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Effect of Closed Kinetic Chain Exercises on Post Menopausal Osteoporosis

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Abstract

Purpose: This study was designed to evaluate the effect of closed kinetic chain exercises (leg press machine) on post menopausal osteoporosis.

Subjects: Forty women participated in this study were selected from outclinic of Obstetrics and Gynecology at Shobrakheet Public Hospital, their mean age were 58.2 ±4.06 years, they were randomly assigned into two groups: Group (A), twenty women who received closed kinetic exercises (leg press) in addition to specific non weight bearing exercises (static abdominal exercises, hip shrugging, pelvic rocking exercises) Group (B) twenty women who received just specific non weight bearing exercises (static abdominal exercises, hip shrugging, pelvic rocking exercises).

Methods: Study was conducted for 4 months, all the subjects were evaluated pre and post completing the study through application of DEXA in addition to quality of life questionnaire.

Results: Post treatment results of the study were significant improvement in both group but Group (A) is highly significant in both DEXA and quality of life questionnaire.

Conclusion: The results highlight that the combination between the closed kinetic chain exercises in conjunction with specific non weight bearing exercises has an effect on bone mineral density in post menopausal women.

Key Words: *Osteoporosis – Menopause – Closed kinetic chain – Leg press machine – DEXA.*

Introduction

MENOPAUSE is a term used to describe the permanent cessation of the primary functions of the human ovaries, the ripening and release of ova and the release of hormones that cause both the creation and shedding of the uterine lining. Menopause typically occurs in women in midlife, during their late 40s or early 50s, and signals the end of the fertile phase of a woman's life **[1]**.

Menopausal symptoms affect about 70% of women approaching menopause. Common menopausal symptoms are menstrual irregularities, which periods may come more frequently, shorten or lengthen, and become light or heavy. Hot flashes which is sudden feeling of warmth or heat that spreads over the body creating redness particularly noticeable in face and upper body, mood swing that the mood one minute up and another minute down, insomnia, vaginal dryness that vagina loss usual moist and may be associated with irritation, fatigue, weight gain especially in abdomen and depression **[2]**.

Osteoporosis is a bone disease where bone mass decreases over time. The disease process results from a net increase of bone resorption over deposition. Osteoporosis and low bone mineral density are major public health problems, affecting about 23 million woman and about 5 million men above 50 years of age in the united state **[3,4]**.

Accelerated bone loss post-menopausal is associated with increased osteoclast activity that bone resorption occurs at greater rate than bone formation and the balance between the two is disturbed, the net resulting being bone loss. Estrogen receptors are present on osteoclast and both estrogen and androgen recoptors have been found on osteoblast, this suggest that the post-menopausal disruption of bone metabolism is at least in part, hormonally mediated **[5,6]**.

The gold standard for diagnosis and determination of fracture risk is Dual X-ray Absorbmetery (DXA) performed at the hip (femoral neck) and lumber spine. DXA is generally the method of

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choice because it has low radiation exposure, is fast, and renders precision measurements at the spine, hip, radius, or other peripheral sites. DXA at the hip is the best predictor of hip facture. There are also portable DXA machines that measure bone density at other sites, such as the forearm or heel, but the ability to predict fracture risk from results at these peripheral sites is unclear [7].

Closed-chain exercises (CKC) involve motions in which the body moves on a distal segment that is fixed or stabilized on a support surface. Movement at joint causes simultaneous motions at distal as well as proximal joints in relatively predictable manner [8].

There is a high correlation between leg press strength and both L2-L4 and femoral neck body mass index. Exercises utilize gravitational forces or ground reaction forces as stair climbing, walking or jumping with weighted vests are effective in stimulating bone formation at L2-L4 and femoral neck [9].

Patients and Methods

Forty postmenopausal osteoporotic women participated in this study to investigate the effect of closed kinetic chain exercise. They were selected from the Outpatient Clinic of Gynecology at Shobrakheet Public Hospital from 10/5/2015 till 10/9/2015.

Inclusive criteria:

- Post menopausal women diagnosed with osteoporosis.
- Age was ranged between 50-60 years.
- Body Mass Index (BMI) was less than 30kg/m^2.

Exclusive criteria:

- Patients with a previous history of hip fractures or undergoing previous hip surgery.
- Patients with artificial menopause.
- Smokers and alcohol addicted women.
- Patients with congenital hip deformities.
- Patients had under taken corticosteroid for long period of time.
- Bed ridden patients for long period of time.
- Patients with BMI more than 30kg/m^2.
- Patient with previous lumber fracture or disease (spondylosis-spondylithesis, lumber disk prolapsed).

Subjects were assigned into two equal Groups (A & B):

• *Group A (study group):*

Twenty post-menopausal osteoporotic women received closed kinetic chain exercises throughout seated leg press machine in addition to specific non weight bearing exercises.

Specific non weight bearing exercises in the form of static abdominal contraction, pelvic rocking exercises as well as hip shrugging will be applied for all patients in both Groups (A & B) for four months.

• *Group B (control group):*

Twenty post-menopausal osteoporotic women received the same specific non weight bearing exercises only as described for Group (A).

Instrumentation:

A- *Evaluative instruments:*

1- Weight height scale.

2- Dual energy X-ray Absorbemetery (DEXA).

3- Quality of life questionnaire.

B- *Treatment instruments:*

Leg press machine: The leg press is a weight training exercise in which subjects push a weight or resistance away from them using their legs. Was used by all patients in Group A during the study period to perform their prescribed exercises.

Results

Group A:

Twenty postmenopausal women with osteoporosis were included in this group that received closed kinetic chain exercises and specific non weight bearing exercises. Their mean age, weight, height, and BMI were 57.05 ±4.46 years, 69.1 ±5.88kg, 160.6±6.68cm, and 26.83 ±2.23kg/m^2 respectively.

Group B:

Twenty postmenopausal women with osteoporosis were included in this group that received specific non weight bearing exercises. Their mean age, weight, height, and BMI were 58.2 ±4.06 years, 70.05±4.16kg, 159.3±5.71cm, and 27.62 ± 1.39 kg/m^2 respectively.

There was no significance difference between both groups in the mean age, weight, height, and BMI (p>0.05).

Comparison between both Groups (A and B) pre treatment showed statistically non significance difference (p<0.05) in BMD at neck of femar and L2-L4 while post treatment showed statistically significance difference between (0.003 and 0.0001) respectively which in favor of Group A than Group B.

Comparison between both Groups (A and B) pre treatment showed statistically non significance difference (p<0.05) in quality of life questionnaire. While post treatment showed statistically significance difference between both groups (0.003 and 0.0001) respectively which in favor of Group A than Group B.

Table (1): Descriptive statistics and *t*-test for the mean age, weight, height, and BMI of Groups A and B.

	Group A $\bar{X}$ ± SD	Group B $\bar{X}$ ± SD	ID	*t*-value	*p*-value	Sig.
Age (years)	57.05±4.46	58.2±4.06	–1.15	–0.85	0.39	NS
Weight (kg)	69.1±5.88	70.05±4.16	–0.95	–0.59	0.55	NS
Height (cm)	160.6±6.68	159.3±5.71	1.3	0.66	0.51	NS
BMI (kg/m^2)	26.83±2.23	27.62±1.39	–0.79	–1.34	0.18	NS

$\bar{x}$: Mean. *t*-value : Unpaired *t*-value.
SD : Standard Deviation. *p*-value : Probability value.
MD : Mean Difference. NS : Non Significant.

Table (2): *t*-test for comparison between pre treatment mean values of BMD of both Groups (A and B).

BMD (g/cm^2)	Group A $\bar{X}$ ± SD	Group B $\bar{X}$ ± SD	MD	*t*-value	*p*-value	Sig.
Neck of femur	–2.48±0.27	–2.45±0.23	–0.03	–0.36	0.71	NS
L2-L4	–1.93±0.2	–1.95±0.32	0.02	0.23	0.81	NS

$\bar{x}$: Mean. *t*-value : Unpaired *t*-value.
SD : Standard Deviation. *p*-value : Probability value.
MD : Mean Difference. NS : Non Significant.

Table (3): *t*-test for comparison between pre-treatment mean values of quality of life questionnaire score of both Groups (A and B).

Quality of life questionnaire score	Group A $\bar{X}$ ± SD	Group B $\bar{X}$ ± SD	MD	*t*-value	*p*-value	Sig.
Physical health	32±1.52	31.75±2.26	0.25	0.4	0.68	NS
Mental health	31.7±2.65	31.65±2.08	0.05	0.06	0.94	NS
Social health	21.05±2.11	20.65±1.72	0.4	0.65	0.51	NS
Total score	85.25±4.02	84.05±3.56	1.2	0.99	0.32	NS

$\bar{x}$: Mean. *t*-value : Unpaired *t*-value.
SD : Standard Deviation. *p*-value : Probability value.
MD : Mean Difference. NS : Non Significant.

Table (4): *t*-test for comparison between post treatment mean values of quality of life questionnaire score of both Groups (A and B).

Quality of life questionnaire score	Group A $\bar{X}$ ± SD	Group B $\bar{X}$ ± SD	MD	*t*-value	*p*-value	Sig.
Physical health	22.15±4.34	27.1±1.74	–4.95	–4.72	0.0001	S
Mental health	23.65±3.45	25.95±1.82	–2.3	–2.63	0.01	S
Social health	26.55±2.91	24.45±2.32	2.1	2.52	0.01	S
Total score	70.55±12.5	77.5±3.45	–6.95	–2.39	0.02	S

$\bar{x}$: Mean. *t*-value : Unpaired *t*-value.
SD : Standard Deviation. *p*-value : Probability value.
MD : Mean Difference. S : Significant.

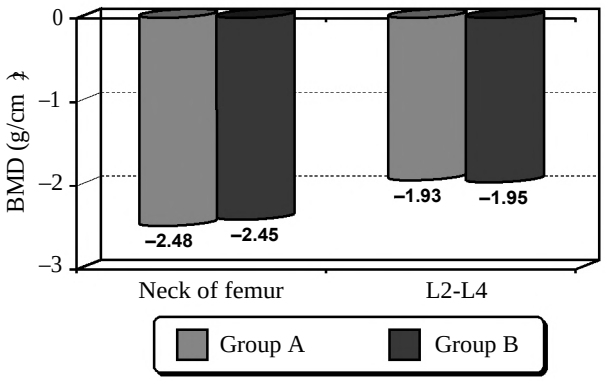

Fig. (1): Pre-treatment mean values of BMD of both Groups (A and B).

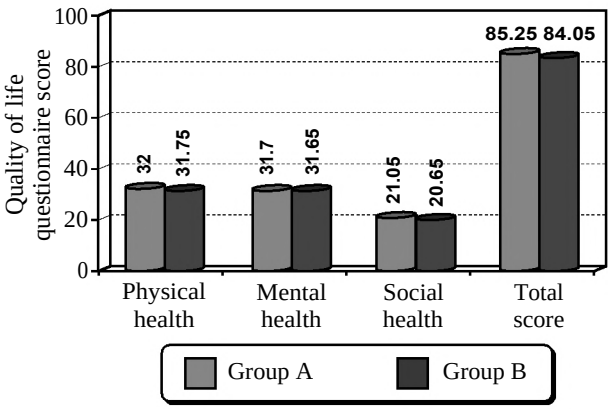

Fig. (2): Pre-treatment mean values of quality of life questionnaire score of both Groups (A and B).

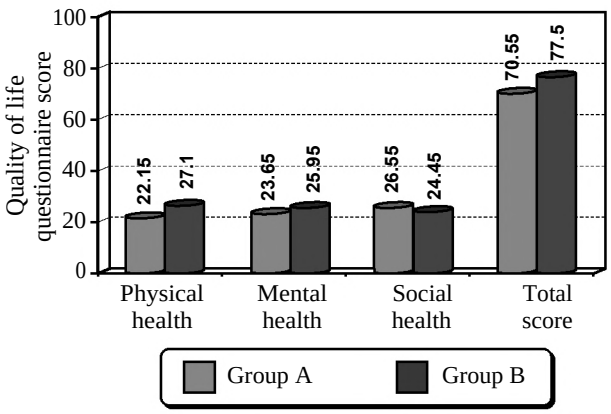

Fig. (3): Post treatment mean values of quality of life questionnaire score of both Groups (A and B).

Discussion

Menopause is the permanent shutting down of the female reproductive system, although a technical definition of menopause refers to the last period; it is not an abrupt event but a gradual process. A natural or physiological menopause is that which occurs as a part of a woman's normal aging process, it is the result of eventual atresia of almost all oocytes in the ovaries. This causes an increase in circulating Follicle Stimulating Hormone (FSH) and Luteinizing Hormone (LH) levels as there are a decreased number of oocytes responding to these hormones and producing estrogen **[10]**.

This decrease in the production of estrogen leads to the perimenopausal symptoms of hot flushes, insomnia and mood changes, as well as postmenopausal osteoporosis and vaginal atrophy. Some main effects of menopause are vasomotor instability, urogenital atrophy (vaginal atrophy), skeletal, psychological and sexual changes. In terms of quality of life, all of these symptoms can be detrimental to a healthy quality of life **[10]**.

Osteoporosis is often a silent disease without obvious indications that it is present. However, there are some signs and symptoms that may accompany the development of the condition such as decrease height, back pain, development of a kyphosis (Dowager's hump), fracture occurring with minimal trauma, low body weight and weight loss of more than 1% per year and vitamin D deficiency due to low intake or little exposure to sun shine **[11]**.

Osteoporosis is the most common type of metabolic bone disease. It results either from the body's inability to form new bone or from an increased resorption of formed bone. Essentially, when there is an imbalance between osteoblastic and osteoclastic activity, skeletal problems arise. Risk factors, such as advanced age, family history, race, estrogen deficiency, tobacco use, steroid use, low calcium intake, physical inactivity, and low body weight, contribute to this condition **[12]**.

Treatment of osteoporosis remains controversial as the focus of management has been on slowing or stopping bone loss or creating new bone. First-line therapy remains diet supplementation and regular weight-bearing exercises, both of which should be started before age 30, numerous medications, either anti resorptives or bone formation agents (anabolics), exist with different patient indications, adverse events, and contraindications **[13]**.

Regarding to BMD (T-score). The results of Group (A) showed that the mean values of BMD (T-score) at the neck of femur before treatment were (–2.48±0.27) and after 4 months of following exercise training program, BMD increased to become (–1.91 ±0.24), also the results of Group (A) showed that the mean values of BMD (T-score) at (L2-L4) pre treatment was (1.93 ±0.2) g/cm. There was an increase in BMD (L2-L4) post treatment to (1.3 6±0.13), 'these results are supported by **[13]**, that during resistance training the variety of muscles forces applied to bone (at places where tendons are attached) generate stimuli capable of promoting a bone osteogenic response. This mechanism promotes action like tension, compression and torsion, creating electrical signal able to stimulate the bone metabolism and the mineral apposition at the places that suffered the muscle tendon force **[14]**. Increasing BMD and possibly inhibiting bone resorption **[15]**.

Aresistance training program of moderate to high intensity (70 to 90% of one maximum repetition- 1 RM), including 3 to 4 bouts of 8 to 12 repetition of each exercises, performed 2 or 3 times a week, is able to maintain or improve the BMD of hip and femur in post menopausal women **[16]**.

Despite the effects of resistance training on bone mass and metabolism, asystmatic review on the effects of resistance exercises on function in older adults with osteoporosis or osteopenia, revealed that intervention s using aresistance training have abenifatial effects on the domains of physical function and activities of daily life **[17]**.

Increases in BMD at the femoral trochanter and the inter trochanteric region were associated with high intensity resistive exercises involving hip flexion, abduction and extension and knee extension and flexion. These exercise were site specific to the femoral trochanter and suggest that the area is sensitive to muscle pull or joint reaction forces to increase BMD **[18]**.

On the other hand, these results are in contradiction with the results of **[19]** who studied the effects of brief daily exercises on bone mineral density in postmenopausal women using weight-bearing exercise. They concluded that the BMD in the women showed no significant increases after 12 months of exercise. Also, this results contradicted by work of, **[20]** who reported that one year trunk exercise program in postmenopausal women has no significant differences in BMD at lumbar vertebrae at baseline, 6 months and 12 months evaluation.

Regarding to quality of life results of Group (A) showed that mean value s of quality of life questionnaire (total score) before treatment were (85.25±4.02) there was decrease in quality of life questionnaire after treatment to (70.55 ±12.5).

These results confirmed with those of **[21]** who conducted a study to examine the effect of exercises therapy on quality of life in postmenopausal women with osteoporosis and osteopenia, this meta analysis revealed better improvement in physical function, pain relief and physical activities in the exercise group.

These results are consistent with that of **[22]** who conducted a study to determine the effects of a 4 months randomized controlled exercise trail on mental health outcomes in 164 previosly low active menopausal women, participant completed body compision and fitness assessment and abattery of psylogical measures at the beginning and end of a 4-months randomized controlled exercises trail with threearms: Walking, Yoga and controle. The results indicate that walking and yoga were effective in enhancing positive effects and menopause related QOL and reducing negative effects. So physical activities appear to enhance mood and menopause related QOL during menopause.

Conclusion:

This study showing that closed kinetic chain (leg press) associated with specific non weight bearing exercises (static abdominal exercises, pelvic rocking exercises, hip shrugging exercises) training was found to be an effective, noninvasive, safe, easy to perform, simple and successful for postmenopausal female.

References

1- WALKER M.L. and HERNDON J.G.: "menopause in non human permates ". Biolgy Reproduction, 79 (3): 398-406, 2008.

2- BACHMANN G.: "Physiological aspect of the natural and surgical menopause" journal of reproductive medicine 46 (Suppl 3): 307-15, 2001.

3- KELLEY D., THAETE F., TROOST K., HEUWE T. and GOODPASTER B.: "Subdivisions of subcutaneous abdominal adipose tissue and insulin resistnce", Am. J. Physiol., 278: 941-8, 2000.

4- KROLL M.H.: "Parathyroid hormone temporal effects on bone formation and resorption", Bulletin Math. Biol., 62: 163-87, 2008.

5- KOUSTENI S.; BELLIDO T. and PLOTKEN L.: "Non genotropic, sex non spacific signaling throught the estrogen and androgen receptors. Dissociation from transcriptional activity", Cell, 104: 719-30, 2001.

6- FERGESON N.: "Osteoporosis prophylaxis and treatment" hospital pharmacist, 7 (3): 69-71, 2000.

7- TUCCI J.R.: "Importance of early diagnosis and treatment of osteoporosis to prevent fracture". Am. J. Manag. Care., 12 (Suppl 7): S181-S190, 2006.

8- ESCAMILA R.F.: "Biomachanics of the knee during closed kinetic chain and open kinetic chain exercises", Med. Sci. Sport exercise, 30: 556, 1998.

9- RYAN A ., LVEY F.M. and HURLBUT D.E.: "Regional bone mineral density after resistive training in young and old men and women", Scand. J. Med. Sci. Sport., 14: 16-23, 2004.

10- MUSHTAQ S.: "Post-menopausal Women: A Study of Their Psycho-physical Changes with an Impact on Family", Anthropologist, 13 (2), 2011.

11- BACHMANN A. and LEIBLUM R.: "Menopause", Journal of the North American Menopause Society, 11 (1): 120-30, 2004.

12- NOTELOVITZ M.: Osteoporosis: Prevention, Diagnosis, and Management" , 5th ed professional Communications, USA , p.p.: 206-22, 131-5, 2008.

13- TURNER C.H. and ROBLING A.G.: Mechanisms by which exercise improves bone strength. J. Bone Miner. Metab., 23 Suppl.: 16-22, 2005.

14- MENKES A., MAZEL S., REDMOND R.A., KOFFLER K., LIBANATI C.R. and GUNDBERG C.M.: "Strength training increases regional bone mineral density and bone remodeling in middle-aged and older men". J. Appl. Physiol., 1993, 74 (5): 2478-84, 1985.

15- IWAMOTO J.: "Effects of physical activity on bone: What type of physical activity and how much is optimal for bone health". J. Osteopor. Phys. Act., 1: 101, 2013.

16- ZEHNACKER C.H., BEMIS-DOUGHERTY A.: "Effect of weighted exercises on bone mineral density in post menopausal women". A systematic review. J. Geriatr. Phys. Ther., 30 (2): 79-88, 2007.

17- WILHELM M., ROSKOVENSKY G., EMERY K., MANNO C., VALEK K. and COOK C.: "Effect of resistance exercises on function in older adults with osteoporosis or osteopenia": A systematic review. Physiother. Can., 64 (4): 386-94, 2012.

18- KERR D., MORTON A., DICK I., et al.: "Exercise effects on bone mas in post menopausalwomen are site specific and load dependant". J. Bone Miner. Res., 11: 218-25, 1996.

19- BASSEY E. and RAMSDALE S.: "Weight-bearing exercise and ground reaction forces: A 12-month randomized controlled trial of effects on bone mineral density in healthy postmenopausal women", bone J., 16 (4): 669-760, 1995.

20- SMITH E. and GILLIAN C.: "Physical activity effects on bone metabolism", Calcify. Tissue Int., 49: 50-54, 1991.

21- CHUN L., CHEN Y., RONG and TSAUO J.: "Effects of exercise programs on quality of life on osteoprotic and osteopenic post menopausal women: A systematic review and meta analysis, Clin. Rehabil., 23 (10): 888-96, 2009.

22- STERIANI E. and EDWARD M.: "Physical activity and mental health outcomes during menopause: A randomized controlled trial". Annals of Behavioral Medicine, 33 (2): 132-42, 2007.

الملخص العربى

الغرض: الهدف من هذه الدراسة كان تقييم تاثير تمرينات السلسلة المغلقة على هشاشة العظام فى السيدات بعد انقطاع الطمث.

العينة: شارك فى هذه الدراسة ٤٠ سيده متوسط اعمارهم ٥٨.٢±٤.٠٦ تم اختيارهم من العياده الخارجية قسم النساء والتوليد بمستشفى شبراخيت المركزى، وتم تقسيمهم عشوائيا الى مجموعتين.

مجموعة (أ) وتضم عشرون سيدة تلقين تمرينات السلسلة المغلقة بالاضافة الى تمرينات محدده بلا تحميل مثل (تمرينات البطن الثابته، استهجان الورك، وتمرينات هزاز الحوض).

مجموعة (ب) وتضم عشرون سيده تلقين تمرينات محدده بدون تحميل (تمرينات البطن الثابتة، استهجان الورك، وتمرينات هزاز الحوض).

استمرت هذه الدراسة مدة اربعة اشهر بواقع ثلاث جلسات اسبوعيا لكل مجموعة.

تم عمل تقييم لكل المشاركات فى الدراسة قبل البدء وبعد انتهاء فتره الدراسة عن طريق جهار قياس كثافة العظام DEXA واستبيان طبيعة الحياه Quality of life questionnaire.

النتائج: ابرزت النتائج ان تمارين السلسة المغلقة لها تاثير واضح على هشاشة العظام فى السيدات بعد انقطاع الطمث.