6.—WOMAC anlysis; 12 months follow-up.

Figure 7.—SF-36 analysis; 12 months follow-up.

Finally, Monticone[44] says that WOMAC and SF-36 short- and long-term outcomes are better encouraging the patient to leave any walking aid before the end of hospitalization stay.

Long-term (12 months) WOMAC data meta-analysis has been made on two studies with a total amount of 210 patients.

Pool analysis average shows that an intensified rehabilitation program has led to not statistically significant better outcomes (-0.06 points, CI -0.29-0.16; P=0.58) (Figure 6).

LOS meta-analysis has been made on two studies (210 patients). Pool analysis average shows that an intensified rehabilitation program does not provide any statistically-significance outcome difference (-0.10 points, CI -0.32-0.12; P=0.38) (Figure 7).

Discussion

The present study was conducted by health professionals of Sapienza University of Rome and ROMA — Rehabilitation & Outcome Measures Assessment Association. The research group has carried out of many outcome measures in Italy.[45-61]

The objective of the study was to analyze outcome differences between heterogeneous rehabilitation programs, paying attention on elements such as program supervision, intensity and start timing.

Regarding the first above mentioned stratification, it is relevant the same amount of treatment minutes between control and study groups for all studies excepted Smith et al.[34, 35] This fact led us to analyze more strictly effects influenced by supervision or no supervision. It is shown a lack of relevant differences on every mid and long-term outcome, while at short term follow-up there are some differences in favor of supervised rehabilitation program.

Umpierres et al.[32] and Heiberg et al.,[33] even if the second one performs the analyzed rehabilitation program three months after THR, are the only two studies with a "short term" follow-up (directly after the treatment period) and they reach similar conclusions. The authors highlight that direct physiotherapist action after THR, had a big relevance for pain reduction, functional recovery and ADL management in the short-term period. Biggest limit of the first study is the lack of mid and long-term follow-up.

Studies with a mid and long-term follow-up, show different results from the two above-mentioned articles. Mikkelsen et al.[31] say that 10 weeks of supervised progressive resistance training, performed twice a week combined with five weekly session of unsupervised exercises, does not provide better HOOS scores compared to seven weekly session of unsupervised exercises. The bigger limit of the study is the possible presence of selection bias. The Authors might have

included more motivated patients willing to follow two weekly supervised exercise sessions, fact that could have weakened the external validity of the study.

Galea *et al.*[36] analyzed QoL and WOMAC at a mid-term follow-up and no between group relevant differences are shown before and after treatment.

Finally, it seems a bit of a stretch to put Smith[34, 35] data into this discussion, despite conceptually inherence of this stratification. In these articles Smith *et al.*, in line with rest of EBMs, say that adding "bed exercises" to standard treatment does not provide any relevant differences in patient's QoL.[34, 35]

Analysis of the first stratification let us affirm that there is a good relation between a supervised rehabilitation program and better short term QoL outcomes.

With regard to the second stratification,[37, 39-41] four out of five of the considered studies, record postoperative length of stay. Meta-analysis results show a statistically significant reduction in length of stay in groups that had followed intensive rehabilitation programs, relevant particularly in the light of QoL outcomes equal or even better compared to control groups. All the studies have recorded a reduction in length of stay, just in Stockton *et al.*[39] patients who received physiotherapy twice daily, showed a trend toward earlier achievement of functional milestones; however, this finding did not translate to decreased LOS. Authors argued that in the private hospital setting in Australia, many patients expect a stay of a minimum seven days, which is often a barrier to earlier discharge.

Outside of example, in the other three articles are notable: relevant differences in length of stay: in Suetta[37] mean±standard error LOS was shorter for the intensive "resistance" training group (10.0 ± 2.4 days, $P<0.05$) than for the standard rehabilitation group (16.0 ± 7.2 days); shorter of 2,9 days for the intensive early rehabilitation program in Larsen[41] and of 3.1 days for the same group in Larsen *et al.*[40] In the last two articles, as mentioned, this reduction in LOS is even associated with average EQ-5D values at three months, improved of 0.30 points in the intensive rehabilitation group compared to the

0.23 points improvement of the standard rehabilitation group in the first one and of 0.43 points compared to the 0.27 points of the control group in the second one. Authors argue that a shortened hospital stay and an early mobilization lead to less compromised physical functions so, to a faster recovery of them.

Finally, in the fifth article, Mikkelsen *et al.*,[38] EQ-5D scores recorded are not statically significant but tend to confirm the data obtained by Larsen *et al.*[40, 41] WOMAC scores, recorded after 3 months, does not show any statistically significant difference.

Meta-analyzed data show a relevant statistically significant support to an accelerated rehabilitation program with regard to LOS and mid-term (3 months) EQ-5D scores.

This led us to strongly prefer an accelerated rehabilitation program that, without any apparent side-effect, seems to result in a faster recovery, a reduced LOS and equal or better mid-term QoL outcomes compared to a standard rehabilitation program.

The last comparison is between an early rehabilitation program and a standard one, includes heterogeneous studies. The three included studies analyze the early beginning: of idrokinesis,[42] of the standard rehabilitation program,[43] or of total weight bearing.[44] Probably due to the different nature of the proposed treatment, Liebs *et al.* results are not congruent to the other. Opposite effects of early aquatic therapy were seen between TKA and THA. For THA patients all WOMAC outcomes were superior in the late aquatic therapy group (14 days post-op. instead of 6). The article has a good sample size of 280 THR patients and a Jadad Score of 3. It does not show relevant limits, just a high drop-out rate: from a 90% rate after 3 months to a follow-up rate of 74% after 24 months. However, 3 months follow-up outcomes are perfectly in line with mid and long term outcomes, this led us considerate it not as a massive bias. Authors are not able to explain why but, total knee arthroplasty (TKA) patients show contradictory outcomes, however, for THR patients, early hydrokinetic physiotherapy seems inadvisable.

Analyzing the following article, Monticone *et al.*,[44] we can say that postpone total weight

bearing until three months after the operation is contraindicated, unless special circumstances arise. Included patients had multiple comorbidities, still requiring medical care 4/7 days after the operation and/or have insufficient home support. Control group (CG) keep using walking aids for three months after surgery while in the study group (SG) patients are encouraged to abandon any walking aid before the end of the hospitalization. After training, the WOMAC Index — physical function score decreased by almost 50% in the SG and by about 20% in the CG. Also, the decrease in pain intensity and the improvement in ADL performance were more significant in the SG than in the CG. In terms of QoL, the physical function, physical role and general health subscales revealed significant between-group differences after training in favor of the SG.

From the third article, Munin et al.[43] is notable that an early beginning of the same rehabilitation program (three-dimensional days post-surgery instead of 7 days) led to achieve same results, concerning SF-36, in less time without any side-effect.

Concerning the comparison between an early beginning and a standard one, due to article heterogeneity, any generalization seems possible.

Conclusions

Considering the great rise of THR surgeries, is important to minimize costs and logistic efforts for the postoperative rehabilitation program ensuring identical or better outcomes.

Thinking of that and of RCTs data it seems evident that, while recognizing physiotherapist as a key element of the rehabilitation program, postoperative treatment should focus on an unsupervised rehabilitation program after a first period of a supervised intensive rehabilitation program.

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