137 - KINESIOLOGYCAL ANATOMY ANALYSIS AND BIOMECHANICS OF STRECHING EXERCISES

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1. **Introductions:** The posture is understood today as base of every functional understanding, orientating therapeutic procedures is in the dysfunctions muscle-skeletal, neuron-muscular or cardio-breathing-circulatory (SOUCHARD, 1990). During the activities of daily life, including the recreational or sporting physical activities, the individual uses inadequate postures, or with spare angles, in which the musculature becomes tense and or weak, causing a discord agonist-antagonist that by repetition of the activity or simply for permanence in this posture takes to unbalances articulate (SMITH et al, 1997; HAMILL & KNUTZEN, 1999). The stretching and the force are the main physical capacities to obtain a more balanced body and with better life quality (WEINECK, 1990). This way the kinesiologycal anatomy study and biomechanical supports the angles and specific postures that they use when executing a stretching.

2. **Materials and Methods:** This research was accomplished in three stages, in the Clinic of Physiotherapy of the Universidade Tuiuti of Paraná, in the city of Curitiba, Paraná. **First stage**: the physiotherapy sessions were observed, during 60 (sixty) days, in 200 individuals. Where 50 were sedentary women, 50 sedentary men, 50 feminine athletes and 50 masculine athletes; age, sex, profession and varied pathologies, and each individual accomplished treatment in different articulations, which are: shoulder, hip, column, knee and ankle. Still in this first stage, all of the stretching exercises were lifted up in a list. In the **second stage** these exercises were submitted to an kinesiologycal anatomy and biomechanical study with base in the literature. In a **third stage** the most important points of the previous stage were elaborated stretching exercises through with angles and correct postures.

3. Results

Orientations about the initial posture

After the kinesiologycal anatomy and biomechanical study, it was based on the stretching exercises being suggested angles and justified postures.

In Foot Posture - initial Posture (I.P.): parallel feet in the width of the shoulders, knees semi flexion maintaining a larger angle than 110°, pelvis retroversion, retro versioned shoulders maintaining the adduction of the scapulas, to point out whenever possible the rotation expresses of the shoulders in the longitudinal axis or in the front plan with 90° of abduction. EX(EXECUTION): for the cervical stretching exercises and superior members suggested the seating position to avoid the unnecessary pelvis scale. However to vary this posture it can be used with much care, always staying the abdomen and gluteus contracted and being avoided the lateral deviations and of inclination of the trunk, when stretching mainly the superior members (MMSS). For the in foot exercises, with the feet one ahead of the other and the inflected previous knee, you don't inflect it a lot, to follow the line of the foot maintaining a flexing of the knee of more or less 90° (HALL,1993;SMITH et al,1997; ANDREWS et al, 2000; ENOKA,2000).**Sat down Posture**- P.I.: Sitting down with the knees inflected more or less 90°, Indian position, however, more extended to avoid the patellar hyper pressure To sit down on the isquiatic' swelling maintaining the erect column, adduced scapulas and cervical rectification. **EX:** It is a quite stable posture to accomplish stretching exercises for superior members, cervical and thoracic column high. To avoid the deviations for the lateral and inclinations, however more stable than the in foot posture (HALL,1993; SMITH et al,1997; ANDREWS et al,2000; ENOKA,2000). **Posture of cats** - PI: Feet and knees moved away in the width of the hip, abdomen and contracted gluteus avoiding scale of the pelvis, erect column, aligned head with the chin inside, the against-lateral arm the leg to be worked should be inflected being supported in the elbow while the other arm on the same side the worked leg makes light semi flexion. **EX:** With feet and knees moved away in the width of the hip have larger stability in this position, abdomen and contracted gluteus maintains fastens the pelvis and it helps to avoid the curved back. The exercises for Cox femoral should follow the normal goniometrical; mainly they should not exceed the 45° in the extension, avoiding like this the lumbar hyperlordosis. For stretching exercises mainly of iliopsoas and quadriceps, to avoid to do excessive flexing or increase of knee pressure as in the adapted positions: to sit down on the heels or barriers exercise: the knee flexing reaches its maximum width with great part of the weight of the body about this articulation, the patella is pressed for against the femoral facet causing hyper pressure patellar, lawsuits and degeneration of the cartilage (HALL, 1993; SMITH et al,1997; ANDREWS et al, 2000; ENOKA,2000). **Posture back decubitus** - P.I.: Lying of backs, aligned head, chin inside, adduced scapulas, if possible shoulders in abduction with rotation express, pelvis retroversion, extended knees and ankle back flexion. **EX:** The rotation expresses of the shoulder in abduction of 90° for the stretching postures in back decubitus, it avoids the adduction and rotation interns of the shoulder that you/they take the lineaments and thoracic cifosis. The retroversion of the pelvis in isolated stretching or simultaneous of members avoids the lumbar hyperlordosis. The dorsiflexion of the feet aids in the stretching of the gastrocnemius that are with stronger and retracted incidence that the musculature previous tibial (SOUCHARD, 1990; HALL, 1993; SMITH,1997; ANDREWS et al, 2000; ENOKA,2000**). Posture ventral decubitus** - **P.I.:** Lying with the leaning abdomen on a cushion, also maintaining the abdominal contraction and gluten, the superior members abducted in 90°, turned externally with the elbows inflected in 90°. Head turned for one on the sides, relaxed legs. For position of relaxation the superior members should be relaxed Stretching the body, the shoulders in rotation intern and palms of the hands upward, elbows relaxed with light flexing. **EX:** Stretching in this position is difficult to accomplish. Taking care of the stretching of the abdomen in this position, because it increases the lumbar hyperlordosis. The iliopsoas stretching and quadriceps when pulled back by the superior members increase the lumbar hyperlordosis and the patellar high pressure (scale exercise) (HALL, 1993; SMITH et al,1997; ANDREWS et al, 2000; ENOKA,2000).

Angles and postures in the stretching:

Cervical: For the movements of cervical stretching the normal goniometric of this articulation should be respected, requiring inclination movements, flexing, combined rotation to the flexing and just as relaxation the cases of extension cervical. **Shoulder**: The stretching for superior members need to obey to the angle of larger lineaments and avoid them. The movements above 90° of abduction with extension back don't need to cross the arms, it is enough the hands to be leaned the exaggerating movement causes ligament laxity of the shoulder as in the swimming athletes' case. The abduction or maximum retropulsion is of

180° there is no need to force the shoulders to pass of this normal angle (KAPANDJI, 1980; SMITH et al, 1997). **Lumbar Column**: Very affected articulation during the EXof stretching exercises should always be protected being avoided the excessive and unnecessary scales, through the simultaneous contraction of the abdomen and gluteus and semi flexion of the knee to guarantee stability. The lumbar column and the pelvis need many stretching presenting in most of the cases weakness and retraction, unlike the abdomen that is usually flaccid and prolonged and their stretching exercises take the lumbar compression. The reeducation of this articulation **Knee**: One of the articulations more harmed by stress and traumas. We needed to take care a lot even in stretching exercises. The knee should never be taken to repetitive efforts with high through pelvic rebalance is fundamental (SON, 1986; SOUCHARD, 1990; SMITH et al, 1997). Pressure or forced in angles of patellar high pressure or to articulate. For the appropriate stretching of this articulation still more than another needed to attempt to the deviations valgus, I pierce, hyperextension or flex a lot. But in all of the quadriceps stretching cases that cross 110° of knee flexing with 45° of extension femoral thigh will go biomechanically to cause lumbar hyperlordosis and patellar high pressure due to maximum extension of the patellar tendon and of the patellar ligament pushing the patella against the femoral facet and still associate to the weight of the body and the compensations (GOLD, 1993; HALL, 1993; SMITH et al, 1997; HAMILL & KNUTZEN, 1999; ANDREWS, 2000; ENOKA, 2000). **Ankle**: In the ankle stretching we suggested that emphasis is given for the plant flexors and investors, because they are stronger and requested. The dynamic ankle stretching as well as proprioception exercises for this articulation are more effective for treating of muscles with long and thin wombs that if lesion for abrupt movements (GOLD, 1993; HALL, 1993; SMITH et al, 1997; HAMILL & KNUTZEN, 1999; ANDREWS, 2000; ENOKA, 2000). **Orientations about the EXof the stretching exercises:** The knees should be inflected when the individual is in the in foot position, because the patella slides caudally Stretching the line intercondylar. If the patellar movement is restricted, this interferes with the width of the flexing of the knee and it can contribute to an extending rest in the extension of the knee, being able to lesion the articulation of the knee (KISNER & COLBY, 1992). To accomplish the pelvic retroversion, and the stabilization of the pelvis and lumbar column for the abdominal muscles against the traction of the muscle iliopsoas are necessary during the flexing of the way hip to avoid increase in the lumbar lordose and previous attrition in the vertebrae (FILHO 1986; KISNER & COLBY, 1992; SMITH et al, 1997). The extraordinary force of the adductors is in relationship with its static function: these muscles collaborate with the abductors to maintain the balanced pelvis in the front plan. Any disturbance from muscular balance harms the erect position and the locomotion functions sensibly. (FILHO, 1986; WEINECK, 1990; KISNER & COLBY, 1992; SMITH et al, 1997;). Should not execute knee flexing above 110°, because the excessive flexing increases eight times more the corporal weight increasing the tension causing patellar compression (KISNER & COLBY, 1992; HALL, 1993; SMITH, 1997). The posterior tibialis muscles are highly susceptive to the traumatisms, for the fact of overrunning two articulations and they exercise functions frequently antagonistic, in elapsing of a same movement and most of the time in eccentric contraction (GOLD, 1993; HALL, 1993; SMITH et al, 1997; HAMILL & KNUTZEN, 1999; ANDREWS, 2000; ENOKA, 2000). The simultaneous occurrence of contraction and distention can take the muscular distortion and the other types of lesions, on everything if the heating exercises and preliminary stretching have been insufficient. (DANTAS, Other typical mechanism that can take in muscular lesions; it is the exaggerating distention of the posterior tibialis muscles, which settles during the forced flexing that before, being the knee in extension. (WEINECK, 1990). The tendons of the knee are destined to support great tension forces, but not force of compression or attrition. (SMITH et al., 1997; POCHOLLE et al, 1999). Not to do quadriceps stretching exercises making the lame-femoral extension supporting the pelvis in the heels, because it can happen cramp in the thigh's subsequent area and also patellar compression increasing the lordosis and also lumbar pressure (SMITH et al., 1997). According to literature, extension exercises complete of trunk with extension femoral cripple, the angle of the lumbar column is accentuated in this position (in foot) and the articulation is submitted to plenty previous shearing by the weight corporal superposition (KISNER & COLBY, 1992; SMITH et al., 1997). Stretching exercises take place, respecting the normal goniometry of the shoulder, because they should stay the normal width of the articulation so that they don't cause lesions (KISNER & COLBY, 1992). In the stretching exercises for the column should be avoided that the high thoracic column bends in surplus causing the cifosis. (HAMILL & KNUTZEN, 1999). In the exercises of lumbar column done in the soil the leg should be inflected for the stretching to be effective (HAMILL & KNUTZEN, 1999). The stretching when used in the warming-up before competition or after exercises of force avoids the formation of muscular nodes. If used associated with the muscular activity work will obtain a developed musculature and prolonged, capable of excellent performances and of superb aesthetic appearance (RODRIGUES, 1986; DANTAS, 1989; GUYTON, 1989; McARDLE et al, 1998). THE prolongation when executed incorrectly can happen in the cervical column divert postural, contracture, precocious wear and tear and cervical hyperlordosis; in the thoracic column the individual can come to have thoracic hypercifosis, pain and when it is retracted by the biomechanical unbalance still presents rotation interns and adduction of the shoulder needling lesions in the shoulder (KAPANDJI, 1980; HALL, 1993; ANDREWS, et al 2000); in the lumbar column determined muscles that present pelvic unbalances and postures deviations associated, as cifosis and scoliosis, they are associating lumbar hyperlordosis, muscular retractions for bad posture and weakness, for bad orientation in the activities of daily life, as well as the lumbago can be present in the individuals that develop their activities with bad posture. The tibialis posterior retracted tibiae's make patellar high pressure and it has a participation in the cause of the lumbar hyperlordosis, however the individual should not accomplish the stretching without a professional by his/her side, because if it doesn't have a postural orientation will execute the movements erroneously without the appropriate angle could also cause other pathologies (GOLD, 1993; HALL, 1993; SMITH et al, 1997; HAMILL & KNUTZEN, 1999; ANDREWS, 2000; ENOKA, 2000). **Orientations about the EXof the individualized stretching exercises:** The stretching exercises should be maintained by 10 to 20 seconds (RODRIGUES, 1986; DANTAS, 1989; McARDLE et al, 1998). All the exercises present not a final position, it is because just the exercise will be maintained in the same position. **CERVICAL COLUMN:** Exercise 1 - Stretching of the Muscle (Muscle's Stretching) Scalene - Initial Position (I.P.): sitting, aligned head, erect column, crossed relaxed legs. EXECUTION (EX): with a hand, to tilt the head on the same side that the hand, the arm contralateral in rotation interns adduced later to the trunk. Final position (F.P.): to repeat other side for 10". Observation: the arm on the other side that the head was tilted should be made an adduction with intern rotation trying simultaneously with the fingers to reach the inferior angle of the scapula against lateral with the objective of also stretching the musculature of the medium deltoid and trapeze to the scalene ones. Exercise 2 - (Muscle's Stretching) Superior Trapeze - **I.P:** sitting, aligned head, erect column, legs crossed relaxed. **EX:** with the two hands in the head, inflect the cervical column. **F.P.:** column cervical inflected with the chin leaned in the trunk by 10". Observation: To avoid that the high thoracic column bends in surplus causing hypercifosis. The hand should notice in the height of the occipital. Exercise 3 - (Muscle's Stretching) sternomastoid and Scalene - **I.P:** sitting, aligned head, erect column, legs crossed relaxed. **EX:** it accomplishes rotation with flexing of the neck for the same side, pulling with the hand on the side that is turning the head. Repeat with the other side. **SUPERIOR MEMBER:** Exercise 4 - (Muscle's Stretching) Triceps - **I.P:** sitting, erect column, legs crossed relaxed. **EX:** rotation expresses of a shoulder and abduction of 180th with elbow inflected. Push the elbow down with the other hand. Exercise 5 - (Muscle's Stretching) subsequent Deltoid, Romboideus - **I.P:** sitting, erect column, legs crossed relaxed. **EX:** the arm is put in horizontal adduction, it holds with the other arm the elbow and maintains it extended. Exercise 6 -

(Muscle's Stretching) Medium Deltoid, Superior and Scalene Trapeze. **- I.P:** sitting, erect column, legs crossed relaxed. **EX:** the arm is put in rotation interns behind the body, it holds with the other arm the elbows that is inflected and pull it inside. It tilts the head for the other side. Exercise 7 - (Muscle's Stretching) Breastplate Larger - **I.P:** sitting, erect column, legs crossed relaxed. **EX:** hands behind the head, therapist pulls the arms back. Exercise 8 - (Muscle's Stretching) Brachial Biceps (long and short head). - **I.P:** in foot, knees inflected, pelvic retroversion. **EX:** with the two perpendicular arms beside the body, therapist for back he/she catches the athlete's hands and it is going arising and adducing later even close of the 60th simultaneously. Exercise 9 - (Muscle's Stretching) Romboideus' Muscle - **I.P:** in foot, knees inflected, pelvic retroversion. **EX:** A hand crossed in the trunk, therapist for the front, adduces horizontally the arms inflected. TRUNK: Exercise 10 - (Muscle's Stretching) Paravertebral - **I.P:** number decubitus, legs inflected. **EX:** to execute flexing lame-femoral and of knee with the hands in the sewages popliteas, avoiding the patellar compression. The leg contralateral continues inflected. Repeat with the other leg. Observation: For individuals with great iliopsoas retraction (lumbar hyperlordosis) the leg against lateral should be inflected prioritizing the stretching of the lumbar. Exercise 11 - (Muscle's Stretching) Paravertebral - **I.P:** number decubitus, legs inflected. **EX:** to execute flexing lame-femoral and of knee with the hands in the sewages popliteas of both legs. Observation: The hands should be interlaced behind the sewage poplitea avoiding the patellar compression. When the objective only goes of the column lumbar inflect the inferior members, but when we want a stretching of the whole column we also inflect the cervical. Exercise 12 - (Muscle's Stretching) Unilateral Paravertebral of the Inflected Leg, Muscle Íliopsoas and Straight femoral unilateral of the extended leg (important retraction). - **I.P:** back decubitus. **EX:** to execute flexing lame-femoral and knee with the hands in the sewage poplitea, a leg is pulled with inflected knee and the other stays in extension. Observation: When we wanted associate to the paravertebrals the stretching of the iliopsoas of the leg against lateral, we maintain the extended leg, however the most effective stretching for iliopsoas is the number 23. Exercise 13 - (Muscle's Stretching) Previous and Breastplate Serratil - **I.P:** sitting, erect column, hands behind the EXhead: therapist pulls the arms upward and back. Observation: If we pull more for top breastplate inferior it is stretched, if down, breastplate superior. Exercise 14 - (Muscle's Stretching) Oblique of the Abdomen - **I.P:** sitting, column erect legs crossed relaxed. **EX:** it tilts the trunk for the lateral with an arm passing over the head and the other underneath in contrary side. Other prolonged muscles are larger and Big Serratil previous, Breastplate Number. Exercise 15 - (Muscle's Stretching) Big Number - **I.P:** in foot, knees in flexion, legs a little moved away. **EX:** inflect the trunk, to put the hands moved away in relation to the shoulder in the bar, aligned head. INFERIOR MEMBERS: Exercise 16 - (Muscle's Stretching) tibialis posterior - **I.P:** number decubitus, inflected legs. **EX:** with the aid of a rope or elastic band to extend one of the legs with flexing lame-femoral and dorsiflexion of the foot. Repeat with the other leg. Exercise 17 - (Muscle's Stretching) tibialis posterior - **I.P:** sitting, erect column, hands behind the head, foot in dorsiflexion. With a stretched leg and the another inflected, heel inside in the line to articulate of the knee, dorsiflexion of the ankle, to maintain the cervical fit in, hands behind the head the adduction of the EXscapulas:, to go down the erect trunk. Observation: to maintain the heel of the leg against lateral in the line to articulate of the knee avoiding the flexing of the excessive knee that it takes the patellar high pressure. If the student doesn't get to go down with the erect column, suggest the support of the hands behind in the close ground of the hip, to elevate the shoulders and to force the flexing of the trunk without bending the column. Always maintain the dorsiflexion of the ankle and very extended knees. Exercise 18 - (Muscle's Stretching) tibialis posterior - **I.P:** sitting, erect column, hands behind the head, feet in dorsiflexion. **EX:** stretched legs, a foot is put on the other, with the aligned head, to go down the erect trunk. **F.P:** with the trunk inflected, it maintains for 10". Observation: Always maintain the dorsiflexion of the ankle and very extended knees. Go forcing the extension of the knee, the dorsiflexion and the flexing of the trunk gradually. Exercise 19 - (Muscle's Stretching) tibialis posterior - **I.P:** sitting with the extended legs, arms supported behind with extended elbows. **EX:** inflect the erect trunk until the limit of the athlete's prolongation. Observation: Initial exercise in position sat down with 90° of trunk flexing with the leaning hands behind the hip, however the pedagogic sequence and of tension to the prolongation can be preceded. Stretch lumbar exercise number 10,11,12, soon afterwards tibialis posterior number 17-19-18, and passing of erect column with the hands behind the hip even maximum flexing of the trunk. At first altering a leg and other later stretch the two legs, because the two, simultaneously, it increases the pressure in the intervertebral disc (take care patient with lombalgia, artrosys, disk hernia). Exercise 20 - (Muscle's Stretching) Ísquios Tibiais - **I.P:** in foot, knee inflected, pelvic retroversion, hands behind the head. **EX:** to put a foot in the bar with the extended knee, knee contralateral inflected, aligned head, and erect trunk. F.P:with the trunk inflected it maintains for 10". Observation: To always maintain the knee against lateral in semi flexion avoiding force the lumbar, but this exercise should be avoided in individuals that present knee lesion due to the patellar high pressure Exercise 21 - (Muscle's Stretching) Triceps Surae - **I.P:** in foot, a knee inflected and the another extended. **EX:** to lean the head in the wall, fleeting a little the trunk, a leg fleeted the front and the other extended behind with the leaning heels in the ground. F.P: with the leaning heels in the ground maintains for 10". Observation: the hip in retroversion is taken ahead for larger effectiveness of the prolongation. Exercise 22 - (Muscle's Stretching) Triceps Surae. - **I.P:** in foot, a knee fleeted and the another extended. **EX:** to maintain holding in the bar, leaning feet in a board in slope, trunk a little fleeted. Exercise 23 - (Muscle's Stretching) Quadriceps and Ilíopsoas - **I.P:** right lateral decubitus, right arm inflected below of the head maintaining the cervical aligned, left arm inflected ahead of the trunk maintaining the balance of the body, leg of inflected right and the left relaxed to be stretched. The seating therapist behind who will be stretched, with his/her hip supports the individual's hip that will be stretching for not letting there to be hyperlordosis. The therapist's right foot supports the individual's right leg. The therapist's right hand supports and it extends the lame-femoral the individual's left and the left hand supports the ankle of the same leg and fleet the knee. **EX:** The therapist's right hand extends the firstly lame-femoral the individual's left and the left hand supports the ankle of the same leg and fleet secondarily the knee. Observation: This prolongation is the most stable for the prolongation of the quadriceps that causes less compensations for the column and knee. Exercise 24 - (Muscle's Stretching) Quadriceps and Iliopsoas **I.P:** in foot, pelvic retroversion, knee fleeted. EXholding with one of the hands in the bar, the knee fleeted is pulled upward. Observation: Not to lean the heels in the gluteus, because it increases the patellar pressure . Exercise 25 - (Muscle's Stretching) Quadriceps - **I.P:** in foot of backs for the bar, one of the feet supported in the bar, knee supported fleeted, retroversion pelvic, free arms. **EX:** inflect the knees. Exercise 26 - (Muscle's Stretching) Quadriceps - **I.P:** a kneeling leg and the other with the foot ahead of the trunk. **EX:** the leg ahead inflected to 90°, the other supported in a bracket inflected the knee. Observation: The front knee should not cross the line of the foot of the same leg, for not increasing the tension of the patella, like this no inflected above 135th the other knee. Exercise 27 - (Muscle's Stretching) Adductors - **I.P:** seating, legs abducted, hands behind the head, erect column. **EX:** with the head aligned inflected the trunk. Exercise 28 - (Muscle's Stretching) Gluteus Maximum - **I.P:** number decubitus, with the legs inflected the heel of the right leg on the left knee. **EX:** With the two hands inflected the lame-femoral of the left leg. Observation: To maintain the leaning shoulders in the ground. Exercise 29 - (Muscle's Stretching) Tensor of fascia Barks - **I.P:** number decubitus, with the legs inflected the heel of the right leg on the left knee, shoulder abducted 90th and same rotation expresses. **EX:** Abduct the right leg and to adduce the left at the same time with the fixed trunk. Observation: To maintain the leaning shoulders in the ground.

4. Discussion: "The stretching has as objective mobilizes the articulation considered in all its width to allow the use of every arch to articulate and to stretch the musculature the one that is dropsied for water and contraction catabolites or stiffened by the rest, sleep or it lowers temperature". The stretching will act in the muscular elasticity, giving like this for the individual a better condition in their activities, to move around and if it mobilizes, propitiating the maintenance of the flexibility and better life quality (RODRIGUES, 1986; DANTAS, 1991; GUYTON, 1989; McARDLE, 1998). The biomechanics of some exercises accomplished erroneously causes retractions and unbalances in some muscular groups, they increase the tension and muscular contractures, they elevate the high pressure and lineaments articulate causing consecutive lawsuits, degeneration and/or precocious artrosys (HALL, 1993; SMITH, 1997; McARDLE, 1998). The notion of the muscular balance is old and very known by the biomechanics. The established muscular balance around an articulation guarantees the good operation of that articulation (HALL, 1993; SMITH, 1997; POCHOLLE et al, 1999). It is not enough to accomplish stretching exercises, it is necessary do them with correct biomechanics with prevalence in the posture.

5. Conclusion: The prolongation exercises for this research studies had an anatomical deepen, kinesiological and biomechanical. Resulting in exercises more elaborated, with correct postures in his/her execution, defined angles as the biomechanics to articulate and still with preventive prevalence that you/they will also be able to be used as scientific complement support for the professionals of health.

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KINESIOLOGYCAL ANATOMY ANALYSIS AND BIOMECHANICS OF STRECHING EXERCISES

Abstract

It is related to a field research and bibliographical revision with deepened study of anatomy, kinesiology and biomechanics. It has as an objective to suggest postures and specific angles during the accomplishment of stretching exercises, which are accomplished as part of classes of physical activities and/or supporting in the treatment of several pathologies related to the great articulations of the human body. Initially in a **first stage** two hundred patients of the Clinic of Physiotherapy of the University Tuiuti of Paraná were observed, in the orthopedics areas, traumatology and sport accomplishing preventive exercises or in treatment. Among the two hundred patients: fifty were feminine sedentary, fifty masculine sedentary, fifty feminine athletes and fifty masculine athletes. They were lifted up all of the stretching exercises that were accomplished inside of a period of sixty days. In a **second stage** these stretching exercises were studied thoroughly with base in kinesiologycal anatomy and biomechanics. In the **third stage**, stretching exercises were elaborated with some angles and correct postures, where there was the concern with the prevention of articulate compressions, decrease of tendon and muscular tensions and also with the posture deviations caring with the posture during the EXof the stretching exercises. The skin, muscles, face, ligaments, cartilage and bone answer to great applications of pressure and tension starting from the normal growth and functional hypertrophy or through the physical activity well guided (SMITH et al, 1997). The muscular participation in the stability of an articulation is essential. The antagonist relationship defines the muscular balance gotten by force exercises and of stretching (POCHOLLE & CODINE, 1999). This way, it is justified a study of kinesiologycal anatomy and biomechanics of the stretching exercises presented in this work.

Keywords: stretching, exercise, biomechanics.

ANALYSE ANATOMOCINESIOLOGIQUE ET BIOMÉCANIQUE D'EXERCICES D'ALLONGEMENT

Résumé

Il s'agit d'une sondage et de révision bibliographique avec étude approfondie d'anatomie, cinesiologie et biomécanique. Il a objectif suggérer des positions et angles spécifiques pendant la réalisation d'exercices d'allongement qui sont réalisés comme partie de leçons d'activités physiques et/ou coadjuvants dans le traitement de plusieurs pathologies rapportées aux grands joints du corps humain. Initialement dans une première étape ont été observé deux cents patients de la Clinique de Physiothérapie de l'Université Tuiuti du Paraná, dans les secteurs d'orthopédie, traumatologie et sportive en réalisant des exercices préventifs ou dans traitement. Entre les deux cents patients: cinquante était sédentaires féminins, cinquante sédentaires masculins, cinquante athlètes féminins et cinquante athlètes masculins. Ils ont été soulevés tous les exercices d'allongement qui étaient réalisées à l'intérieur d'une période de soixantes jours. Dans une seconde étape ces exercices d'allongement ont été étudiés minutieusement avec base *anatomocinesiologique* et biomécanique. Dans la troisième étape, ont été élaborés des exercices d'allongement avec angles et des positions correctes, où il y avait la préoccupation avec la prévention

de compressions articulaires, diminution de tensions tendineuses et musculaires et encore de détours de postures avec des soins dans la position pendant l'exécution des exercices d'allongement. La peau, les muscles, la fascie,(couverture fibrose) les ligaments, la cartilage et les os répondent à des applications excellents de pression et de la tension à partir de la croissance normale et de la hypertrophie fonctionnelle ou à travers l'activité physique bien guidée (SMITH et al, 1997). La participation musculaire dans la stabilité d'un joint est essentielle. La relation agoniste/antagoniste définit l'équilibre musculaire réussi par des exercices de force et d'allongement (POCHOLLE et CODINE, 1999). En étant ainsi, s'il justifie une étude anatomocinesiologique et biomécanique des exercices d'allongement présentés par ce travail.

Mots Clés: Allongement, Exercices, Biomécanique.

ANÁLISIS ANATOMOCINESIOLÓGICA Y BIOMECÁNICA DE EJERCICIOS DE ESTIRAMIENTO

Resumen

Se trata de una investigación de campo y revisión bibliográfica con estudio profundo de anatomía, cinesiología y biomecánica. Tiene como objetivo sugerir posturas y angulosidades específicas durante la realización de ejercicios de estiramiento, los cuales son realizados como parte de clases de actividades físicas y/o coadyuvantes al tratamiento de varias patologías relacionadas a las grandes articulaciones del cuerpo humano. Inicialmente en una **primera etapa** fueron observados doscientos pacientes de la Clínica de Fisioterapia de la Universidad Tuiuti de Paraná, en las áreas de ortopedia, traumatología y deportiva realizando ejercicios preventivos o en tratamiento. Entre los doscientos pacientes: cincuenta eran sedentarias femeninas, cincuenta sedentarios masculinos, cincuenta atletas femeninas y cincuenta atletas masculinos. Fueron levantados todos los ejercicios de estiramiento que eran realizados dentro de un período de sesenta días. En una **segunda etapa** estos ejercicios de estiramiento fueron estudiados minuciosamente con base anatomocinesiológica y biomecánica. En la **tercera etapa,** fueron elaborados ejercicios de estiramiento con angulosidades y posturas correctas, donde había la preocupación con la prevención de compresiones articulares, disminución de tensiones tendinosas y musculares y también de desvíos posturales con cuidados en la postura durante la ejecución de los ejercicios de estiramiento. La piel, músculos, fascia, ligamentos, cartílagos y huesos responden a aplicaciones óptimas de presión y tensión a partir del crecimiento normal e hipertrofia funcional o a través de la actividad física bien orientada (SMITH et al, 1997). La participación muscular en la estabilidad de una articulación es esencial. La relación agonista/antagonista define el equilibrio muscular conseguido por ejercicios de fuerza y de estiramiento (POCHOLLE & CODINE, 1999). Siendo así, se justifica un estudio anatomocinesiológico y biomecánico de los ejercicios de estiramiento presentados por este trabajo.

Palabras clave: estiramiento, ejercicio y biomecánica.

ANÁLISE ANATOMOCINESIOLÓGICA E BIOMECÂNICA DE EXERCÍCIOS DE ALONGAMENTO

Resumo

Trata-se de uma pesquisa de campo e revisão bibliográfica com estudo aprofundado de anatomia, cinesiologia e biomecânica. Tem por objetivo sugerir posturas e angulações específicas durante a realização de exercícios de alongamento, os quais são realizados como parte de aulas de atividades físicas e/ou coadjuvantes no tratamento de várias patologias relacionadas às grandes articulações do corpo humano. Inicialmente em uma **primeira etapa** foram observados duzentos pacientes da Clínica de Fisioterapia da Universidade Tuiuti do Paraná, nas áreas de ortopedia, traumatologia e desportiva realizando exercícios preventivos ou em tratamento. Entre os duzentos pacientes: cinqüenta eram sedentárias femininas, cinqüenta sedentários masculinos, cinqüenta atletas femininas e cinqüenta atletas masculinos. Foram levantados todos os exercícios de alongamentos que eram realizados dentro de um período de sessenta dias. Em uma **segunda etapa** estes exercícios de alongamentos foram estudados minuciosamente com base anatomocinesiológica e biomecânica. Na **terceira etapa,** foram elaborados exercícios de alongamento com angulações e posturas corretas, onde havia a preocupação com a prevenção de compressões articulares, diminuição de tensões tendinosas e musculares e ainda de desvios posturais com cuidados na postura durante a execução dos exercícios de alongamento. A pele, músculos, fáscia, ligamentos, cartilagem e osso respondem a aplicações ótimas de pressão e tensão a partir do crescimento normal e hipertrofia funcional ou através da atividade física bem orientada (SMITH et al, 1997). A participação muscular na estabilidade de uma articulação é essencial. A relação agonista/antagonista define o equilíbrio muscular conseguido por exercícios de força e de alongamento (POCHOLLE & CODINE, 1999). Sendo assim, se justifica um estudo anatomocinesiológico e biomecânico dos exercícios de alongamento apresentados por este trabalho.

Palavras-chave: alongamento, exercício, biomecânica.