"Effect of Aquatic Strengthening Exercise on Strength and Range of Motion after Hip Joint Replacement"

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Abstract

Aquatic strengthening exercise is recommended for people with hip joint replacement; however, limited studies and inconsistent results were founded. Primary disability of hip joint replacement is caused by osteoarthritis. Exercise is vital for managing and preventing the joint functional movement limitations. The aim of the study is to examine the effects of aquatic exercise on strength and range of motion after hip joint replacement. A woman undergoing primary hip joint replacement (age, 44) participated in aquatic strengthening exercise over 12 weeks. Isokinetic testing was collected to monitor average torque, average work, average power and range of motion after hip joint replacement. Data were collected before surgery and after 3 months of aquatic strengthening exercise. Repeated measures analysis of variance showed that aquatic strengthening exercise improved both hip muscles strength and range of motion. Beneficial short-term effects of aquatic strengthening exercise were found after hip replacement.

Keywords: Aquatic Exercise – Strength – Hip joint replacement – Range of motion - Osteoarthritis.

Introduction

Constant hip pain with disability is a main cause that leads to hip joint replacement. Osteoarthritis, traumatic arthritis, and rheumatoid arthritis are the most common forms of arthritis, as highest percentage of the hip replacement surgeries from it (Neogi, 2013). Osteoarthritis (OA) has been recognized as the most common rheumatic disease affecting older adults (Wang et al., 2011), as high percentage experience degenerative joint changes (Lim et al., 2010). Dysfunction and pain are the common symptoms in the affected joints (Ansari et al., 2014). Aquatic exercise considered a non-pharmacological way that is highly recommended for OA treatment symptoms (Eulenburg et al., 2015). Nevertheless, intensify symptoms on joints occur from land based exercise (Kim et al., 2012).It has been proven that effective way for fast recovery from hip joint replacement either full or partial is aquatic exercise (Eulenburg et al., 2015) and it is optimum for various population (Łyp et al., 2016). Aquatic exercise with low impact has been recognized as one treatment modality that could be well suitable for older adults with hip joint replacement mean while weight loading is reduced by the water's buoyancy, which simultaneously guarantee; decreases stress on joints,

lower injury risk, less fatigue and relieves pain (Kinnaird & Becker, 2008). Moreover, hip replacement recovery protocol with aquatics has a positive impact on patient's mood and clinical positive recovery indication this includes; reduced probability of falls (Liebs, Herzberg, Rüther, Russlies, & Hassenpflug, 2016), joint inflammation in recovery and joint stress (Rewald et al., 2016), improved strength and range of motion, reduced risk of mutual side effects and postural corrections (Łyp et al., 2016). Therefore, the main aim of this study is to examine the effect of aquatic exercise on strength and range of motion after hip joint replacement.

Materials and Methods

Subject

A woman age (44 years), height (163 cm), weight (74 Kg) undergoing primary hip arthroplasty. A case study participated in aquatic strengthening exercise for three months after hip joint replacement. Isokinetic test was used to monitor range of motion (ROM), average torque, average work and average power before hip joint replacement surgery and after 3 months of aquatic strengthening exercise.

Isokinetic Testing

Isokinetic testing was assessed three days before the hip joint replacement surgery and after three months aquatic strengthening exercise to monitor hip joint working muscle strength and ROM. Average work, average torque, average power and ROM were measured during; adduction, abduction, flexion and extension movements for both legs, averages of ten trials were taken.

Aquatic Exercises

One week before the aquatic training exercises period started researcher demonstrated and explained training protocol and how to correctly perform all aquatic exercises. Moreover, sample trained modified aquatic exercise throughout 12-weeks intervention. The first month included aquatic exercise to enhance mobility and balance. The second month included exercises to enhance power, muscular endurance and range of motion. The third month included functional training to maintain muscular strength and muscular endurance. The aquatic training session were approximately 45-120 in duration, and performed three times a week, for 12 weeks. Session duration required 45-60 min for the first month, 60-90 min for the second month and 90-120 min for the third month. Each session comprised of a warm up, and exercises focused on strength, endurance, balance, and stretching. All training sessions were preceded by a 10-min warm-up. Followed by the main aim of the exercise; a combination of body-weight aqua fitness, body-weight aqua jogging, resisted aqua-fitness and resisted aqua-jogging, followed by cooling down exercise. Aquatic exercises included bounces, jogging, kicks, twists, jumping jacks and side steps walking and aqua jogging with weights

exercises focused on flexibility, balance, coordination, aerobics and resistance.

Statistical Analysis

Averages and progress percentage for ROM, torque, work and power were analysed during abduction, adduction, flexion and extension movements for both sides.

Results

Table1 ROM during (Abduction/Adduction) for right and left hip joint

Variables	Pre Right	Post Right	Progress %	Pre Left	Post Left	Progress %
ROM	28	53	89.29%	18	24	33.33%
Start Position	1	5	400.00%	1	5	400.00%
Ending Position	28	58	107.14%	23	24	4.35%

Table1 Aquatic exercise program enhancement on ROM before and after hip joint replacement during abduction and adduction movements on isokinetic test for right and left hip joint.

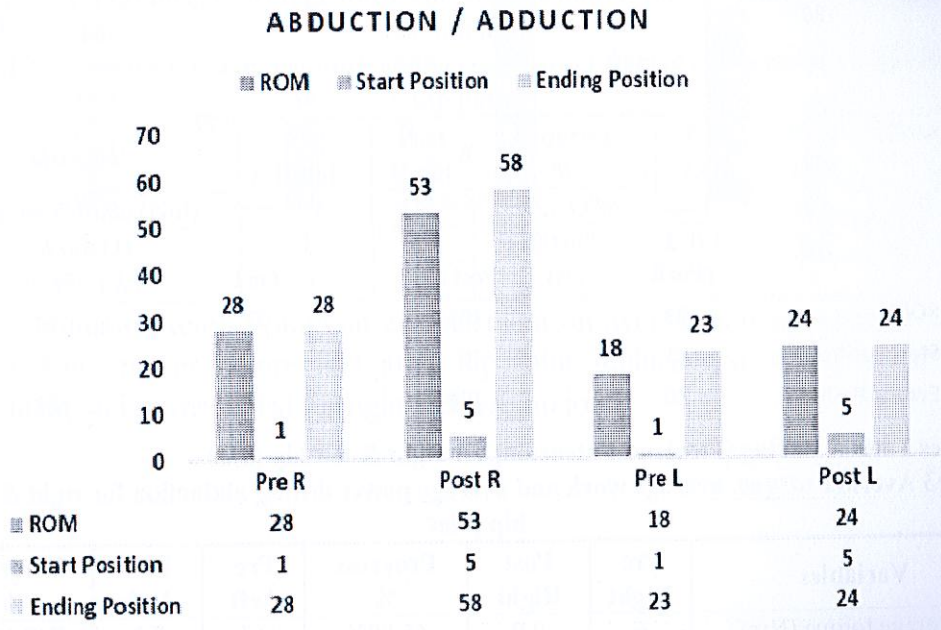
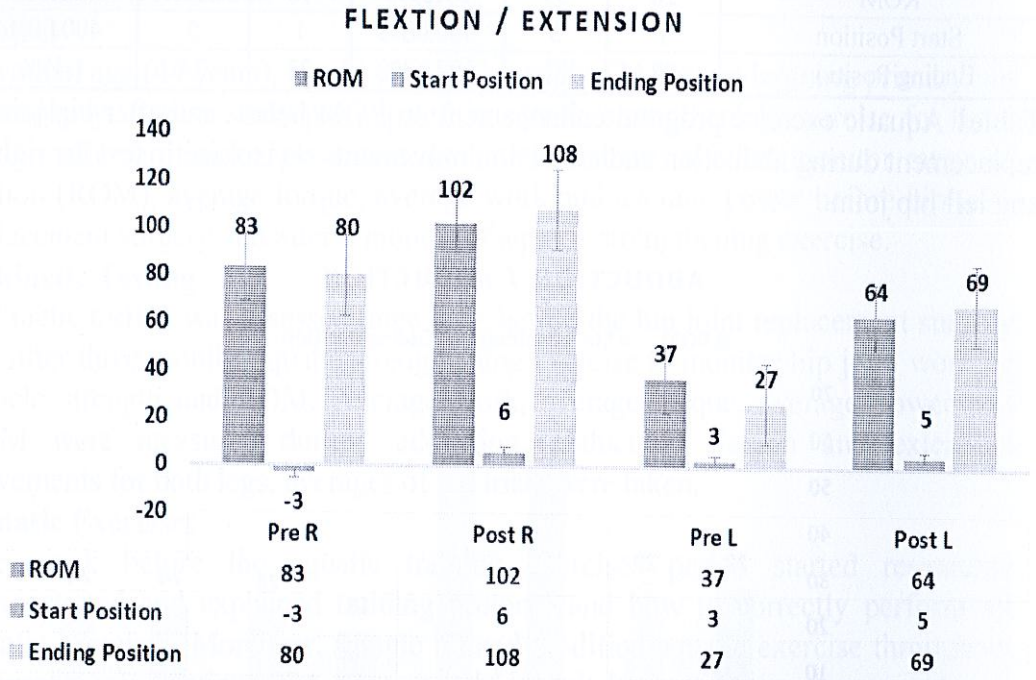


Figure 1 ROM during (Abduction/Adduction) for right and left hip joint.

Table2 ROM during (Flexion / Extension) for right & left hip joint

Variables	Pre Right	Post Right	Progress %	Pre Left	Post Left	Progress %
ROM	83	102	22.89%	37	64	72.97%
Start Position	-3	6	300.00%	3	5	66.67%
Ending Position	80	108	35.00%	27	69	155.56%

Table 2 Aquatic exercise program enhancement on ROM before and after hip joint replacement during flexion and extension movements on isokinetic test for right and left hip joint.



Figures 2 ROM during (Flexion / Extension) for right & left hip joint

Table3 Average torque, average work and average power during abduction for right & left hip joint

Variables	Pre Right	Post Right	Progress %	Pre Left	Post Left	Progress %
Average torque (Nm)	6	9.9	65.00%	2.1	7.3	247.62%
Work (J)	0.3	2.2	633.33%	0.1	0.4	300.00%
Power (W)	0.1	0.4	300.00%	0	0	0%

Table3 Aquatic exercise program enhancement on average torque, average work and average power before and after hip joint replacement during abduction movement on isokinetic test for right and left hip joint.

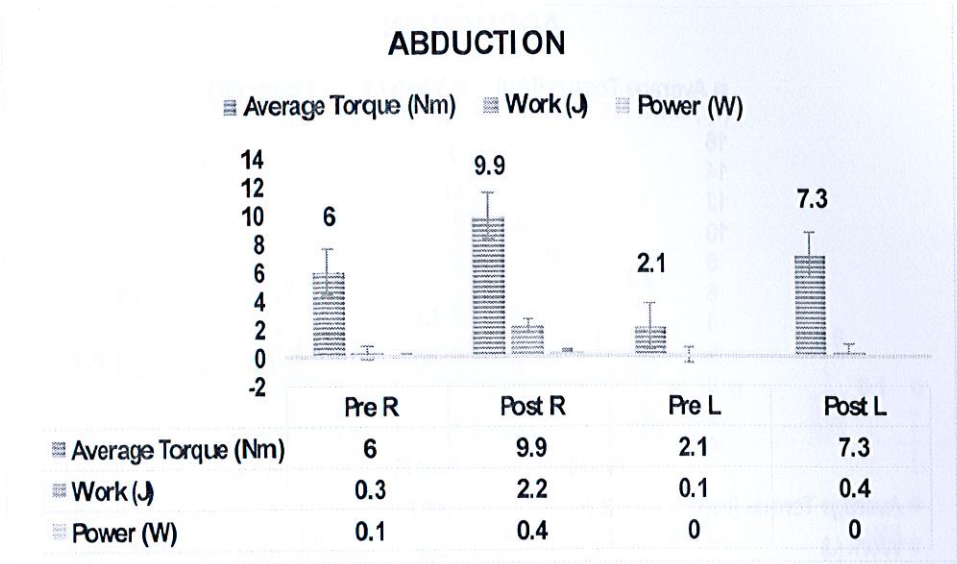


Figure 3 average torque, average work, and average power during abduction for right & left hip joint

Table4 Average torque, average work and average power during adduction for right & left hip joint

Variables	Pre Right	Post Right	Progress %	Pre Left	Post Left	Progress %
Average torque (Nm)	2.7	11.7	333.33%	1	2.8	180%
Work (J)	1	2.8	180.00%	0.1	0.2	100.00%
Power (W)	0	0	0%	0	0	0%

Table4 Aquatic exercise program enhancement on average torque, average work and average power before and after hip joint replacement during adduction movement on isokinetic test for right and left hip joint.

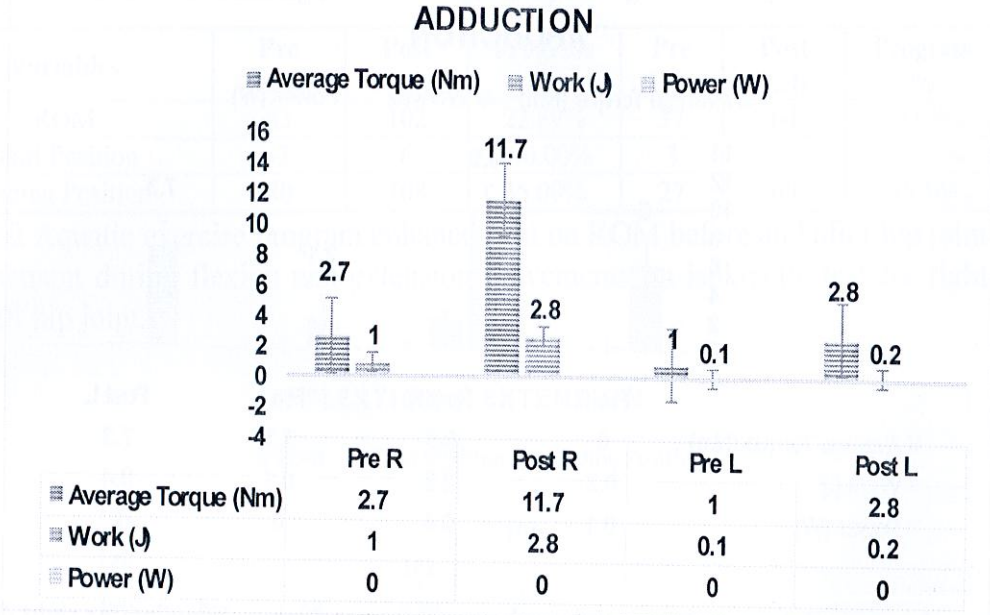


Figure 4 average torque, average work and average power during adduction for right & left hip joint

Table 5 Average torque, average work and average power during flexion for right & left hip joint

Variables	Pre Right	Post Right	Progress %	Pre Left	Post Left	Progress %
Average torque (Nm)	7.2	14.2	97.22%	3.1	3.6	16.13%
Work (J)	2.8	11.5	310.71%	0.1	0.1	0%
Power (W)	3	9	200.00%	0	0	0%

Table5 Aquatic exercise program enhancement on average torque, average work and average power before and after hip joint replacement during flexion movement on isokinetic test for right and left hip joint.

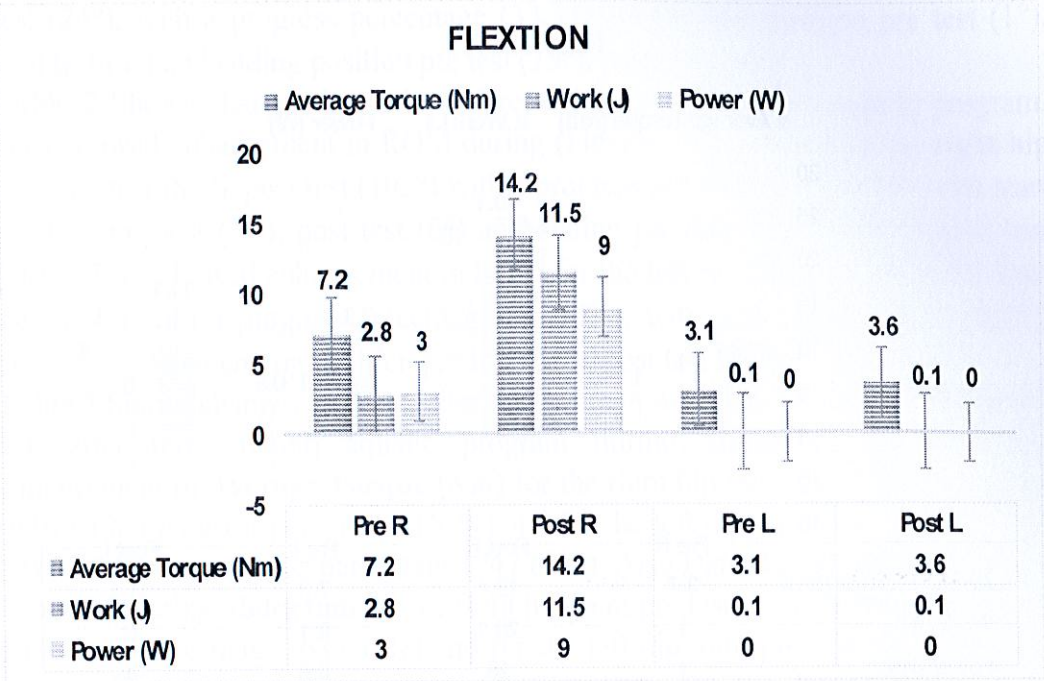
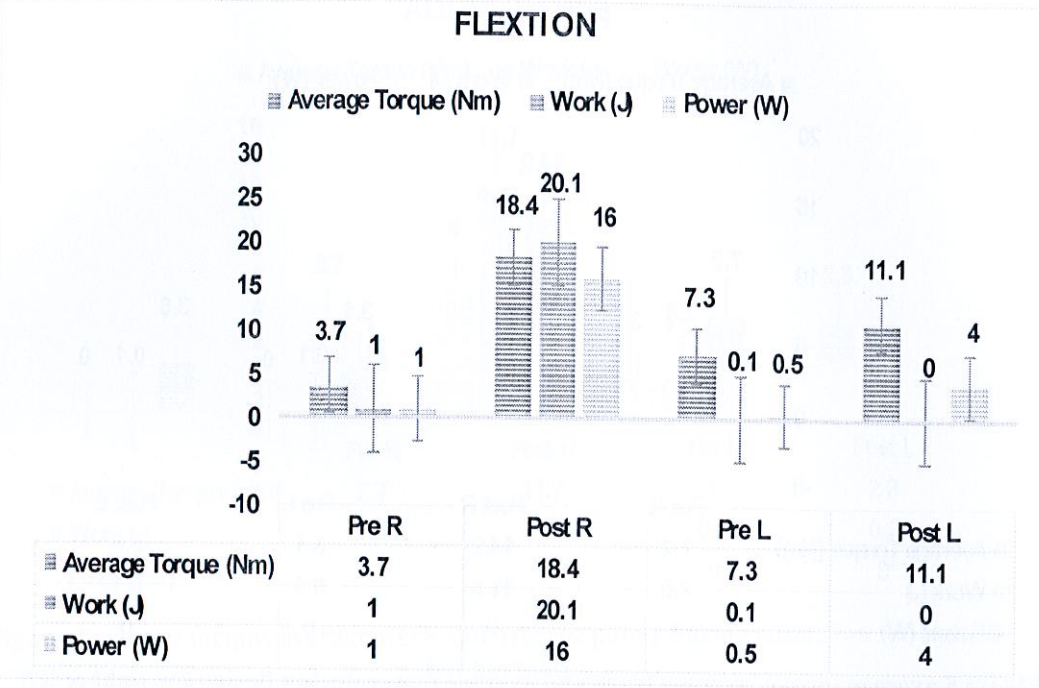


Figure 5 average torque, average work and average power during flexion for right & left hip joint

Table6 Average torque, average work and average power during extension for right & left hip joint

	Pre Right	Post Right	Progress %	Pre Left	Post Left	Progress %
Average torque (Nm)	3.7	18.4	397.30%	7.3	11.1	52.05%
Work (J)	1	20.1	1910.00%	1	4.8	380.00%
Power (W)	1	16	1500.00%	0.5	4	7.00%

Table6 Aquatic exercise program enhancement on average torque, average work and average power before and after hip joint replacement during extension movement on isokinetic test for right and left hip joint.



	Pre R	Post R	Pre L	Post L
Average Torque (Nm)	3.7	18.4	7.3	11.1
Work (J)	1	20.1	0.1	0
Power (W)	1	16	0.5	4

Figure (6) average torque, average work, and average power during extension for right & left hip joint

Discussions

Major surgery like hip replacement can take long track, with slow improvement in function and in range of motion that might lead to depression until returning closer to normal. One of the most important benefits of using aquatic exercise after hip joint replacement is it enjoyment. (Ansari et al., 2014 ; Fisken et al., 2015; Kim et al., 2012; Lim et al., 2010; Wang et al., 2011), agreed that aquatic exercise has a significant decrease in pain, enhanced range of motion, decreased body fat, better motor functioning, enhanced self-efficacy, reduced depression and improved quality of life, which supported the results of the current study. The main aim of present study was to examine the effect of aquatic exercise on strength and range of motion after hip joint replacement. Findings of the study were discussing; ROM, average torque, average work and average power for (adduction, abduction) and (flexion, extension) movements during isokinetic testing. Results showed that aquatic exercise are worth and effective during the process of recovering from hip joint replacement.

Table1 Shows changes in ROM before and after three month aquatic program. Data showed enhancement in ROM during (abduction / adduction) for the **right** hip joint pre test (28°), post test (53°) with a progress percentage (89.29%). with start position pre test (1°), post test (5°) and ending position pre test (28°), post test

(58°). Data showed enhancement in ROM for the **left** hip joint pre test (18°), post test (24°), with a progress percentage (33.33%) with start position pre test (1°), post test (5°) and ending position pre test (23°), post test (24°).

Table 2 Shows changes in ROM before and after three month aquatic program. Data showed enhancement in ROM during (Flexion / Extension) for the **right** hip joint pre test (83°), post test (102°) with a progress percentage (22.89%). with start position pre test (-3°), post test (6°) and ending position pre test (80°), post test (108°). Data showed enhancement in ROM for the **left** hip joint pre test (37°), Post Test (64°) with a progress percentage (72.97%). with start position pre test(3°), post test (5°) and ending position pre test (27°), post test (69°).

Table 3 Shows changes in average torque, average work and average power before and after three month aquatic program during **abduction**. Data showed enhancement in **Average Torque (Nm)** for the right hip joint pre test (6), post test (9.9) with a progress percentage (65%) and for the left hip joint pre test (2.1), post test (7.3) with a progress percentage (247.62%). Also Data showed enhancement in **Work (J)** during **abduction** for the right hip joint pre test (0.3), post test (2.2) with a progress percentage (633.33%) and for the left hip joint pre test (0.1), post test (0.4), with a progress percentage (300%). Data for the **Power (W)** during **abduction** for the right hip joint pre test (0.1), post test (0.4) with a progress percentage (300%) and for the left hip joint pre test (0.0), post test (0.0) with a progress percentage (0%).

Table 4 Shows changes in average torque, average work and average power before and after three month aquatic program during **adduction**. Data showed enhancement in **Average Torque (Nm)** for the right hip joint pre test (2.7), post test (11.7) with a progress percentage (333.33%) and for the left hip joint pre test (1), post test (2.8) with a progress percentage (180%). Data showed enhancement in **Work (J)** during **adduction** for the right hip joint pre test (1), post test (2.8) with a progress percentage (180%) and for the left hip joint pre test (0.1), post test (0.2) with a progress percentage (100%). Data showed enhancement in **Power (W)** during **adduction** for right and left hip joint pre test (0.0), post test (0.0) with a progress percentage (0%).

Table 5 Shows changes in average torque, average work and average power before and after three month aquatic program during **flexion**. Data showed enhancement in **Average Torque (Nm)** for the right hip joint pre test (7.2), post test (14.2) with a progress percentage (97.22%) and for the left hip joint pre test (3.1), post test (3.6) with a progress percentage (16.13%). Data showed enhancement in average **Work (J)** during **flexion** for the right hip joint pre test (2.8), post test (11.5) with a progress percentage (310.71%) and for the left hip joint pre test (0.1), post test (0.1) with a progress percentage (0%). Data showed enhancement in **Power (W)**

during **flexion** for right and left hip joint pre test (0.0), post test (0.0) with a progress percentage (0%).

Table 6 Shows changes in average torque, average work and average power before and after three month aquatic program during **extension**. Data showed enhancement in **Average Torque (Nm)** for the right hip joint Pre Test (3.7), post test (18.4) with a progress percentage (397.30%) and for the left hip joint pre test (7.3), post test (11.1) with a progress percentage (52.05%). Data showed enhancement in average **Work (J)** during **extension** for the right hip joint pre test (1), post test (20.1) with a progress percentage (1910%) and for the left hip joint pre test (1), post test (4.8) with a progress percentage (380%). Also Data showed enhancement in **power (W)** during **extension** for the right hip joint pre test (1), post test (16) with a progress percentage (1500.00%) and for the left hip joint pre test (0.5), post test (4), with a progress percentage (7.00%).

Conclusion

1- It has been proved that aquatic strengthening exercises has a positive effect on ROM and average torque, work and power after hip joint replacement.
2- Applying aquatic exercise after hip joint replacement mandatory for re-improve joint functional movement.
3- Applying aquatic exercise after hip joint replacement for three weeks to one month is obligatory for re-improve balance and mobility.
4- Applying aquatic exercise after hip joint replacement for six weeks to two month is obligatory for re-improve coordination and muscular strength and endurance.

Recommendations

1. In this study, aquatic exercise should be carried out to improve performance after hip joint replacement.
2. The rareness of data examining hip replacement specific needs for further aquatic exercise research on all age groups.
3. The study was conducted with female (41years). More research should be carried out among male and female indifferent age groups.
4. Further studies could include biomechanical motion analysis for forces, work and power.
5. Further studies could include analysis for ROM and forces, work and power in external and internal motion.
6. Further studies could study other variables that might have effects on enhancement of aquatic exercise according to individual nutrition programs.
7. Further studies should study bigger number for sample.

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