6: DISCUSSION

Possible mechanisms of effects of yogasanas: Variations in yogasan poses improved flexibility and all areas of joint surfaces are brought under stress/contact, this must be helpful in possibly avoiding wear and tear of restricted areas and hence preventing arthritic changes.

The BMI remained almost constant indicating that yogasans practice was effective in maintenance of weight. These findings were similar to the findings made in a large scale study on Yoga practice by Kristal et al (2005) on 15,550 adults, aged 53 to 57 years and in overweight category. Regular yoga practice was associated with attenuated weight gain, most strongly among individuals who were overweight. All determinants of the aerobic training intensity, duration, frequency, and mode and reversibility principle as mentioned in the literature (ACSM’s guidelines 2001) are applicable to yogasanas.

Weight control must have been achieved by an aerobic like exercises. Aerobic exercises are activity with large muscles, which is less than maximal intensity for 3 to 5 minutes repeated after rest or mild exercise of similar duration, may develop aerobic power and endurance capabilities. ATP is supplied by the phosphate, anaerobic glycolytic and aerobic systems (Glenn and Mulcare 2002). Yoga exercises have a varied range and intensity of exercise. It could be as intense as aerobic exercises if done without any pauses or breaks between change of postures, and if advance postures held for longer time with practice. This effect perhaps may have been demonstrated as minimal change in sports and recreation component of KOOS by seven points in OA group and five points in OA group knee club members.
Powers and Howley (2001) state that the individual improves in the exercise task used for the training and may not improve in other tasks. Most of the yogasans postures are functional movements itself, hence possibly effects were seen in ADL component of KOOS. Three and half points change noted in OA group C & same in knee club member group D.

Muscle performance refers to the capacity of a muscle to do work (APTA 2001). Muscle performance is a complex component of functional movement. It is affected by all of the body systems including morphological qualities of muscle, neurological, biochemical and biomechanical influences. The metabolic, cardiovascular, respiratory, cognitive and emotional functions are important factors for the muscle performance as well. The key elements of muscle performance are strength, power and endurance. If any of these areas are impaired, functional limitations and disability or increased risk of dysfunction may occur. The use of Yoga exercises for group B seen over two years demonstrated to be an appropriate therapeutic intervention to improve the integrated use of strength, power, and muscle endurance during functional movements, to reduce the risk of injury and to enhance physical performance.

Muscle Strength is a broad term that refers to the ability of contractile tissue to produce tension and a resultant force based on the demands placed upon the muscle (Levangie & Norkin 2001; McArdle et al, 2000). Functional strength relates to the ability of the neuromuscular system to produce, reduce, or control forces and work in a coordinated manner. Insufficient muscular strength can contribute to major functional losses of even the most basic activities of daily living. The development of muscle strength is an integral component of most rehabilitation or conditioning
programmes for individuals of all ages and all ability levels. Strengthening exercise or strength training is defined as systemic procedure of a muscle or muscle group lifting, lowering, or controlling loads for a relatively low number of repetitions or over a short period of time (Kisner & Colby 2002). In these terms Yogasanas fitted strengthening exercises as seen by change in the reduction of quadriceps lag in patients with OA in knee club group and yogasanas programme in group C as well as two case studies. Changes in positions and use of body parts’ weight working as resistance.

The eccentric control of quadriceps and hip extensors though not directly quantified in this study, seems to be gained. The maximum force a muscle can exert is dependent on the speed at which it is contracting. The maximal isometric force of a muscle is always greater than the force that can be exerted during shortening, and the maximal force exerted during lengthening is always greater than that exerted during isometric contraction. This effect may be possible during advancement in Virbhadrasan and Dhanurasan. It must have reflected in improvement in attaining squat, attaining Vajrasan.

Progression of Yogasans practice was made by small variations and moving into complex positions as much possible. This programme variation and periodization must have been important factor for continuous effect on muscle strengthening. Variation in training programme was important for optimal gains in strength. Slight variations in the position of foot, hand or other body parts that did not affect the safety in performing the exercise could have been valuable in producing continued gains in strength. Variation may also be achieved through alterations in intensity, volume, order of exercise and amount of rest between sets. Variation in programme also enhances long-term adherence
by reducing boredom with the exercise programme. This is been seen as there were participants practicing yoga for more than twenty five to forty years! As noted in the prospective group.

Endurance is a broad term that refers to the ability to perform low-intensity, repetitive, or sustained activities over a prolonged period of time. Muscle endurance is the ability of a muscle to contract repeatedly against a load, generate and sustain tension, and resist fatigue over an extended period of time. The term aerobic power is sometimes used interchangeably with muscle endurance. Maintenance of balance and proper alignment of the body segments require sustained control or endurance by the postural muscles. The key elements for muscle endurance are low intensity muscle contractions, high repetitions and a prolonged time period. Change in endurance must have reflected by improvement in ADL, Sports & Recreation and QOL of KOOS.

Neural factors and their influence on motor learning and recruitment are well observed during practice of yogasanas. Every time the asana is made complex, new challenges and perturbations, stimulate the neuronal firing. The importance of neural factors in affecting muscular strength has been recognized through the dissociation between changes in strength and muscle size during a strengthening programme. The gains in strength during first few weeks of such training occur without any change in muscle size. The general consensus is that these early changes reflect neural adaptations that may include improved muscle activation and improved task performance from motor learning and coordination (Enoka, 1988). Improvement in muscle function during short practice of yogasanas also was tremendous. Maximal force production from a muscle requires the maximal recruitment of all motor units. This had come
through training during practice. This was reflected in various components of KOOS; symptoms, sports & recreation and QOL.

Rehabilitation programmes earlier focused primarily on strengthening and little attention was paid to neuromuscular proprioceptive training of the knee joint. Kibler & Herring (1997) mention that such training stimulates joint neuro-receptors to provide afferent stimulation to the central nervous system. In turn, descending control is exhibited on muscular contraction. Yogasans practice in standing; Tadasan, Trikonasan and Virbhadrasan are good examples of proprioceptive neuromuscular facilitation (PNF). There are potential benefits of these techniques: large gains in flexibility, greater strength, greater balance of strength and improved stability about a joint. PNF techniques also have been claimed to improve endurance (Alter, 1988). Diagonal patterns involve multiple joints and complex movements. In many books and chapters on PNF patterns only brief mention is done about the inputs from yoga and mention is done in Bibliography and not as reference.

Improved co-contraction during standing asanas was possibly a key in gaining dynamic stability at the knee complex. The change in KSKS for OA groups C and D might be due to these effects on the knee complex.

Flexibility has increased as seen by reduction of hip flexor and hamstrings tightness. Finger-floor distance was indicator flexibility of thoraco-lumbar fascia, spine extensors, hamstrings and gastrocnemius soleus muscles. Multiple components must have brought this change. The myofascial release is one of these. The soma is a functional system that will rebalance and re-harmonize itself if given a chance. In functional disorders what is required is change in human system’s awareness of its own functioning. The somatic system needs more information of itself and
more efficient control. The human soma needs sensory information and new motor control (Hanna 1979, 1988). Barnes (2000) states that as we go through life, with its major and minor traumas, emotional and physical, we tend to fall into habitual patterns of posture and movements. These patterns over time may not be beneficial and we become unaware of our dysfunctional patterns of use. Fascia is the tissue which spreads throughout the body in a three-dimensional web from head to toe. It surrounds muscles, bones, nerves, blood vessels, and all organs. It provides support and stability. Tightening of fascial system is biomechanical protection to trauma. If this continues over a period of time, the fascia loses its pliability, the collagen becomes dense and fibrous, and the elastin in it loses its resiliency. This may lead to poor muscular biomechanics, altered structural alignment, decreased strength, endurance, and coordination. Subsequently some functional capacity is lost.

Fascial restrictions can create abnormal strain patterns which have influence on the osseous structures and lead to change in their normal alignment. This could result in increase in compressive forces on the related joints, may lead to pain and dysfunction. Neural or vascular conditions also may result. Shortening of the muscular component of the myofascial fascicle can limit its functional length, reducing its strength, contracting potential, and deceleration capacity (Levin 1990).

Various myofascial release postures which are now investigated appear to be derived from yogasanas. It can be observed that yogasanas lead to the release of the myofascia. Tissues become soft and pliable. The restoration of the length and health of the myofascial tissue takes pressure off the pain-sensitive structures; restore alignment and mobility to the joints (Barnes 2000). Active elongation in yogasanas is a combination of a
passive stretch and neuromuscular work. This is accomplished through activating one side to stretch myofascial structures on the other side.

Release of myofascia through postures may bring tonal release; breakdown of dysfunctional patterns help abandon old habits, acquisition of new improving control and pleasurable relationship with environment. Resetting efficiency of proprioceptors and nociceptors help greater quality and quantity of movement. Stretching is a general term used to describe any therapeutic maneuvers to increase mobility of soft tissues and subsequently improve range of motion by elongating or lengthening structures that have adaptively shortened. Regardless of the types of stretching procedures, if the gain in mobility to become permanent, it must be complimented by an appropriate level of strength and endurance and used on a regular basis in functional activities. If a slow stretch force is applied to muscle, the Golgi tendon organs (GTO) fire and inhibit the tension in the muscle, allowing the parallel elastic component the sarcomere of the muscle to remain relaxed and lengthened.

Intensity of stretch force is determined by the load placed on the soft tissue as it is being elongated. There is a general agreement among clinicians and researchers that stretching should be applied gently, that is, at a low intensity by means of a low load (Kisner & Colby 2002). Low intensity stretching makes the stretching maneuver more comfortable and minimizes voluntary or involuntary muscle guarding. Low intensity stretching coupled with longer duration of stretch results in optimal rates of improvement without exposing tissues, possibly weakened by immobilization, to excessive loads and potential injury.

Stretching was carried with a combination of active movements and passive positions. The asana postures were gradually sustained, holding
the stretch. Gain of muscle flexibility and joint ranges was observed in all groups tested including the case studies. As aptly stated by Alter (1988) with this technique of stretching, individuals have enhanced their agility, co-ordination flexibility and muscular strength as observed in this study.

There are various techniques described for mobilization. The technique of mobilization with movement to gain the flexion range of movement in the knee joint (Kisner & Colby 2002). Self treatment is guided to place the tibia in internal rotation to gain the knee flexion. The Vajrasan was a beautiful example to gain passive also controlled knee range. The advantage of self glides was that it could be relatively safe as this was controlled by the participant and limits could be easier. This may have avoided any over stretching as modification was made by hand support.

Variations in the yogasanas, the yoga postures must be giving continuous sensory input to brain. Reflexes from vestibular system, for balance and orientation, with sensations from touch and pressure pathways provide sensory input to the nervous system and drive musculoskeletal system for improved function. The change observed in components of KOOS for improvement in QOL may be due to these varied dimensional factors.

There have been considerable effects on the pain component as reflected by KOOS pain scales in both OA groups and case studies. Mechanism of pain relief is complex and effects may have been due to multiple components. Increase muscle control, flexibility can have direct impact. Mechano-receptors’ stimulation can occur in Dhanurasan and Pavan-muktasan which may help pre-synaptic or segmental pain inhibition. Shavasan has been known as one of the ways to obtain relaxation and evaluated by many researchers.