

THE BIOMECHANICS OF PELVIC TILT

M C Siff *

SUMMARY

Emphasis on the use of pelvic tilt fails to take account of several other types of pelvic rotation involved with three dimensional pelvic stability and mobility. It is necessary to have a thorough understanding of the biomechanics of all types of pelvic rotation in order to safely and efficiently use the spine during all physical activities.

One of the physiotherapeutic terms which has been adopted readily by fitness, dance and sports professionals is the "pelvic tilt". Armed with this impressive jargon, they advise clients to use "pelvic tilt" to minimise the risk of injury when one is lifting or performing dance or floor exercises. It is apparent that they believe there is only one "correct" pelvic tilt for all human movement. The physiotherapist can play an important role in educating both health professionals and the general public about the mechanics of pelvic tilting and its relevance to spinal health.

It is the objective of this article to discuss, analyse and apply the variety of different types of pelvic tilt which are necessary to optimise stability and mobility in three dimensional space.

Most fitness and aerobics instructors inadequately understand what is meant by "correct" pelvic tilt. They generally are unaware of the functional difference between anterior and posterior pelvic tilt. They are even less aware that the advisable type of pelvic tilt depends on the specific phase of each exercise.

Even some physiotherapists are unaware that the generally recommended pelvic tilt is inappropriate for lifting loads from the ground, a fact confirmed by video, force plate and EMG analysis of Olympic Weightlifters and Powerlifters¹. They have to be reminded that there is a correct lumbar-pelvic rhythm in which one form of pelvic tilt synchronously changes to the other throughout the lifting process².

Prescription of any pelvic tilt depends firstly on a clear understanding of anatomical terminology. There are essentially two systems used to describe the direction of pelvic tilt. One describes tilting of the top of the pelvis (or the iliac crest) relative to the neutral pelvic position, the other of the bottom (or pubic symphysis) relative to neutral.

Before advising a particular pelvic tilt, it is vital to recall that the purpose of deliberate pelvic tilting is to maintain the neutral lumbar curvature as closely as possible, since excessive or prolonged lumbar flexion can be particularly stressful to the lumbar intervertebral joints and the periarticular soft tissues.

Thus, a neutral pelvic tilt or normal position of pelvis offers the least stressful position for sitting, standing and walking. It is only when a load (or bodymass) is lifted or resisted that other types of pelvic tilt become necessary. Even then, only sufficient tilt is used to prevent excessive spinal flexion or extension.

With reference to the iliac crest convention, the posterior pelvic tilt is the appropriate pelvic rotation for sit ups or lifting objects above waist level.

Conversely, biomechanical analysis of weightlifters and other athletes reveals that anterior pelvic tilt (of the iliac crest) is the correct pelvic rotation for squatting, lifting heavy loads off the floor or toe touching¹. It is particularly dangerous to commence lifting movements or squatting with a posterior pelvic tilt, since this causes

OPSOMMING

Posterior bekken kanteling word oorbenadruk as 'n meganisme vir beskerming van die rug. Hierdie standpunt neem nie in aanmerking ander posisies van rotasie wat ewe belangrik is vir drie-dimensionele stabiliseering en mobiliteit van die bekken. Dit is belangrik om 'n deeglike begrip te hê van die biomeganika van alle vorms van bekken kanteling om sodoende die rug veilig en effektief te gebruik gedurende fisiese aktiwiteit.

lumbar flexion and exposes the lumbar discs to the possibility of damage.

At this point it is relevant to emphasize that the anterior-posterior model of pelvic tilting is too restrictive to adequately describe the full 3-dimensional freedom of the pelvis. There can be rotation of the pelvis relative to any of the X, Y and Z axes (Fig 1), where rotation about the X-axis refers to anterior-posterior tilting. The mechanics of the pelvis in all planes of action is highly relevant to safe, efficient use of the lumbar spine and lower limbs, since these systems both interface directly with pelvic structures.

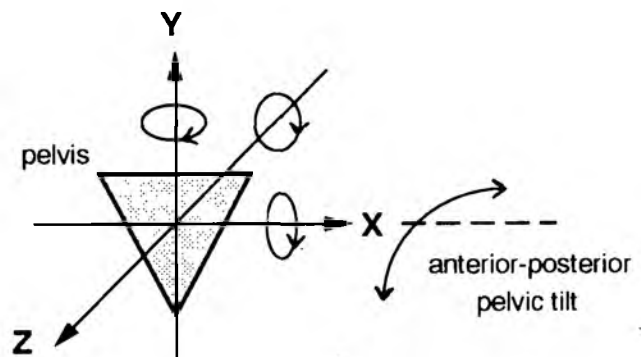


Fig 1: The three axes of pelvic rotation

It is, therefore, surprising that few texts discuss the other types of pelvic rotation, namely rotation about the Y and Z axes. Rotation about the Z-axis is associated with the tilting up or down of the left and right iliac crests relative to one another (superior-inferior tilting, or lateral tilting). This characteristic "wiggling" of the pelvis, occurs during all normal walking. This rocking of the pelvis is natural and safe in walking, but can precipitate injury if it is permitted to happen during squatting, overhead jerking or pressing, standing calf-raises, all forms of alternate dumbbell exercises, seated overhead pressing, deadlifting, upright rowing or any other gymnasium manoeuvres which necessitate a level or statically stable pelvis.

Rotation about the vertical Y-axis also occurs naturally during numerous activities such as walking, running, hitting, throwing and kicking. Excessive range of passive Y rotation, in particular, imposed for long periods or with high intensity by the momentum of heavy objects, sporting opponents or gym machines, can be especially harmful for the lumbar spine. The risks of such activity are exacerbated.

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bated if Y rotation is accompanied by unskilled rotation about the other axes, thereby producing simultaneous spinal rotation and hyperextension or hyperflexion.

Similar unstable patterns of asymmetric pelvic rotation can occur during most sporting and manual labour actions such as pushing in the rugby scrum, bowling in cricket, kicking in karate or aerobics, swinging a golfclub, rapid twisting situps, loading bricks, digging, sweeping, serving in tennis and hurdling in athletics. Just as there are recommended patterns of Proprioceptive Neuromuscular-Facilitation activities, so there are optimal patterns, principles and timing sequences of pelvic stabilisation and movement. Inappropriate speed, duration or sequences of transitions from one extreme of pelvic rotation to another, and between different phases of stability and mobility can cause many of the lumbar problems seen by physiotherapists today.

BOOK REVIEW

AQUA-RHYTHMICS

by Desireè Carse

Published by Human and Rousseau

Price R39.99 plus GST

The author is a dancer and gymnast who suffered debilitating spinal pain following an accident. She has successfully overcome her problem without surgery using exercise in water. The book provides a detailed rationale for these exercises and a comprehensive description of exercise techniques. Attention to posture is excellent throughout.

Different programmes are provided for fitness level. The exercises are well chosen bearing in mind that it would be safer to limit hamstring stretching to one leg at a time and to drop the legs to approximately 45° when exercising in prone positions. There is slight confusion as to the role of diaphragm and the abdominal muscles. Generally this is a useful book for water fitness instructors and anyone needing exercise in a pool at home.

Gillian Oosthuizen

OBITUARY - ANNE MIOT

The physiotherapists of Southern Transvaal and all those who knew her, were deeply saddened to learn of Anne Miot's death on Monday 3rd June 1991. Although ill for several years, Anne had continued, as clinician, teacher and chairman of the Southern Transvaal branch of SASP - to strive for excellence from herself and those around her, whilst maintaining a full family life. Her determination to continue for as long as possible when so ill was admired by all who knew her.

Anne had a vision of physiotherapy in this country, in the future. It was a vision she tried to impart to all those who had contact with her and should serve as an inspiration for all of us.

She promoted interprofessional development and communication through her ongoing involvement with different disciplines and groups. Her farsightedness has ensured the continuation of this process within the Southern Transvaal branch.

Anne will be missed as a close friend, a paediatric physiotherapist of the highest calibre whose clinical teaching will be remembered by students and staff, and someone whose energies and loyalty in pursuit of the full philosophy of physiotherapy were unlimited.

Anne's vision will be carried on by Southern Transvaal, as she instilled the importance of leadership, responsibility and forward thinking into the younger members of the profession.

She is sorely missed, not only by the staff of Wits, Johannesburg Hospital and the Southern Transvaal branch of the SASP, but by all those who knew her and loved her. The profession and her family have lost someone very special.

A Bizos, H Block, T Wallner

Obviously, the concept of pelvic tilt is not as simple as implied by many texts and health professionals. It embraces an interrelated series of different types of pelvic rotation, each appropriate to a different phase of human stabilisation and movement in three dimensions. The physiotherapist is particularly well placed to play a major research, educational and preventative therapeutic role in the correct use of the pelvis.

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TESTING THE EFFECTS OF AN EXERCISE PROGRAMME ON THE QUALITY OF LIFE OF PATIENTS WITH CHRONIC OBSTRUCTIVE PULMONARY DISEASE

by D Cohen

Johannesburg Hospital Physiotherapy Department

Improvement in quality of life is often the most obvious sign of improvement in patients participating in a rehabilitation programme. Controversy exists concerning the measurement of quality of life and many questionnaires have been designed to measure this. In the Respiratory physiotherapy outpatient department at the Johannesburg Hospital these questionnaires have been used with minimal success. Presently a disease specific questionnaire designed to measure the quality of life of patients suffering from respiratory problems is being used by us.

We will describe how this questionnaire is being used in our department to assess the effects of progressive exercise training on patients suffering from chronic obstructive pulmonary disease.

The results obtained will be reported on, analysed and discussed.

RISK FACTORS FOR CORONARY HEART DISEASE IN RENAL TRANSPLANT PATIENTS

by W Diesel

Johannesburg Hospital Physiotherapy Department

AIM: Thirty (30) stable renal transplant patients from Johannesburg Hospital volunteered for the study. All patients were screened by the renal doctors prior to entering the study. Each patient underwent a full exercise stress test, on a treadmill, to determine their functional capacity. The patients were instructed to have a fasting lipogram done before the stress test.

RESULTS: Eighteen (18) patients were on anti-hypertensives. All patients received steroids (seventeen (17) on triple therapy, thirteen (13) on double therapy). Functional capacity, expressed as a percentage of age/sex predicted maximums, was 78 (19%). Percentage body fat, using the BROCA index, was 25 (5%) for both males and females in the group. Nine (9) out of thirty (30) patients were currently smoking. Six (6) out of fifteen (15) patients who had a fasting lipogram taken had total cholesterol/HDL ratios in excess of five (5). Six (6) patients had history of prior cardiac abnormalities.

CONCLUSION: In this group of transplantees it would appear that the risk of cardiac disease is greater than one would expect from a "normal" sedentary population. Due to current successes of rehabilitation programmes for people suffering from heart disease we therefore need to incorporate renal transplant patients into similar programmes.

THE ACCEPTANCE OF SELF-RESPONSIBILITY IN PATIENTS WHO HAVE UNDERGONE CABG

by C Eales

University of the Witwatersrand Physiotherapy Department

Coronary Artery Bypass surgery is increasingly being used as a method of treatment for patients with ischemic heart disease. The cost involved in this procedure is extremely high and considering the

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escalating costs and availability of medical care in South Africa, it is most appropriate to consider the factors that contribute to successful rehabilitation of these patients. In Cardiac rehabilitation greater attention should be paid to such issues as self-responsibility and quality of life.

The acceptance of self-responsibility is an essential feature of successful rehabilitation and the focus should be on the patients participation in the rehabilitation programme. In order for the patient to function in this way he should be provided with adequate knowledge about his disease and rehabilitation programme and he should comply.

A study was conducted at the Johannesburg Hospital to determine the level of patients knowledge (and thus their ability to accept self-responsibility) and to what extent they complied with the rehabilitation programme.

The experimental sample consisted of 43 patients. Patients knowledge about the disease was assessed as well as the knowledge of the spouse or care-giver. Compliance with the rehabilitation programme was also assessed. The results indicated that patients had limited knowledge about the chronic nature of their disease, their medication and exercise programmes.

From the results it was concluded that structured educational programmes are necessary for both the patient and the spouse/care-giver to help them to cope post-operatively, by accepting self-responsibility. By promoting successful rehabilitation in this way, the quality of their lives will be enhanced.

TRAINING OF PHYSIOTHERAPISTS FOR THE FUTURE

by C Eksteen

University of Pretoria Physiotherapy Department

It is necessary to reconsider training of physiotherapy students for the future pro-actively in order to take part in inventing the future. If we don't do it urgently we might become passengers instead of leading health professionals. The influence of population and economic growth rate, community needs, geographic distribution of physiotherapists and the type of practice, change in the national health care policy, and economic growth, on the curriculum and clinical training of physiotherapy students, the standard of training and research, will briefly be discussed.

MUSCULOSKELETAL FITNESS AND HEALTH

by N F Gordon

Institute for Aerobics Research, Dallas, Texas

During the past 30 years, medical interest in regular exercise as a means of preventive health care has surpassed that of most other interventions because of the numerous potential benefits. This interest is reflected in the considerable increase in the number of scientific publications on exercise and health in recent years. However, previous studies have investigated primarily the health-related benefits associated with endurance or cardiorespiratory fitness. Consequently, very little is presently known about the health benefits of other physical fitness attributes, such as strength and flexibility. Likewise, although musculoskeletal disorders constitute the leading cause of activity limitation in the general adult United States population, researchers in the field of exercise and health have tended to focus on cardiovascular disease prevention. In view of this, we recently initiated a 5 year study of approximately 12,000 male and female subjects, the primary objective of which is to focus on the potential value of strength and flexibility as contributors to musculoskeletal health (defined as the avoidance of musculoskeletal disorders and the ability to perform occupational, recreational, household and self care tasks). During this presentation the specific aims, significance, and design of this study will be outlined.

CARDIAC REHABILITATION IN THE 1990'S

by N F Gordon

Institute for Aerobics Research, Dallas, Texas

The 40 years after Herrick's description of acute myocardial infarction

(MI) in 1912 were characterized by a classic approach to therapy which included 4 to 8 weeks of enforced bed-rest in hospital. The initial challenge to this dictum of prolonged bedrest as an extended period of inactivity after acute MI was provided in 1952 when it was shown that patients could be seated in an armchair by the third day after MI without any apparent adverse effects. In recent years, there has been a dramatic reduction in the time course of hospital care for acute MI, with the period of restriction and disability being greatly compressed. Moreover, ageing of the population and the advent of more efficacious medical and surgical interventions against MI have resulted in change in the clinical spectrum of patients who are suitable for cardiac rehabilitation. A Major challenge for cardiac rehabilitation professionals in the 1990's will be able to cope with the consequences of "compressed morbidity" and the great diversity in the clinical spectrum of cardiac patients. To accomplish this, increased emphasis will need to be placed on the early stratification of patients into higher and lower risk groups, and the individualization of cardiac rehabilitation services. During this presentation, I will outline the key components of the risk stratification process and how it may be used to help individualize rehabilitative care for patients with different pathophysiologic severities of cardiac disease. I will also discuss the need for greater emphasis on comprehensive coronary risk reduction for all cardiac patients in the future.

VENTILATORY DYSFUNCTION AND RESPIRATORY REHABILITATION IN POST TRAUMATIC TETRAPLEGIA

by P Gounden

University of Durban-Westville Physiotherapy Department

INTRODUCTION: Pulmonary complications continue to pose a serious threat to the lifespan of patients with complete lesion of the cervical cord. The neuromuscular respiratory insufficiency in tetraplegics is secondary to the paralysis of the intercostal and abdominal muscles. The need for a comprehensive and continuous respiratory care programme is mandatory.

AIM: To test the effect of progressive resistive loading on accessory expiratory muscle strength in tetraplegics with lesions below the fifth cervical segment.

METHOD: A preliminary investigation involved electromyographic examination of accessory respiratory muscles in ten tetraplegics.

The main study involved 40 tetraplegics who were randomly divided into control (n=20) and experimental (n=20) groups. Pre-training measurement included maximum static expiratory mouth pressures (PE_{max}) and vital capacity. The experimental group underwent an eight weeks course of resistive breathing.

RESULTS: An eight week long course of progressive resistive loading on accessory expiratory muscles showed a significant improvement in mean vital capacity from 1.48L to 1.98L (p<0.001) and a dramatic improvement in mean expiratory muscle strength from 43.76 cmH₂O to 68 cmH₂O (p<0.0001).

Comparison of values in the control group obtained eight weeks apart showed no significant change.

CONCLUSION: The increased PE_{max} in the exercise group should enable them to generate higher intra-thoracic pressure swings during coughing.

Long term controlled studies should now be performed to determine the effects of this procedure on the clearance of bronchial secretions in such subjects.

EVALUATION OF A HELP/AID ORGANISATION USING PRE-DETERMINED OBJECTIVES

by I Marren

In this paper the need for help/aid organisations is acknowledged. A classification of the different types of societies/organisations is given. Using the long and short term aims set by a specific society the present activities of that society is evaluated. A SWOT analysis is used to point out the present and future situations.

In conclusion recommendations are made which are applicable to all help/aid organisations. ♣