**CHANGES IN BIOMECHANICAL COMPONENTS WITH EXERCISES ON A GERIATRIC OBESE SUBJECT WITH OSTEOARTHRITIS KNEE– AN EVIDENCE BASED STUDY**

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|  | ***Abstract*** |
| ***Keywords:*** *BMI – Body Mass Index, WC – Waist Circumference, Womac Score – Knee functioning on a 5 point scale, Proprioception – Joint, Muscle sensory means, Osteoarthritis – Degenerative changes, Joint Biomechanics – Changes in structural changes of joint.* | Obesity, a globally increasing factor and its impact on healthcare needs to be focused. Geriatric subjects with obesity and osteoarthritis knee changes influences level of dependency, and decrease quality of life. Aims and objectives of this study was to analyse the role of weight reduction exercises, dietary regulations on obesity and physical function, to evaluate the efficacy of exercises based on biomechanical causes and changes that follows. Materials & Methodology: With ethical committee approval and subjects concern, weight reduction exercises with dietary advice along with exercises based on the altered biomechanics in a obese subject with osteoarthritis knee were analyzed in this original experimental case study design, for a period of 3 months from February 2017 to April 2017 at TamilNadu, India. He was treated with non pharmacological means, using specific exercises with weekly twice frequency at 50% - 70% of his M.H.R, Results: statistically highly significant (P<.001) with womac score on physical functioning functional betterment and significant (P<.05) indicating reduction in obesity of this subject with osteoarthritis knee following treatment with =. Conclusions: Apart from routine exercises in subjects with osteoarthritis knee, weight reduction means and treating the underlying cause for altered mechanics of movements with specific exercises makes a huge improvement in therapy outcome were the main outcome of this original research study. |
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**Introduction**

Osteoarthritis is one of the most common musculoskeletal complaints worldwide (Badely 1994 & Tellnes 1989) and Osteoarthritis knee is the most common joint disorder, causing pain, functional disability (Kjerstistorheim 2014) and is associated with significant health and welfare costs (Felson etal 1995)

Disability due to osteoarthritis knee is expected to continue to rise with an increasingly obese, sedentary and ageing population (Vos etal 2010) .Osteoarthritis knee is a chronic degenerative joint disability having a significant economic impact on our health system worldwide (Victor Valderrabanno etal 2011) with symptoms such as pain, a decreased joint ROM (Range of Motion), stiffness, particular muscle weakness and atrophy, joint effusion and swelling, physical disability, despite the high prevalence of the disease, the pathogenesis reasons for progression are not entirely understood. The common characteristic structural changes of the entire joint includes partial to full thickness loss of articular cartilage, subchondral bone sclerosis osteophyte formation and thickening of capsule with clinical and radiological signs (Classens etal 1990) proprioception plays an integral role in neur motor control of the knee joint (Bennell etal 2003) and deficits in knee joint Proprioceptive activity were much documented (Hassan etal 2001).

As there is no cure for osteoarthritis, besides different symptoms- reducing drugs as well as joint preserving and replacement surgery potentially amenable factor in the prevention and treatment such as muscle weakness in osteoarthritis due to its atrophy which is believed to be secondary to joint pain (arthrogenic muscle inhibition) (valdereban etal 2007) and age related loss of muscle volume further increases risk for osteoarthritis knee (Ikeda etal 2005).

The surgical outcome among osteoarthritis knee subjects with pain relief (Hurwitz etal 2000) and radiographic disease severity (Sharma etal 1998) are related to peak external knee adduction movement. Mechanism that has been suggested to decrease the external knee adduction movement is to increase the to out angle (Wang etal 1990). Hurwitz etal 2002 have recorded that subjects with varus knees had larger peak knee adduction movements. Relative contribution of mechanical and metabolic components to joint structural changes were not much studied (Lauren King etal 2013) but the pathogenesis of osteoarthritis knee in obese people begin with expansion of adipose tissue (Lai 2008). This innovative study where with associated weight loss strives to analyse biomechanical changes and clinical prognosis on his physical functions of the subject with osteoarthritis knee using specific exercises.

Aims & Objectives of thisStudy was to evaluate to effects of weight reduction with exercises among osteoarthritis knee subject on quality of life and to analyse the biomechanical causes and changes with exercises on this geriatric study subject with osteoarthritis knee.

**Background Information**

Mr. Gopinath, 70 years aged Male, father of two female children, non diabetic, non hypertensive, vegetarian, retired from TamilNadu State govt service with sedentary life style

**C/O**

Difficulty in walking and pain in both knees

BMI: 91 kg/m2 Waist Circumference: 114cm

Peripheral joints of both upper extremities full and free

Motor power of both knees 3/5, abdominal muscles at grade II/V with exaggerated lumbar lordosis

For Activities of Daily Living (ADL) and transfers he was independent, able to walk unaided for short distance with pain increasing on left knee. **Gait:** Ambulant with antalgic gait

Medial joint line tenderness grade I (Left knee), nil joint effusion/and no atrophy of quadriceps and he has moderate exercise tolerance.

**X- Ray Report**

Bilateral tibiofemoral joint space reduction, osteophyte seen in both tibial and femoral Knee Joints Grade II osteoarthritis knee left> right, Crepitus increase on inner range of knee extension left> right,

Knee joint active range of Motion in prone lying:

Left-5-120 Right-0-130

**Materials & Methodology**

After due consent from the subject, this original study was conducted in Chennai from February 2017 to April 2017. With twice a week frequency using specific core, Proprioceptive exercises using Physioball and manual resistance. A set of 16 exercises were used in supine, side, prone and sitting postures. Progression was made gradually with including isometric contractions and increasing number of repetitions. Subject’s womac, BMI, WC, were measured at the beginning of the study and again after three months completion with exercises. The data were recorded, tabulated and analyzed as below:

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***Core Strengthening Using Physioball***

**Results**

He was adviced to continue his routine daily activities. During the first few sessions, the amount of perceived exertion, increased breathing and heart rate were noted, but duration and intensity of further sessions he was able to perform the said physical activities with ease. Generalized sweating were recorded. With no exacerbation of symptoms of knee, he was able to complete each session. With 5 sessions of therapy he was adviced for continue walking for up to, within pain free limits (10 minutes) which was increased gradually to 25-30 minutes.

***Table: 1 Pre and post results of the subject on WC, BMI, Womac score***

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Test | BMI  Kg/m2 | | | | WC  Cm | | | | Knee Joint Functional Index  Womac Score % | | | |
| Pre | 51 | | | | 114 | | | | 54 | | | |
| Post | 43.6 (Decreased by 4.5%) | | | | 103 (Decreased by 9.6%) | | | | 27 (Decreased by 50%) | | | |
|  | SD | SE | t | p | SD | SE | t | p | SD | SE | t | p |
| 5.37 | 3.10 | 2.58 | <.05 | 7.78 | 4.49 | 2.45 | <.05 | 19.09 | 7.79 | 3.80 | <.001 |

WC- Waist Circumference, BMI – Body Mass Index, Womac Score – Subjective rating Scale on Knee Functioning of 17 items on a 5 point scale

SE – Standard Error, SD – Standard Deviation, P – Level of Significance, P<.05 – Statistically Significant, P<.001- Statistically highly significant

**Discussion**

Referring from the results of this study as displayed in the above table, the following empirical questions arises and were getting answered with scientific evidence and clinical knowledge gained by the author as below:

1. Does biomechanical and metabolic components are involved in osteoarthritis knee and among obese subjects?
2. Are physical exercises with weight reduction effective in this subject and does influence on quality of life?
3. What are the biochemical physical and changes associated with resisted exercises and obesity reduction on this obese subject with osteoarthritis knee?
4. To what extent exercises were effective on obesity reduction and on physical functioning?
5. Does proprioception improves with exercises?

Biomechanical changes and impact of exercises on them and metabolic associations with osteoarthritis knee

1. **Cartilage**

people with obesity have greater absolute knee adduction movements, an important mechanical variable associated with knee osteoarthritis, (Brouwer etal 2007) resulting in slower walking velocity (Lai etal 2008) and the articular cartilage may not be able to respond to the higher levels of absolute knee adduction movement during gait (Andrichi etal 2006), but metabolic and mechanical components to joint structural changes gets complex, among obese OA knee subjects (Aspeden 2011) weight loss in obese subjects with knee OA were found to have decreased circulating levels of Leptin and an increased circulating levels of Adiponectin (Richette etal 2011) and it is worthy to note Leptin to increase levels of degenerative enzymes and pro inflammatory cytokines (Simopoulon etal 2007) but the role of adiponectin in joint disease less in known compared with systemic anti inflammatory effects (Gomez et al 2011).

1. **Effect of Exercises on these Metabolic & Bio Mechanical changes:**

Regular resistance training has been shown to prevent and reduce the loss of muscle mass during aging (Klitzgardetal 1990) an improvement in the muscle fiber cross sectional area with 3-6 months at resistance training along with favourable effects physical function and quality of life (Binder etal 2002). **With reduction in pain during his daily activities, walking and decreased Crepitus on movements were clinically noted. Also cadence has increased.**

1. **Obesity**

Messier etal 2005 have recorded that 1:4 ratio of loss of body weight to decrease of load on the knee joint, indicating that 1kg of weight lost will result in a 4kg reduction in the mechanical load exerted on the knee joint per step during daily activities. (Forsythe etal 2008) have reported in a meta analysis of 66 weight loss interventions weight loss was associated with reduced levels of inflammatory markers; hence reduced pain, improved physical activities and reduction in physical disability. Weight loss of greater than 5% reduction physical function per week over a 20 week period can lead to significant improvements in disability (Christensen etal 2007) and reductions in knee load (Messier etal 2005) in people with knee OA. An 8 week study with improved function , reduced pain , muscle strength and walking time with low and high intensity strengthening programme to be benefitial among OA knee core ( Jan etal 2008). Changes with ageing on musculoskeletal system. Including sarcopenia, the loss of muscle that accompanies ageing is associated with daily energy expenditure and bone mineral density reductions, which may have implications for incidence of osteoporosis (Ciolac etal 2010). **This study subject where a reduction of BMI by 14.5% and WC by 9.6% were reduced, hence with lowered obesity, a reduced pain, an improved physical function and an enhanced self confidence for his self care and social activities were recorded. As evidenced with statistical analysis, the reduction in obesity as shown in table on results** **statistically significant a major findings of this research study.**Increased dynamic loads on the medial compartment of the knee may contribute to the development/progression of the knee osteoarthritis as increased load in the articular cartilage is one factor associated with the pathogenesis of osteoarthritis (Frost 1994 Radin etal 1991) and subjects with knee Osteoarthritis with medial joint space narrowing have been shown to have greater than normal peak knee adduction movements (Baliunas etal 2002)

1. **Proprioception**

Pain influencing proprioception among OA knee patients were reported by (Sharma etal 1997: Perri etal 1997,Hassan etal 2002 and Bennell etal 2003) have reported that Proprioceptive impairment among OA knee subjects were not due to pain but disruption of afferent input from joint, skin and muscle receptors or efferent commands to the quadriceps muscle. **This research where proprioception was not included as a tool of prognosis, but few closed kinematic exercises were involved in the exercises he was treated with.**

1. **Quality of life**

In over weight patients undergoing dietary induced weight loss, strength training is important to minimize, loss of mean muscle mass that would otherwise exacerbate muscle weakness (Toda 2001). Following three months of **specific exercises this study subject’s quality of life along with knee joints functioning has improved by 50% as seen in the results table, indicating highly statistically significant, hence this study subject following 3 months of specific exercises along with reduction of obesity, biomechanical changes has shown greater improved functional activities of his daily physical routines, was a major outcome of this research report.**

**Critical Appraisal of this Study**

As age advances, with modern lifestyle changes and nuclear families, Self care mainly related to health was major concern. Coupled with due dietary advice and regular specific physiotherapy techniques applied together based on individual subjects clinical condition, evaluation, therapy should be goal oriented, tailor made, concur and convincing the subject with prognosis were key components of this inclusive physiotherapy care. However sustainance of improved joint mobility, reduction in pain and obesity, enhanced functional activities. Have to be followed up, and for detraining effects of this therapy to be studied further. But home programme with exercises, diet control, regular walking, changes in life style were the other components influencing the maintenance of the progress achieved here.

**Conclusion**

Physical inactivity with ageing along with obesity can increase the dependency, depression and disability. Hence, with specific physical therapeutic means any weight reduction, strengthening of core muscles around hip, an improved level of physical activity and self care should be the prime goal of treatment and not alone with symptomatic relief using electrotherapy modalities. Proprioceptive techniques help to improve joint and muscles efficiency around weight bearing joints. Core exercises helps to improve and tone lumbar pelvic muscles. Thus the outcome of this finding of the study could be extended on larger number of population. Limitations and Further Recommendations: With osteoarthritis changes of both sex and for longer duration follow up. Other variables such as intra articular tissue response, gait measures comparing with controls treated with electronic modalities, detraining can further be studied. Thus being a case study, functional activities and anthropometric means were the only variables included.

The Author has no financial conflict in publishing this original case report which is done with sole aim of promoting physiotherapy research and with evidence..

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