NL Diplomarbeiten
als bestellen
▷ Forschung.
▷ Tanzmedizin

ev SD design
coop HMTZ

Shonach Mirk
Etzelstr. 60
8810 Horgen

Dr. Christian Larsen
Spiraldynamik Medical Center
Restelbergstrasse 27
8044 Zürich

Horgen, 16.04.07

Dear Christian,

At the risk of seeming pretentious and at the suggestion of Barbara Rust, I am sending you a copy of the Diplomarbeit that I wrote for the Nachdiplomstudium in Dance Education at the Hochschule für Musik und Theater, Zürich, that I recently finished. I was overjoyed to receive a 6 on the work, with the mention that it was of high interest and merited an even higher mark than that which was given!!! The director of the graduate course and head of the department of dance at the HMTZ, Oliver Matz, was very interested in the work and told me that he had learned quite a bit while reading it.

If you have any time to send me a little feed-back over your thoughts, I would be very happy. I know what a busy schedule you have, and am not expecting you to be able to do it right away.

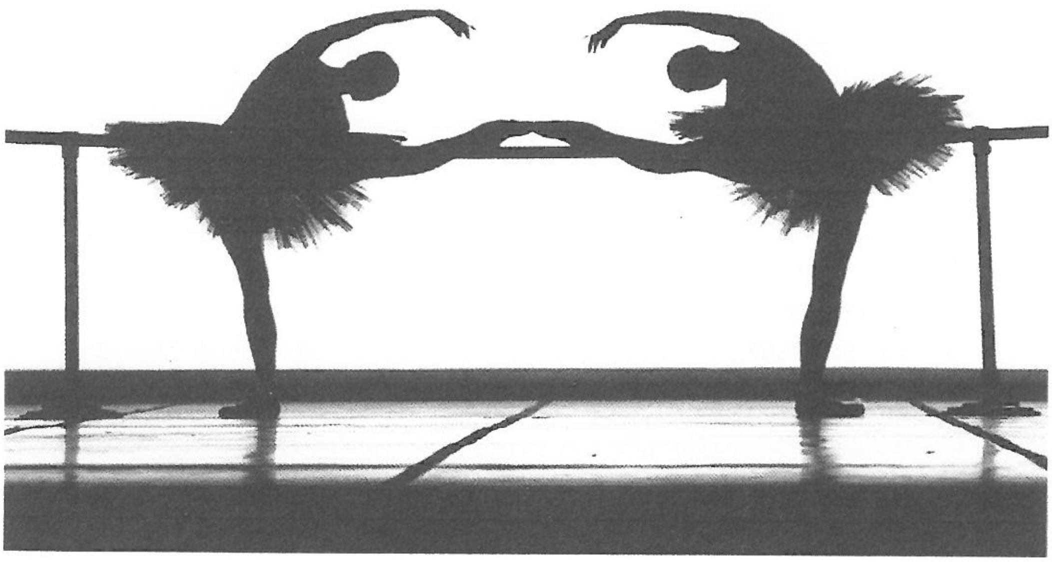
I hope that you find some time to be enjoying the beautiful spring that we are having.
With my best wishes and thanks for all that you have done in my life (whether you are aware of it or not, the encounter with Spiraldynamik has been a turning point in my life)!

Wishing you all the best,

Shonach

Intelligent turn-out

The integration of Spiraldynamik® principles in the teaching of the classical ballet *en déhors*



Diplomarbeit
Shonach Mirk Robles
Horgen, December 2006

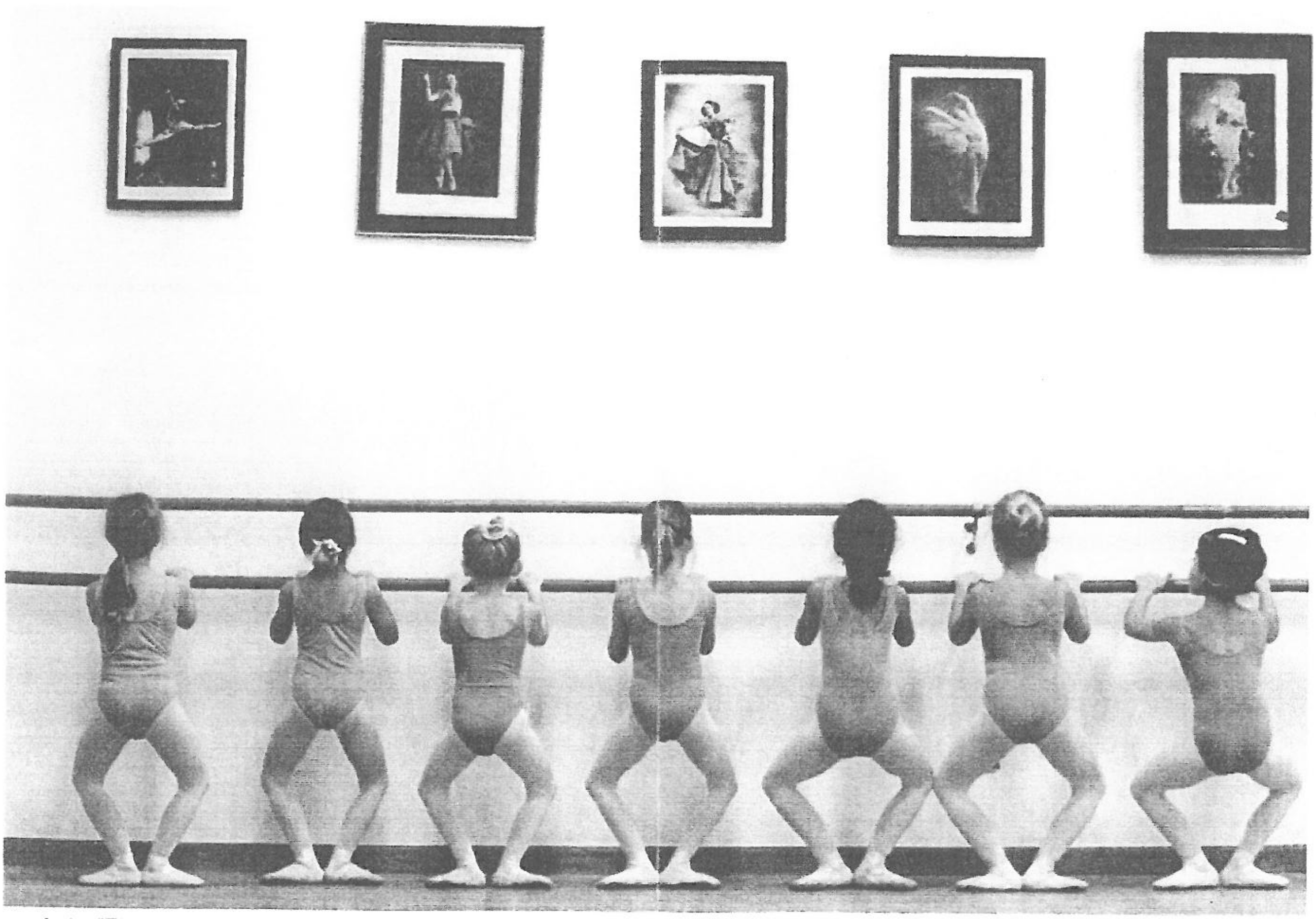
Nachdiplomstudium Tanzpädagogik 2004-2006
Hochschule für Musik und Theater Zürich
Departement Tanz

Intelligent turn-out

The integration of Spiraldynamik® principles in the teaching of the classical ballet *en déhors*

I am aware that the length of my work far exceeds the required amount. The subject matter that I have chosen to research is vast. The topic is extremely important to me and to treat it superficially, which is what I would have had to do in order to meet the recommended length, is of no interest to me. I explained this to Ursula Pellaton, and she has expressed enthusiasm in my ideas and has encouraged me to research it as thoroughly as I can. I would like to thank her for her moral support and interest throughout the writing process. Big thanks to Barbara Eichenberger, my Spiraldynamik teacher, for her invaluable information! I would also like to thank my two "models", Jennifer and Alina, for giving me their time and patience with my lack of "digital photo" knowledge, and my husband and children who have had so much patience and understanding during my research and writing.

And lastly, I would like to thank my two wonderful parents who have taken the time to read through every page and correct my written English. Without their support and trust, I would never have had the wonderful learning experiences and career that I was fortunate enough to have. I have inherited their curiosity and desire to learn, and I thank them for that. It is the greatest gift that one can ever offer...



Cover photo: "Etudes" by Harald Lander, l'Opéra de Paris, photo by Jackques Moattti
Above photo unknown

Table of Contents

Introduction

Every living thing on earth, and every natural phenomenon that occurs, are directly affected by gravity. As dancers, we are constantly aware of this as we struggle to turn out, lift our legs, jump higher, etc. Often, the wears and tears of dance technique weaken the articulations in our bodies and lead to injuries. Spiraldynamik is a concept built around the principles governed by the laws of nature to better protect the body's joints, promote better coordination and economize energy. After having studied in depth the Russian ballet technique (the Vaganova method) and being in the middle of a formation in Spiraldynamik, I am convinced that the integration of Spiraldynamik into the teaching method of the "*en déhors*" in classical ballet, the outer rotation of the leg in the hip joint ("turn-out"), would not only build stronger, more coordinated dancers, but would also prevent many of the injuries that occur to dancers during and after their careers.

I was trained as a child in top-notch ballet schools in America and England. In George Balanchine's "School of American Ballet", my teachers were ancient Russian women who shouted at us with thick, barely intelligible accents as they limped around the ballet studios with their canes. These walking aids were also used to poke at hanging stomachs, whack bent knees, push forward heels and smack any legs that were being held too low. We were in absolute terror of these women, but also in awe of the many years of tradition that they were passing on to us. They were "doing their jobs" teaching us the base of the technique that Balanchine had developed into a fine art. His choreography demanded more speed and more height. The lines that he insisted upon asked for more "*en déhors*" and the technique taught in his school, although stemming from the Vaganova method, had evolved to meet his needs as a choreographer. Later on, I moved to London, where I was trained at the Royal Ballet School. The teachers there were of a more reserved lot than their colleagues in my previous school in New York. They were not in need of walking sticks, much to my relief. It made me wonder at the difference in the technique being taught to me in England compared with the Russian technique I had learned across the ocean. As a teenager, I found the English technique restrictive and lacking in excitement, controlled to the point of boredom. Looking back at it now, I realize that because the technique was not as pushed in the extremes as the Russian/American school was, the dancers had longer careers and could dance more often injury-free than the American dancers could. In both schools, we were constantly told to "turn-out". "Heels forward!" we were ordered. There was never any anatomical explanation of exactly how we were supposed to turn out, just "Do it"! With all the different teachers I had as a student, I was repeatedly told to "turn out". Over and over I would hear this, but I was never told *how* to achieve this turning out.

While preparing the final work for the psychology class of this post-graduate pedagogic course, I chose to research the subject of stress. I realised that as dancers, we subject ourselves to many different kinds of stress; psychological and physical as well as emotional. I am convinced that as teachers, it is our responsibility to be aware of this stress and to address this in our teaching. By studying the work of different psychologists, I learned that the more tools we have for dealing with stress, the less it affects us in a negative way because we learn the coping mechanisms to balance it out. It made me start to think a lot about how little the traditional methods of teaching ballet actually give us the tools for understanding this complicated dance technique and protecting our bodies from injury.

Ballet technique is constantly evolving. The profession itself is one of high stress, both physical and psychological. Long hours of work constantly pushing the body to its maximum potential, the demands of high discipline, and the expectations during performances all tend to make this profession one of very high stress. Today's choreographer's styles vary from pure classical ballet to ultra modern. A dancer in a professional company is expected to be able to adapt to all these different styles.

In most companies, a daily morning ballet class warms up the body to prepare it for the day's subsequent needs of rehearsals and/or performances. The dancers of some companies are not protected by a union limiting the number of hours each may work in the day, as many choreographers feel restricted in their creative impulse by such time limitations. This means that in many companies, a normal day could mean a class of an hour and a half, followed by a two or three hour rehearsal or more, and a two hour performance in the evening, a total of six hours or more straining the body to its maximum every day! If the body has not been properly trained, the continual daily strain often results in an eventual accident or a long term injury.

In this dissertation, I will to examine the "*en déhors*". What is it exactly? How did it become such a determining factor in ballet technique? What is the difference in the teaching methods of *en déhors* (turn-out) between the Russian and the English schools? How does a leg turn out? What are the injuries that occur because of a poorly learned turn-out? What are the basic Spiraldynamik° principles, and how can they be integrated into the methodical teaching of "en déhors"?

Turn-out: What is it?

To understand what turn-out is, we must understand where it came from and how it became an integrated base of ballet technique.

Historically, the Italian Catherine de Médicis, the granddaughter of Lorenzo the Magnificent and the wife of Henry II, King of France, is credited for having organized the first *ballet de cour.* Being of a short nature, she is also thought to be the first woman arriving at a party wearing high heels. The *ballet de cour* was rapidly adopted as entertainment by and for the nobles of the courts to watch and/or perform in, and high heels became a standard in the mode in the dress of the court nobles.

The ballet technique and vocabulary as we now know it started during the time of Louis XIV, who reigned from 1643 to 1715. Dance had a special importance in the life of the monarch, a lover of the arts. One of the highest paid teachers in the king's entourage was the dancing master Pierre Beauchamps, who descended from a family of violinists and dancing masters. Beauchamps was a choreographer as well as a teacher, although none of his ballets succeeded him after his death. One can get an idea of the existing dance technique of the day from the prints and writings that do still exist.

Beauchamps was the first person to record the five basic feet positions in ballet. Although some historians argue that the rotated foot position came from the vanity of the court dancers, including the king himself, to show off the modish buttons and ribbons on the interior of their shoes that was the style of the day, most probably the turned out position originated from a different source. In Jack Anderson's book, "Ballet and Modern Dance: a concise history", he says: "In Louis XIV's day, when dancers wore heeled shoes and bulky costumes, the amount of turnout was less. Turnout was first introduced into ballet technique as a theatrical adaptation of the fashionable fencer's stance. Dancing masters discovered that turnout helps the dancer to increase flexibility and balance while permitting the body to open outward toward the audience. Therefore, because of the way it facilitated clarity and visibility of movement, turnout became one of ballet's cardinal principles..."1.

Although Louis XIV stopped dancing in 1670, he made sure before leaving the stage that the ballet technique would continue by founding the *Académie Royal de la Danse*, which was later to become the *Académie Royal de la Musique* which we now know as the *Paris Opéra*. With the opening of the *Paris Opéra*, the development of professional dancers was started. The stage was no longer reserved for the nobles of society, and the doors were opened not only for the commoner to learn the profession, but also for women to take to the stage in a field that had largely been dominated by men, even in the female roles.

Nearly a half century later, a dancer named Marie-Anne de Cupis de Camargo, student of the teacher, dancer and choreographer Françoise Prévost, became famous dancing one of her teachers' ballets, *Les Characteres de la Danse.* Prévost, fearing a rivalry from her technically brilliant student, relegated her to the back rows of the *corps de ballet.* One day, when one of the leading men fell ill, Camargo danced his role and dazzled the public by performing the man's jumps and leaps, unheard of in that day for women dancers. To be able to perform these, she not only cut off the heels of her dancing shoes, but also shortened the skirts of the bulky dresses that she wore as a costume. A colleague of hers, Marie Sallé, who was admired by the public less for her technical skills than for her dramatic dancing and who had an unusual success on the stage in London, choreographed in the year 1734 the ballet *Pygmalion*, based on a Greek fable. In the ballet, a sculptor's statue comes to life and dances. To portray the role more exactly, Sallé took off the powdered wig and the hooped undergarment that were the norm of the epoch. She let her natural hair down, and draped a muslin robe around her body. The reforms in the costumes by both dancers, added to the technical development and evolution of ballet at the time.

Ballet continued to develop in France and around Europe during the next century. Schools were formed in different countries, and the various styles, reflecting the society of the time evolved in each school.

August Bournonville (1805-1879), the Danish dancer, teacher and choreographer, created the ballet *La Sylphide* (1836) among other ballets that are still performed today, and developed a distinct style that is know as the Danish School, or the Bournonville school.

The Italian dancer and ballet master Enrico Ceccheti (1850-1928), who taught and danced in St. Petersburg and London, developed a syllabus of training that is widely associated with the Italian school.

The dancer and teacher Agrippina Vaganova (Russia, 1879-1951) developed a teaching method that is used around the world today. The same method is used to train dancers all over the former Soviet Union, although just as there was a rivalry in style during the 19th and 20th centuries between the two main Russian dance capitals, Moscow and Leningrad (St. Petersburg), the same rivalry also exists between the capitals' schools. Moscow's ballet style is more flamboyant and external; Leningrad's more interior and subtle.

In England, the Irish-born Edris Stannus, better known as Ninette de Valois (b.1898), returned to London in 1925 after having danced with Diaghilev's Ballets Russes for several years. She formed the Vics-Wells Ballet, which was later to become The Royal Ballet, and started the English school to prepare dancers for the company. This method has become a set syllabus (R.A.D.) and is studied in many schools around the world.

George Balanchine (1904-1983), the Russian dancer and choreographer, emigrated to America in 1933 and created The School of American Ballet, which exists to this day. As Balanchine's choreography evolved from classical to neo-classical, so did the technique of his dancers evolve to meet his ever demanding needs.

In all of these existing schools, the vocabulary and the steps are the same, all stemming from the original French school started by Beauchamps back in the time of Louis XIV. What differentiates one school from another are the choreographic demands of the companies affiliated with these schools. Therefore, the Danish school developed more the *petit allegro* jumps that were found in the ballets by the founder of the style, August Bournonville. The Italians, under Ceccheti, were also known for their small jumps, and the Russians more for their big jumps and *pirouettes*. The English, with the choreography of Frederic Ashton among others, were more sedate and developed a more lyrical style, with more concentration on the expression of the upper body. The American school, influenced by Balanchine, developed a more linear style with higher legs and more speed to meet the musical needs of the choreographer.

The *en dehors*, or turn-out, is the base of all ballet, although it is more or less exaggerated according to the school and its needs. The English school, for example, respects the physical limits of the dancer and does not over-force the rotation of the feet to the hips. The Russian and American schools, on the contrary, insist upon a 180° turn-out of the feet. The American school believes in building this rotation gradually, the Russian school requires this from the first day of a child's ballet classes.

One must remember that the Russian method, developed by Agrippina Vaganova, came into existence during the Communistic era. At that time, the government decided for many children what they were to become in the future according to their physical and intellectual strengths, in order to better serve the nation. Experts would examine thousands of children and only the very few with the perfect "ballet bodies" were chosen to pursue a career in ballet. Not only did the children need to have extreme rotation in the hip joint, but their genetic make-up must also have shown a tendency for long limbs combined with muscular strength. Now that the political situation in the former Soviet Union and other satellite countries has become "democratized", most of the schools have become private and children are allowed to choose for themselves what they would like to be in the future. The schools, in order to exist financially, are forced to accept more students with less physical capabilities than before.

After the industrial revolution in the end of the 1800's, modern dance started to develop in America and in Europe. As it evolved, more and more choreographers became influenced by the freedom and expression allowed in the modern dance techniques. The use of the weight of the body and its relationship to the floor, the natural stance of the human body, the three dimensional mobility of the torso instead of the linear, vertical use of the back-bone are just some of the principles differentiating modern dance from ballet.

Many classically trained dancers, breaking away from the confinements of ballet technique, became modern dance choreographers. In today's ballet companies, the repertory spans the period from the purely classical ballets of the 1800's to the actual contemporary choreographers of our day, and dancers are expected to adapt to all the different styles and techniques demanded of them.

Throughout all this evolution of dance, what is surprising is that the teaching methods of classical ballet, passed on from generation to generation, have done very little evolution themselves. One can walk into a ballet class in almost any of the above mentioned schools and watch a class that, if one closes their eyes and just listens to the teacher and the musical accompaniment, could have been taught fifty years ago, if not earlier. The teaching methods that were designed to form ballet dancers, some of them over a hundred years ago, are in need of evolving to meet today's demands.

Anatomical turn-out

Turn-out, or *en déhors,* in ballet is what one calls the rotation of the leg in the hip joint, which permits the feet to be faced in a side-ways position as opposed to looking forward. The amount of turn-out one has in the hip joint is determined by the genetic structure of the person. The way that the bones of the hip joint are shaped makes an absolute limitation in the range of turn-out that cannot be changed by exercises or stretching. The most determining factors are the depth of the acetabulum, or hip socket, and the angle at which the head and neck of the femur are set onto the shaft of the thigh bone, the femur. Also a major factor in the amount of turn-out one has, are the ligaments surrounding the hip joint. Ligaments are very hard to stretch after the age of puberty, and tightness in these tissues will limit turn-out. Muscles also play a role in the physical range of turn-out in the hip, but as these are easier to stretch than ligaments, they are not as much a limiting factor.

The hip joint is where the torso meets the lower limbs of the body. It is not only of determining importance in the rotation of the leg, but also in the upper body posture. In the evolution of mankind, the hip joint became the turning point of the body that permitted man to come out of the horizontal position on all fours to walking erect on the legs. It carries the weight of the upper body onto the legs and receives the reverberations of every step and movement made by the lower limbs. Almost all the muscles that are needed to move the leg originate either in the pelvis or the lumbar vertebrae of the spine. Some of these same muscles are also responsible for the position of the pelvis. A pelvis that is not placed correctly does not permit the rotation of the femur in the hip joint. That is why one cannot speak of the *en déhors* of the leg without also talking about the placement of the upper body. The two belong together. We will examine this later in further detail.

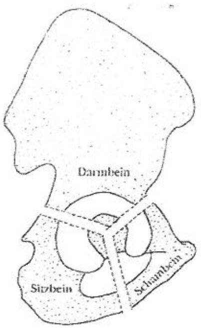
When we speak of the *en déhors* of the leg, we imply the whole leg. The coordination unit "leg" entails the entire leg, from the hip joint down to and including the foot, as the correct body placement on the foot is imperative to a correct turn-out. This, also, will be examined in detail later.

The anatomical structure of the hip joint and leg

The Hip

First, let us look at the hip joint itself. The hip joint is made up of the hip bone, or coxal bone, and the head of the femur, the thigh bone. It is a ball and socket joint, permitting movement around multiple axes. In it we find: flexion-extension, abduction-adduction, and inner and outer rotation. In the hip joint, we have the possibility of moving the pelvis around the fixed femur, moving the femur in the fixed hip bone, or moving both the femur and the coxal bone at the same time.

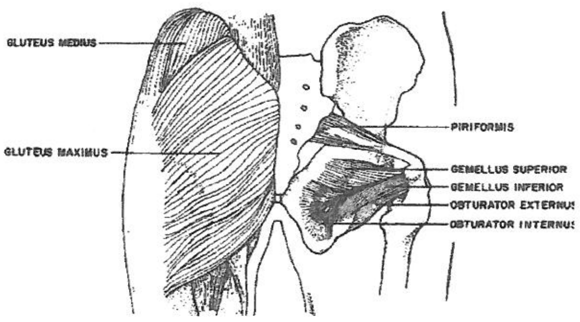
The coxal bone is a part of the pelvic girdle, which is composed of the two coxal bones, and the sacrum and coccyx. This hip bone, the coxal, is itself made up of three bones that grow together during foetal life, the ilium, the pubis and the ischium. These bones fuse together in the form of a Y, where the meeting point of the three bones finds itself exactly in the middle of the socket, or acetabulum, formed by this fusion. The acetabulum is deeply concave (in comparison, for example, with the shoulder, another ball and socket joint in the body), permitting extreme mobility coupled together with stability. The coxal bone is spiral shaped, being wide and open at the top and smaller and narrower at the bottom.



We see here the fusion of the three bones composing the coxal bone. The higher one, here in German called the Darmbein, is the Ilium. To the lower right, called here the Schambein, is the Pubis, and to the lower left, the Ischium or Sitzbein as it is named here. We see that the center of the hip socket is found where the three bones fuse together.

Pic.1 – *Anatomie der Bewegung; Technik und Funktion des Körpers* - Blandine Calais-Germain, pg.45

The ilium is the largest of the three bones, resembling a rather heavy wing. Its top edge is thick and is called the iliac crest. It receives the weight of the upper body and therefore protects the hip joint, which lies vertically below it. Many of the important posterior and lateral trunk muscles attach to the iliac crest. Its outer surface is convex and is where, among others, the large gluteal muscles originate and extend to the top of the femur, along with the deeper, smaller outer rotator muscles. Together they are responsible for extension, abduction and rotation of the thigh. On its inside, which is concave so that it can hold the abdominal weight of the body in the vertical position, is found the iliopsoas muscle, which originates in the lumbar vertebrae and arrives and extends and attaches onto the inner side of the upper thigh bone. This muscle is the flexor of the hip joint, and also aids in the outer rotation of the upper leg.



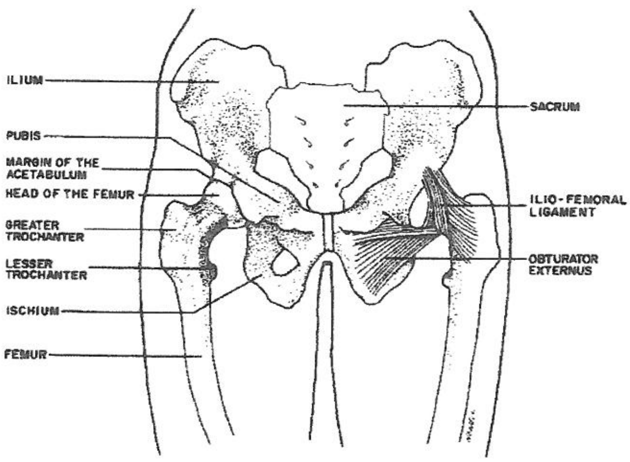
The main muscles in the pelvis used for the *en déhors*. The gluteus maximus, although primarily the hip stretcher, also functions in stabilizing the outer rotation of the standing side hip. Notice how the five deeper, smaller outer rotators are formed like a fan, wide on the hip bone and arriving together at one point on the back of the femur top. The coordinated contraction of these muscles rotates the femur outwards while continuing to stabilize the hip.

Pic. 2 – *The Dancer's Book of Health* – L.M. Vincent, M.D. pg. 110

To the front of the pelvic girdle, the Ilium comes together with the pubis. The pubis extends medially to the forward centre of the body (the anterior midline) where it meets the pubis from the other side of the pelvic girdle. At this junction is an articulation called the symphysis pubis. It is a type of cartilage disc held in place by very strong ligaments. Onto the pubis are attached a group of important muscles in the functioning of the turn-out, namely the adductors.

The Ischium descends from the Ilium inferiorly and joins to the pubis. Its lower protrusion is the ischial tuberosity, or sit bone as it bears our weight when we sit on it. It is an attachment place of the diaphragma urogenitale muscle, the transversal fibre of the pelvic floor muscle.

To the rear of the pelvic girdle, the coxal bones articulate with the superior part of the sacrum. All the weight of the spinal column rests on this joint, called the sacroiliac, which is supported by very strong ligaments that span the joint both anteriorly and posteriorly. The ligaments pass not only between the Ilium and the sacrum but also between the Ilium and the lower lumbar vertebrae and between the ischium and sacrum as well. The long fibres of the pelvic floor muscle span front to back between the pubis and the coccyx bones.



Here, we see the anatomical structure of the hip and top of femur as seen from the front. Note the strong ilio-femoral ligament and the obteratus externus muscle, one of the strongest of the outer rotators of the femur.

Pic.3 – *The Dancer's Book of Health* – L.M. Vincent, M.D., pg. 110

The Femur

The femur, or thigh bone, is the largest, longest and strongest bone of the body. It is formed in a spiral, with the bottom of the bone rotating slightly interiorly in comparison to its upper extremity. The proximal joint of the femur is the hip joint which permits a wide range of motion in comparison to its distal joint, the knee. The head of the femur is rounded like a ball and fits exactly into the acetabulum. The articular surfaces of both bones press together and are held by atmospheric pressure, like a suction cup, so perfectly do they fit together. Surrounding both the surface of the femur head and the inside of the acetabulum is a layer of articular cartilage. This cartilage protects the surface of the bones and allows them to roll smoothly within one another. Around the whole hip articulation is a synovial membrane, and around this is the articular capsule, made of very strong tissue fibre.

To permit movement of the leg in all directions, the femur has a neck descending from its' head to the shaft of the bone. The angle made between the axis of the femur neck and the axis of the forward facing knee is called the femoral neck anteversion (FNA). This angle decreases after birth the more that the hip joint stretches and weight is put onto it. Thus the FNA of a new born baby is larger than that of an adult. In a baby, the angle is about 40° but reduces during growth to an average of 10° to 15°. The dancers' turn-out needs a small FNA. The more the neck of the femur is angled toward the front, or anteriorly, the larger the FNA angle will be, and the less the amount of turn-out will be allowed.

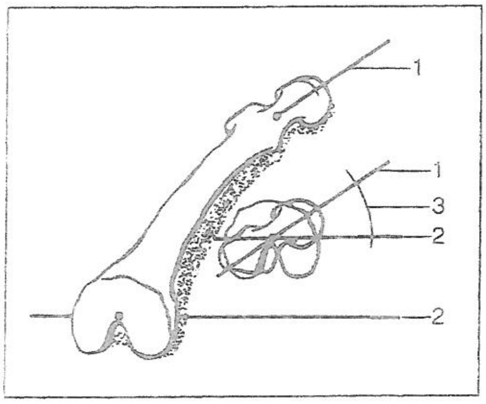


Fig. 67 *FNA angle of the right upper femur:* The oblique axis of the neck of the femur forms an angle with the transverse axis through the femoral condyles. This is the FNA angle. It varies in individuals.
1. Oblique axis of the neck of femur
2. Transverse axis through the femoral condyles
3. FNA angle.

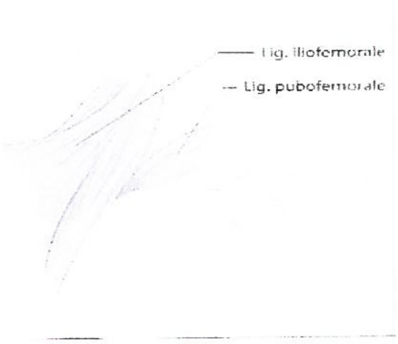
Pic. 4- *The Dancer's Body; a Medical Perspective on Dance and Dance Training* Joseph S. Huwyler, M.D. pg.83

On the superior, lateral side of the femur is a protrusion called the greater trochanter. It is the attachment place of the gluteus and some of the outer rotator leg muscles. On the interior side of the femur shaft is the lesser trochanter, the fixing point of the iliopsoas muscle, responsible for flexing the hip joint.

Three strong ligaments surround the hip articulation, limiting its movement possibilities, but giving it more stability. They are: the ilio-femoral ligament, which is the strongest ligament in the body and stretches from the Ilium to the top of the femur shaft; the ischio-femoral ligament, which, as it's name implies, crosses over from the ischium around the neck of the femur to attach itself at the top of the femur; and finally the pubo-femoral ligament, stretching from the pubis bone to the inner side of the femur just over the lesser-trochanter. These ligaments are very thick in the front, almost a centimetre in width. They stabilize the hip especially during the standing leg phase. Together, these ligaments form an "N" as they spiral around the front of the articulation. On the back side of the hip joint are more spiral forming ligaments that are weaker than their partners in the front. These ligaments are not important to us in the understanding of *en déhors*.

The ischio-femoral ligament (not shown in the picture to the right) comes from behind the ilio-femoral ligament, crosses over to the top of the femur around its neck.

Pic. 5 – *Das Neue Denkmodell in der Physyotherapie, Band 1: Bewegungssystem* – Antje Hüter-Becker, Ulrich Betz, Christian Heel Pg. 113



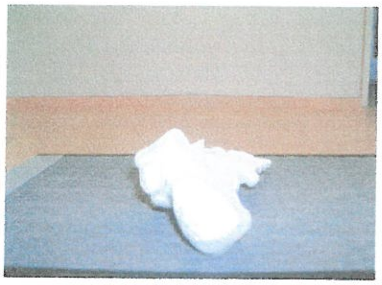
These ligaments relax during a flexion of the hip, and conversely are stretched during an extension. The same is true in an inner/outer rotation of the hip joint. During an inner rotation the ligaments are relaxed, during an outer rotation they are stretched. The tightness of these ligaments can limit the range of turn-out in a dancer. With many years of intensive training, they can be stretched a little and the turn-out can be slightly improved, along with the hip extension (arabesque).

The Knee

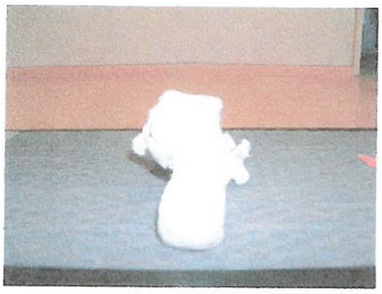
The distal end of the femur articulates with the bones of the lower leg, the tibia and the fibula, to form the knee. This joint is considered a hinge joint as there is only the possibility of bending and straightening it, but because of the slightly concave top of one side of the tibia, it is also a pivot and sliding joint allowing a slight rotation in the flexed position, but not in the stretched. Two cartilage surfaces are found between the condyles of the femur and the tibia, called the lateral and the medial meniscus. They not only provide smooth, gliding surfaces between the bones, but also work as shock absorbers in the knee to absorb shock stress. The knee has quite an unstable articulation, demanding extremely strong ligaments limiting movement possibilities both on the sides and in the middle. Two powerful ligaments, the anterior and posterior cruciate ligaments, pass through the space between the femur condyles, crossing over each other to form an "X". The anterior cruciate ligament starts next to the medial meniscus on the front of the tibia, crosses backward, upward and laterally to attach itself on the back, inside of the lateral femur condyle. Its' function is to prevent the forward displacement of the tibia on the femur, and also to prevent overextension of the knee joint. The posterior cruciate ligament does the contrary, starting from the front of the femur between the two condyles and attaching behind the tibia on the back side of the lateral meniscus. It keeps the femur from sliding forward on the tibia, and helps in preventing over flexion of the knee. On both sides of the knee joint are the collateral ligaments. They stretch over the joint from femur to tibia on the medial side, and to the fibula on the lateral side. These ligaments prevent the sideways bending of the knee joint. On the front of the knee is the patella, a floating, rounded bone that not only protects the knee joint, but also serves as a smooth surface for the muscles and tendons descending from the upper leg to the lower leg to glide over. Without the patella, these tendons would scrape against the edges of the femur and tibia and eventually break. The patella is a reference point for us as dance teachers for the correct alignment of the leg.

The lower leg
The lower leg articulates with the foot at the ankle joint. The strong, thick tibia and the slender, elastic fibula descend almost parallel to each other from the knee. These two bones articulate with each other superiorly as well as inferiorly, but as they are designed for weight bearing, their movement with each other is extremely minimal. At the proximal end of the tibia, directly below the patella, is the tuberositas tibial. It is the attachment place of many of the quadriceps muscles that descend from the top of the femur over the knee and also serves as a reference point for checking the leg alignment. At their distal ends are the medial malleolus of the tibia, and the lateral malleolus of the fibula, known as the ankle bones. They are the attachment points of the major medial and lateral ligaments of the ankle.

The Foot
The foot is separated into three groups of bones: the tarsals, the metatarsals and the phalanges (the toes). The two largest of the tarsal bones are situated directly underneath the tibia and the fibula. The distal ends of the two lower leg bones articulate with the talus, the highest of the ankle bones. In this articulation is a possibility of flexion and extension. Under the talus is the heel bone, the calcaneous. The weight of the body descends through the tibia onto the talus from which it is distributed in part onto the calcaneous and partly onto the other tarsal bones. The calcaneous is the attachment place of the mighty Achilles tendon which, when pulled upwards by the calf muscles belonging to it, cause the foot to bend down in a plantar flexion. Particular to the calcaneous is its clear structure, with an obvious platform for supporting weight.



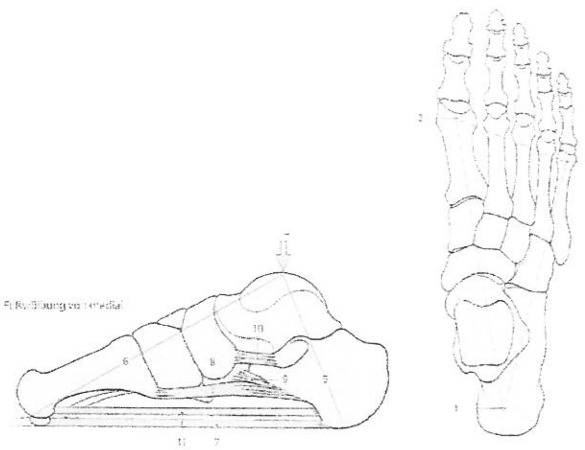

To the left we see the bones of the foot when the foot is rolling in. The calcaneous is on its inner edge, which makes it impossible to correctly hold the bodies' weight. The longitudinal arch is flattened out, and the toes and forefoot lose their coordination and stance on the ground.




Here, we see a correctly placed calcaneous. We can clearly see the flat edge, designed for contact with the floor. The calcaneous itself is straight up and down, and directly behind the middle of the foot. The longitudinal arch is held naturally, and the toes are straight forward. A foot held in this position is coordinated, strong and dynamic.

Within the articulation formed between the talus and the calcaneous, and the calcaneous and proximal tarsals, we find the movement possibilities of inner/outer rotation, and inversion/eversion, also known as supination/pronation. The other tarsal bones of the foot are ingeniously formed in an arch to support the weight of the body and distribute it equally among them, using the principle of tensegrity. The Romans, studying the anatomy of the foot, understood the benefits of this natural architecture and used this principle to build their bridges and aqueducts, thousands of years ago. Many of these bridges are still standing today, surviving not only the abuses of nature but also the weight of thousands upon thousands of travellers. The superior side of the tarsals is wide and rounded the inferior side thin, like a boats keel. At their distal end they articulate with the metatarsals, which in turn articulate with the toes, or phalanges. The metatarsals also work as shock absorbers and distributors of weight and the toes function as stabilizers, both during movement and also in the standing position.

The foot has two natural arches built into it: the longitudinal arch, going from the posterior, lateral, inferior side of the calcaneous to the inferior, medial side of the articulation between the first metatarsal and the big toe, and the transversal arch, extending under the metatarsals from the joint with the big toe and the articulation with the little toe. These two arches form a three dimensional triangle that perfectly distributes the weight on the foot, and also stimulates the correct muscles for movement impulse through the leg.



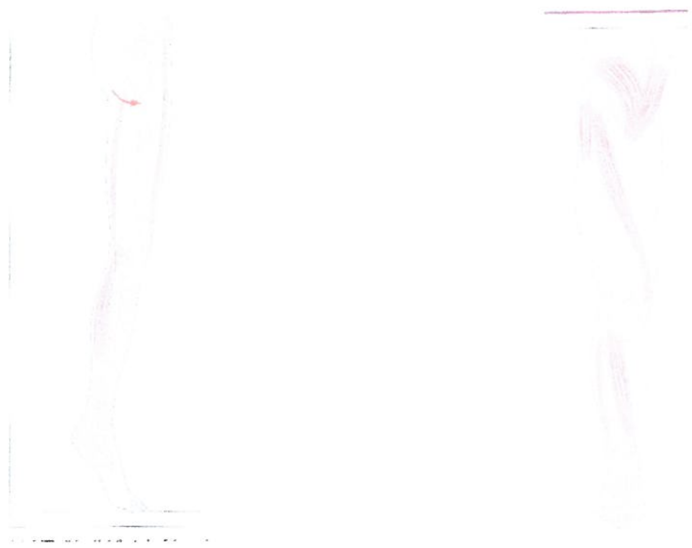
In the pictures, we see the two triangles of the foot. Together, they make a three dimensional triangle, building the transversal and longitudinal arches. Note that the middle of the calcaneous is the apex of both triangles.
Pic. 6- *dtv – Atlas Anatomie, Band 1: Bewegungsapparat* – Werner Platzer, Pg. 229

The whole leg is a masterpiece in its construction. The massive, weight bearing, stabilizing bones of the hip and femur gradually descending to the two finer but still strong lower leg bones, terminating in the ankle and the many bones of the foot, each with its function in the distribution of weight and the coordination of movement. The greater the distance from the center of the body, the finer the bone structure is. The skeletal leg construction is absolutely brilliant in itself, but the most ingenious in the functioning and coordination of this unit is the muscular system.

The muscle systems of the leg
Evolution has provided us with two distinct muscular systems throughout the whole body; the axial or straight system, and the oblique system, or guiding muscle system. How these two systems work with each other gives strength, stability, coordination and a harmonious balance to movement. When we look at the muscles of the body, we can easily see to which of these two systems the muscle belongs.

The Axial system is responsible for strength, forward movement and standing upright, permitting the flexing and extending of the leg joints. The muscles run nearly straight up and down the front and back of the legs. A triple-flexion of the leg (triple, because the flexion occurs simultaneously in the three leg joints: hip-knee-ankle) takes place in the flexing of the hip by the iliopsoas, in the knee by the ischiocrurales muscles (the back upper leg muscles, or ham-string) and in the ankle by the tibialis anterior, a muscle descending the shin bone from the top of the tibia across the ankle to the bottom of the inner foot. The coordinated activation of these muscles makes the leg bend. A triple-extension of the leg is caused by the activating of the glutei muscles to extend the hip, the femoral quadriceps muscles to stretch the knee, and the triceps surae muscle, or calf muscle, to stretch the ankle.

The Guiding muscular system is responsible for coordinating the rotation direction of the movement and stabilizes the articulations. The muscles wrap around the leg like the colours on the barber-shop poles in America. They serve the spiral screwing of the leg during the flexion-extension movements to coordinate the direction of the bones of the upper leg, lower leg and foot. In the flexion, the coordinating muscles are the iliopsoas, the Sartorius, a muscle that begins at the top of the medial side of the tibia, crossing over the front of the knee to the lateral side of the iliac crest, thus being used as a hip and knee flexor, an abductor and outer rotator of the upper leg, and the tibialis anterior, that, due to its attachment under the foot causes an inversion of the back foot. In the extension: the peroneus longus, starting at the big toe joint and passing under the fore-foot to go up the lateral side of the ankle and lower leg to attach at the fibula head, the tensor fascia latae, which stretches the hip joint and acts as an outer rotator for it, and the glutei muscles, which are the strongest of the hip stretchers and stabilize the outer rotation, all work together to coordinate the stretching of the leg.



In the picture to the left, we see the axial muscle system of the leg in an extension (missing are the gluteus maximus and the tibialis anterior) and to the right, the guiding muscle system. Notice how the muscles of the guiding system are spiral formed. Pic.7 –*Das neue Denkmodell in der Physiotherapie; Band 1: Bewegungssystem* – Ulrich Betz, Christian Heel – pgs. 154, 155

The main Spiraldynamik principles

In architecture, space is defined as a right triangle with one open angle. Consider a right triangle lying flat on the ground (Diagram No. 1 below). If AB is the length of the triangle, and AC is the width, then by lifting up the end of the side BC, we obtain the third dimension of the room, the height (Diagram No. 2 below).

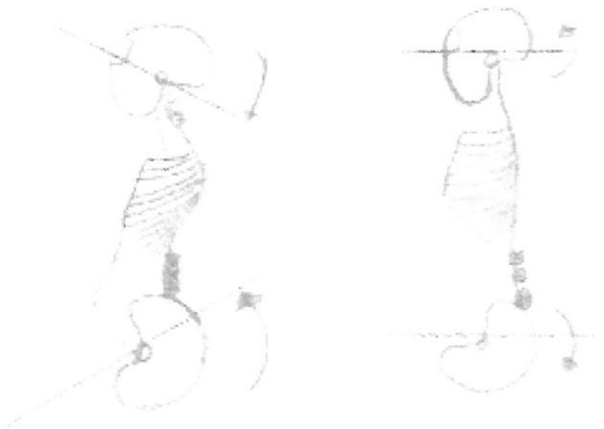
No. 1

No. 2

If we consider each of the sides of the triangle to the right to be a plane, space is defined by these same planes. Through this open-ended triangle we obtain what is know as the Z-Cobra, the definition of which is two angles with two open ends. This is the geometric variation of a spiral. A spiral is therefore an organizational principle in space as well as within the body. The natural structure of the body – the spiral-formed bones, the various movement possibilities of the joints and the spiral course of the muscular system, organizes itself around this principle.

Anatomically speaking, the body is described in relation to these three planes passing through the body. Through any given point of these planes is an axis. Each of the articulations in the body has the following three axes going through it: (1) the transversal axis going from side to side, (2) the sagittal axis from front to back, and (3) the longitudinal axis from top to bottom. Movement rotating around as well as translocation along each of these axes is possible. This means that in total one has twelve movement possibilities, depending on the joint under consideration. A hinge joint, for example, has four movement possibilities: flexion/extension as well as translocation in two directions. An articulation with the twelve possibilities of movement is a ball-and-socket joint. Here one finds a flexion/extension rotation around the transversal axis coupled with a translocation along the sagittal axis forward and backward, as well as an abduction/adduction rotation around the sagittal axis partnered with a translocation up and down along the longitudinal axis, and finally an inner and outer rotation around the longitudinal axis together with a translocation along the transversal axis from side to side.

To study movement using the Spiraldynamik principles, we separate the body into coordinative units; the trunk, shoulder, arm, hand, hip, leg and foot. Each of these units is composed of a pole on either end, with a certain corporal volume between the two poles. The way these units function is defined by two ground principles: the upright, and the spiral principles. Thus, we speak of the coordinative unit of the trunk, for example, using the head and the pelvis as the two poles. The principle governing this unit in the vertical, standing position is the upright principle; the axial muscle system is active. The two poles rotate around the transversal axis in opposite directions away from each other, the head pole rotating up, the pelvic pole rotating down. The volume between them (the spinal column and torso) is stretched, giving it stability, dynamic balance and strength. The abdominal region is shortened, giving the abdominal muscles tonus.



To the left, we see an uncoordinated trunk. The two poles have reversed the rotation around the transversal axis, causing the back to slouch. The abdominal muscles are inactive and there is compression in the neck and lower back. By rotating the two poles away from each other, the back stretches, giving it tonus, strength and balance. The lumbar vertebrae and neck are lengthened.

The rotation in opposite directions around the transversal axis is known as a C-curve. In the upright principle, we have a movement possibility of flexion/extension. As soon as one starts to turn, shift weight or start any locomotion that comes into a third dimension, the spiral principle governs. As we have mentioned, each pole (or sphere) is capable of moving around and along the three different axes, making a three dimensional movement.

In the spiral principle, the coordinative unit is guided by the two poles moving three dimensionally opposed from each other, with the corporal volume integrating into the movement, and the oblique muscle system is active. The two poles always rotate around the three axes, making a C-curve, an S-curve, and torsion around an axis. In the S-curve, the poles rotate in the same direction. In the C-curve and the torsion around the axis, the poles rotate away from each other. Due to the coordination of the two poles in opposed directions, the movement of the integrated corporal volume is balanced and harmonious. The bones and articulations are supported on all sides, resulting in a healthier and more efficient use of energy.

A mechanical understanding of turn-out

So what exactly happens anatomically when one turns out? To understand how the *en déhors* takes place, one has to think of how the body functions mechanically. Let's look at it step by step.

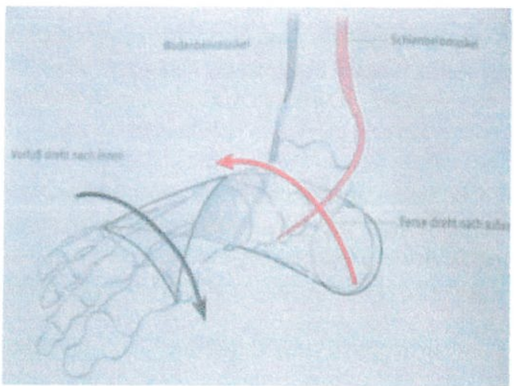
The first thing to take place is the contracting of the pelvic floor, the diaphragma uro-genitale muscle that crosses from one ischium to the other. This contraction brings the two ischiums closer to each other, opening the two iliums of the hip bones away from each other. Through this action the acetabulum rotates slightly outwards. The small, outer rotator muscles contract, which causes the lateral side of the top of the femur shaft to rotate towards the back, and the adductor muscles contract to help support the rotation. Simultaneously, the forefoot pushes the floor, causing the intrinsic muscles under the foot to form the transversal arch. The pushing of the large toe articulation stimulates the tibiales anterior muscle, which makes a slight supination of the rear foot, causing the calcaneous to place itself correctly on its flat edge, thus forming the longitudinal arch. At the same time, the Sartorius muscle which goes from the inside of the knee to the outside of the illiacal crest is active, supporting the knee in the outer rotation of the leg.

It is important to always keep an image in mind of how the body functions mechanically. When one thinks of how the bones are placing themselves, the deepest muscles closest to the bones activate. This provides an economical use of energy as the use of the more exterior muscles pulls one further away from one's centre of gravity.

A Spiraldynamik understanding of turn-out

To understand turn-out using the Spiraldynamik principles, we consider the three coordinative units of the hip, the leg, and the foot. An understanding of how each unit works separately is imperative to the understanding of how they work combined. We will start with the two extremities, the foot and the hip. The foot is the base we stand on, and, just as all constructions need a good foundation to stand on so does the body. Without the correct placement of the foot the leg axis is wrong and there can be no *en déhors*. Understanding the role of the hip is important because this is where the mechanics of turn-out occur, and because it is where the placement of the femur is determined. We will first consider these structures in a normal, parallel position.

The foot:
We have seen that the foot, through its natural structure, has a longitudinal and a transversal arch. The coordinative unit of the foot consists of the two poles, the forefoot and the heel, and the corporal volume between them. The foot functions according to the rules of the spiral principle, meaning that the fore foot rotates inwards and the heel rotates outwards. More precisely, the forefoot rotates forward around the transversal axis, while making a pronation around the sagittal axis, and a rotation outwards around the longitudinal axis. Through this torsion, the short, intrinsic muscles of the transversal arch are stimulated; the big toe is strongly grounded. The heel does the opposite; a rotation towards the back around the transversal axis, a supination around the sagittal axis, and finally, an outer rotation around the longitudinal axis. This activates the longer foot and lower leg muscles. Because of the opposition of the two poles, the incorporated volume is balanced, stable, and flexible at the same time, ready at any moment to support the body weight or to spring dynamically for movement.



The structure of the foot lends itself to spiral torsion. The forefoot rotates inwards, the heel outwards. The result is stability, ability to accept and distribute the body weight harmoniously, and a dynamic possibility of movement. By dancers with poor understanding of turn-out,
one often finds the two poles reversed, resulting in a rolling in of the ankle. The two arches flatten out; the coordination of the foot is lost.

Pic. 7 – Apiraldynamik International AG – Bewegungs qualität und Verletzungprophylaxe – Barbara Eichenberger-Wiezel und Barbara Rust Weber in zusammenarbeit mit Patricia Schmid

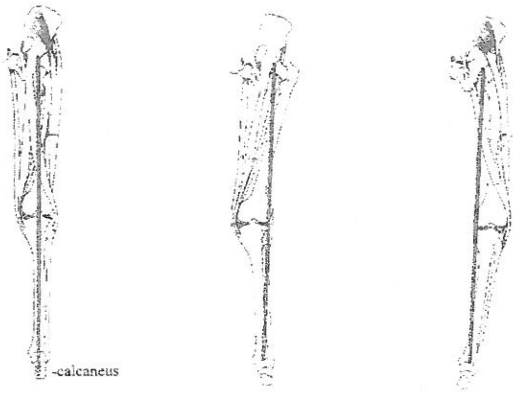
The hip:
Because the position of the hip bone is dependent upon the position of the pelvis, we are assuming that the upright principle is already being applied to the coordinative unit of the trunk. In the standing position, the pelvis is correctly held by the coordination of the concentric work of the large gluteus muscle and the pelvic floor muscles; the diaphragma pelvis and the diaphragma urogenitale. Because of the previously mentioned spiral shape of the hip bone, when these muscles contract, the lower, inner edges of the pelvis approach each other and the superior, wider edges open away from each other. The large gluteus muscle contracts slightly to extend the hip, while the iliopsoas muscle works eccentrically to lengthen and open the front of the groin. The hip bone rotates around the head of the femur towards the back.

The two poles of the hip unit are the acetabulum (hip socket) and the caput femoris, or head of the thigh bone. In the static, standing parallel position, the upright principle applies to the hip unit. The femur, due to its' natural inner spiral form, *is always held in an outer rotation* (even in the parallel position) by the concentric work of the five deeply-lying outer rotator muscles of the pelvic girdle, the pelvi-trochanter muscles. Thus, the hip socket and the femur head are rotating away from each other, making a C-curve.

When the weight is shifted to one leg, the upright principle continues to govern the standing leg hip, whereas the spiral principle is applied to the hip of the working leg. The hip bone of the working leg makes an inner spiral, rotating forwards, upwards and inwards around and along the three axes, while the femur continues in an outer spiral, making a flexion around the transversal axis, an adduction around the sagittal axis and an outer rotation around the longitudinal axis. On the standing leg, the hip bone is rotating backwards, downwards and outwards, while the femur is making an extension, abduction and an outer rotation around the three corresponding axes.

The leg:
The forefoot and the femur head are the two poles of the coordinative unit leg. The volume between them is all the bones: femur, patella, tibia, fibula, as well as all the ankle and foot bones and the toes. As seen above, the forefoot rotates inwards, the femur head outwards. The volume lying between them follows this pattern – the lower leg rotates inwards and the heel outwards. The spiral structure of the leg is plain to see through the construction of the knee joint (a hinge with minimal rotation possibilities) the crossing ligaments and the diagonal course of the guiding leg muscles. This structure cannot be reversed. Through the coordination of the two poles, the distal forefoot inwards, the femur head outwards, the leg axis is centred and balanced. If either of the two poles reverses its rotation, a dis-coordination occurs, creating an unequal pressure on one or more of the leg articulations.

The natural construction of the leg demands the working of the muscles used in the *en déhors*. Due to the longitudinal and transversal arches of the foot, a spiral twisting between the forefoot and the heel occurs giving the foot stability and at the same time enabling it to be dynamic at any moment. The muscles and the ligaments of both the foot and the lower leg function with each other in a balanced way, ensuring a coordination and protection of the articulations. At the same time, at the proximal end of the coordinative unit, the femur is held in an outer rotation. The *en déhors* in ballet is thus dependent upon the entire leg alignment, and vice versa. We cannot have one without the other. It is therefore important to ensure this in the beginning stages of a dance education. As seen, the same muscles are active in the parallel position as in the turned-out position. One must start then, strengthening these same muscles in the parallel position before attempting the rotation into the classic ballet positions.



In the leg to the left, we see a well coordinated, balanced alignment of the leg. The axis of the leg runs centered through the hip, knee and ankle joints. The leg in the middle is typical of a rolling in of the foot, what often occurs when turn-out is forced. The interior of the knee is over-stretched, weakening the corresponding ligaments. To the right, the opposite is true of the bow-leg. In both the center and right pictures, the outer rotators of the femur are in-active, the foot is uncoordinated (note the position of the calcaneous).

One must think of the body as a whole in order to understand the mechanics of turn-out. A well turned-out dancer is not only open from the hips, but stable and aligned on the feet. The pelvis is placed and centered over the feet. The knee is integrated into the direction of the rotation of the leg to be looking over the middle of the foot. The foot is active and dynamic. Both axial and oblique muscle systems are active, providing strength, stability, dynamism and coordination.

The most important areas to be strengthened are:

- The back posture – the opposite rotation of the head and pelvic poles away from each other. This lengthens the back bone, strengthening the muscles of the pelvic floor and the stomach muscles; and the lengthening of the ilopsoas muscle stretches the lumbar region to prevent sway backs.
- The forefoot – the intrinsic and short foot muscles of the transversal arch must be stimulated to give strength to the forefoot to be able to hold the transversal arch.
- The heel - the heel must be held in an outer spiral in order to hold the longitudinal arch of the foot.
- The outer rotators of the femur – the deep pelvi-trochanter muscles spanning between the coxal bone and the greater trochanter of the femur, responsible for the outer rotation.
- The leg alignment – both the axial and guiding muscle systems of the triple flexion/triple extension must be strengthened.

The teaching of *en déhors*

Before a child is introduced to the idea of turn-out, a teacher must take special care in preparing the young student's body for this demand. The important muscle groups should be worked on from the start in the parallel position. As mentioned earlier, the pelvis position and the stance on the foot are primordial in the working of the *en déhors.* It is in the child's and the teacher's interest to ensure that both of these are corrected and understood by the child before continuing on to a turned out leg position. Exercises should be incorporated into the class to strengthen the muscle groups needed for this task.

The introduction of *en déhors* should come only when the children have understood and strengthened these important muscle groups. One must never demand more turn-out than that which is physically possible due to the femoral neck anteversion angle. Imperative in the first stages of turning out is the notion of staying vertical in all movements, especially during the *demi plié.* If a vertical posture in this movement is not maintained, the hip tends to make a flexion, using the iliopsoas muscle and therefore provoking a lordosis of the lower back.

The rotated position changes the influence of gravity through the body, and the dancer must learn to make changes in his/her corporal placement to adjust to the difference. If one considers the body as a pyramid, with the head as the top of the three dimensional triangle, and the feet as the base, one sees that the length and the width of the feet are what determine the base of the pyramid in order for the weight of the volume to be carried comfortably in the centre of it. Think of the centre of gravity falling through the body like a pendulum with a great weight on the bottom. In the parallel standing position, with feet facing forward, the pendulum has a natural swinging motion forward and back, as that is where the most room at the base of the pyramid is. In a turned-out position, the natural swinging motion would be more from side to side, as that is where the most room for weight change would be. From front to back in the rotated standing position there is much less possibility for weight change. The need for the correct foot placement is therefore imperative in this rotated position in order to protect the articulations from excess strain.

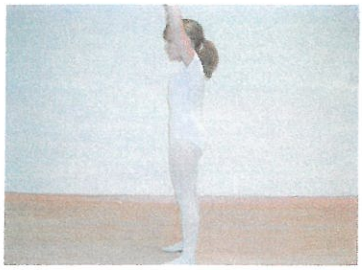
The outer rotators of the femur head are in need of support in order to hold and control the exaggeration of the rotated femur used in the *en déhors.* The adductor muscle group of the upper leg plays a large role in aiding the stabilisation of the *en déhors* of the standing leg. This muscle group must therefore be strengthened as well as the outer rotator group. Dancers with hyper extended knee problems often have very weak outer rotators and adductors. They are often prone to a pronounced lordotic position. The tilting of the pelvis aggravates the hyper extension as it brings the weight onto the heels of the feet and stimulates the reflex of the femoral quadriceps for balance. One must first correct the position of the pelvis, i.e. the coordinative unit of the trunk, strengthen the foot placement and relax the knee (to bring it into the line of the leg axis), stimulating the activity of the outer rotators. The ilopsoas muscle must also be stretched, as the continual lordotic position often shortens this hip flexor.

Suggested exercises

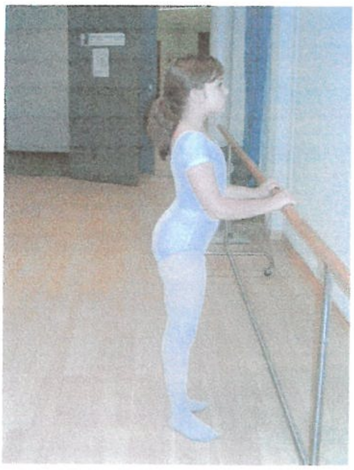
Exercise 1: The correct pelvis position

The child stands with the feet apart, the knees bent and the hands on the knees. She lets the lower back fall into a slight lordotic position.

Using the muscles of the pelvic floor, she approaches the two sit bones towards each other, which centers the pelvis and lenthens the lumbar vertebrae.



Holding the contraction of the pelvic floor muscles, she stands up, keeping the pelvis in the centered position.

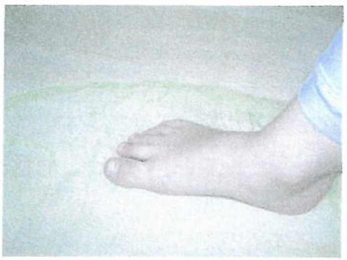


Standing at the barre, the child repeats the exaggerated swayed-back position.

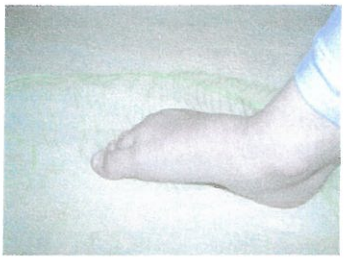
Using the pelvic floor muscles, she correctly places the pelvis by approaching the sit-bones towards each other.

Exercise 2: The strengthening of the intrinsic forefoot muscles

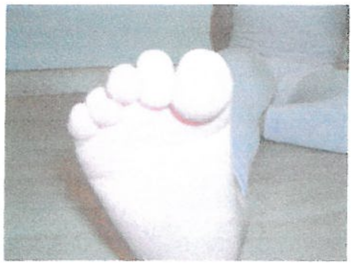
Exercise 2.1-



The child lays a scarf on the floor and stands on it, making sure that the heel is well placed behind the middle of the foot.



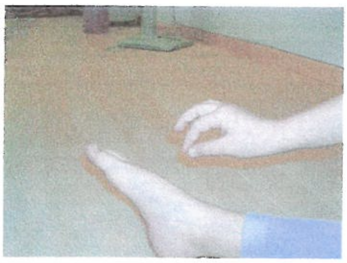
Keeping the toes long on the floor, she contracts the underneath part of the foot, playing „worm", so that the scarf moves under the foot.



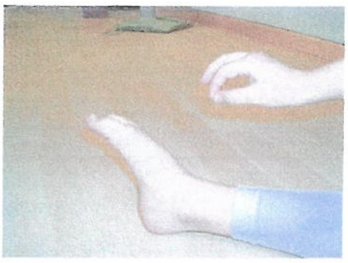
Once the muscles are felt and working correctly, the child attempts to hold the muscular contraction under the foot without curving the toes underneath (in the picture she has tendancy towards this.)

Exercise 2.2 –

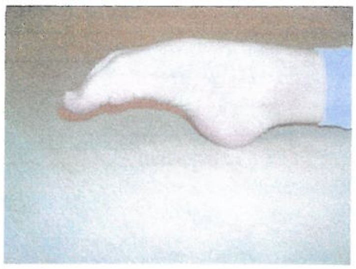
This exercise is done after the children have successfully done the first exercise.



The child pinches an imaginary string between the thumb and the index finger. She imagines that the string is attached to the top of her foot between the 2nd and 3rd metatarsals.



She „pulls" on the string, making the intrinsic muscles under the foot contract to form the transversal arch



Holding the transversal arch, she makes a plantar flexion (points the foot) trying to keep the toes long.

Exercise 3: The correct foot placement

Sitting on the floor with the foot in line with the hip joint, the child wraps a theraband around the forefoot, taking care that the toes are long.

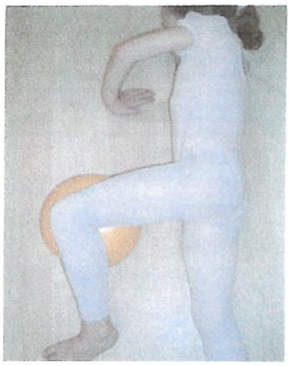
With the inside hand, she pulls the foot into a sickled position.

Keeping the ankle flexed, she pushes the articulation of the large toe against the theraband, in the direction of an eversion with the forefoot, until the foot is straight

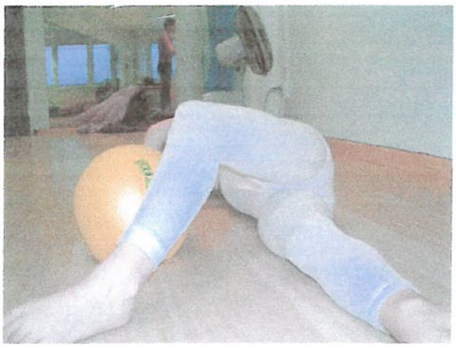
Relaxing the foot, she repeats the movement in the opposite direction, pulling with the outside hand so that the forefoot relaxes into an eversion.

Keeping the ankle flexed, she pushes the articulation of the small toe against the theraband, in the direction of an inversion with the forefoot until the foot is straight. She repeats this series until the muscles responsible for holding the correctly placed foot have been strengthened.

Exercise 4: The strengthening of the outer rotators

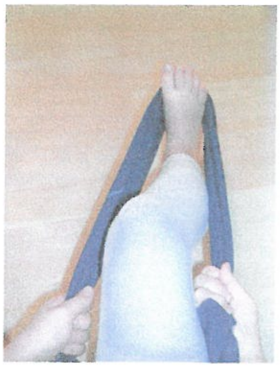


The child lies on the floor on her side. The top leg is bent at a 90° angle at the hip and the knee, which is resting on a soft ball. The foot is flexed on the floor. One must make sure that the back is straight and that the pelvis is held in the upright position. The lower leg must be straight at the hip joint.



Keeping the position of the back and the foot on the floor, the child lifts the knee towards the ceiling. Holding it at it's maximal height, she breaths deeply in and out. Relaxing the outer rotator muscles a bit, she lets the knee descend a little, and then re-lifts it again to its maximal height, trying each time to go higher. This is repeated at least 5 times. One tries to increase the number of times and the length of holding the leg up.

Exercise 5: The leg alignment



The child sits on the floor with the correctly placed foot in the theraband. She stretches out the leg, keeping the tension in the foot.

The child is told to imagine that her 2nd and 3rd toes are the top of a mountain and that the front of her knee is the sun rising. Looking in the mirror, she is asked to bend her knee up. What normally occurs is that the knee lifts in an inner rotation, so that the "sun" comes up in front of the big toe.

One reminds the child of the outer rotators felt in the previous exercise, and tells her to contract those muscles while lifting the knee, always keeping the foot straight forward. While looking in the mirror, she has the reference points of the center knee and the 2nd and 3rd toes that must stay aligned. One repeats this exercise until the child is comfortable in the flexing and extending of the leg while holding the correct alignment.

Injuries caused by poor turn-out

In understanding the *en déhors* one must be aware of both the skeletal system and the muscular systems and how they work together. Too many teachers have only a vague idea of the anatomy of the instruments they are working with. This would be unheard of in a musician, who knows every part of his instrument and its range limitations. Although the human body is definitely the most complicated of instruments to understand, it should be the responsibility of every teacher to educate themselves and their students in the anatomical construction of the instrument they are working with in order not only to maximise the results of their hard labour, but also to protect this marvellous instrument from abuse.

Much research has been done on dancers' injuries and what causes them. Of all the books that I have read, and through my own research, I find that all the authors, whether they are doctors or dancers, agree that the most common injuries to dancers occur because of a faulty technique, and most specifically to a poor understanding of turn-out. The doctor and orthopaedist Dr. William Hamilton, resident physician to the New York City Ballet among other dance companies, says that "Most of the problems we see with dancers are the same as in any athlete; strains, stress fractures, muscle pulls. But specific to dancers are sprained ankles from jumps and hip trouble because of foot turnout..."[2] Dr. Justin Howse, orthopaedic surgeon to the Royal Ballet Schools and the Royal Academy of Dancing, and Shirley Hancock, principal physiotherapist to the same schools have written in their book "As most dancers are not anatomically perfect for dance, there will be physical limitations and constraints which may play a part in preventing the development of a perfect technique. Certainly the commonest anatomical cause of potential problems and injuries is limitation of turn-out (external rotation) of the hips...Over turning the foot in relation to the hips is probably the commonest single teaching fault, e.g. demanding a flat or 180° turn-out at the feet which is not matched at the hips. As a general rule, the feet should not be turned out further than the available turn-out at the hips."[3] They go on to say, "Very few dancers have flat turn-out (180°) and even if they do, they cannot work like this because of the difficulty of achieving correct balance. Therefore they tend to drop into the lordotic position, thus weakening the trunk muscles.
Much more disastrous than any of the above is the method of teaching which demands a flat 180° turn-out at the feet, despite the fact that the hips cannot approach anything like this degree of external rotation. The consequences are

1. A marked pelvic tilt forward with the development of a lordosis.
2. Severe weakening of the trunk muscles, particularly the abdominals
3. A greatly increased rate of injury in the lumbar spine, including stress fractures...
4. General sequential weakening of the various muscle groups from above downwards – the abdominals, the back extensors, the latissimus dorsi (as the shoulders are back), the glutei, the hamstrings (especially the lateral hamstrings), the adductors and the vastus medialis, the lateral part of the calf muscle and the lateral intrinsic muscles of the feet. This in total produces complete imbalance of the legs...Teachers who demand this flat turn-out demonstrate their total ignorance of the mechanics of the body and by this culpable attitude must accept complete responsibility for injuries they cause to their students. The situation is not only a cause of injuries but it is also greatly detrimental to the development of a good technique."[4]

These are hard words coming from the doctors, but a reality that ballet teachers must face up to. Through the weakening of the above-mentioned muscle groups, a number of injuries can occur. Some of the main ones are:

1. Stress fractures of the lumbar vertebrae - common among dancers who have weakened abdominal muscles due to a lordotic posture (sway back) in order to try to give more external rotation at the hips and over turning of the feet.
2. Damage to the medial meniscus of the knee - one of the most frequent injuries, aggravated or caused by over-turning the feet which causes muscular imbalance and lack of control of the knee. When standing on one leg, the strain on the medial side of the knee is increased because the weakened adductors not only do not hold the leg correctly under the body, but also create an un-balance in the controlling of the hip turn-out, aggravating the turn-out of the foot.
3. Stress fractures of the tibia – often associated with hyper-extended knees, which are usually a direct result of uncoordinated muscle groups, and especially of a lordotic posture and the weakening of the outer rotators of the femur. Stress fractures of the fibula are also often due to a failure to hold turn-out at the hips, causing stress in the lower leg.
4. Sprain of the lateral ligaments of the ankle - the most common injury to dancers. The causes of these sprains are varied, but include the weakness of the intrinsic foot muscles, and weak ankle control, especially of the peroneal group of muscles. The lack of turn-out control allows the knee to turn in, causing the leg over the ankle to go out of alignment so that the weight isn't placed correctly over the foot. Due to the lack of strength in the intrinsic foot muscles and the weight on the medial side due to poor leg alignment, the supination/pronation of the foot is reversed, weakening the ankle muscles. Also, an unstable pelvis position usually aggravates instability at the far end of the leg chain.
5. Hallux Valgus and bunions are often caused by prolonged rolling of the feet due to forcing the foot turn-out, often the result of hyper extended knees that reverse the natural spiral of the leg muscles and weaken the outer rotator muscles.
6. Achilles tendonitis, and many other leg and foot tendonitis are caused by faulty leg work, fatigue and working with the weight held too much over the heels (due in part to weak outer rotators of the upper leg and poor pelvis position).

The list could go on and on. The position of the pelvis and the weakening of the muscle chains in the coordinative unit of the leg are the greatest factors in the cause of injuries in dance.

Conclusion

The three dimensional anatomical understanding of the leg mechanics and the integration of exercises into the early teaching of children to strengthen the various critical muscle groups, could prevent many dancers' injuries, prolong their careers and build technically stronger dancers. This is why it is important to integrate Spiraldynamik° into the daily ballet class, a movement concept that enhances the understanding of three-dimensional anatomy in order to comprehend the consequences of the effect of gravity through the body.

The human body (the instrument of dancers) is probably the most complex of all artists' instruments, but how it functions mechanically is absolutely logical. We find in nature everywhere the two different principles, upright and spiral. Their combined use is evident all around us: the tree that grows simultaneously upwards and outwards; the tornado reaching to the ground swirling around as it cuts a straight path before it; the delicate fern leaf unrolling in spring time. Our bodies have evolved subjected to the same natural forces we see around us. There exists a balance between the straight, strong, goal oriented and the winding, coordinating, stabilizing. Philosophically, one could make the same analogy about how one lives one's life, and dance, as I have discovered through teaching, has everything to do with this. The understanding of the Spiraldynamik principles can be applied to a vast number of disciplines. I am convinced that classical dance and its dancers could be enhanced by the understanding and integration of these principles into the daily training.

List of quotations:

1 – Jack Anderson; *Ballet & Modern Dance: A Concise History, Second Edition;* copyright 1992 by Prinston Book Company, Publishers. Page 43
2 – Caroline Mosely; *A Dancer's Doctor: orthopaedist William Hamilton '54 sees to feet, legs and hips;* http://www.princton.edu/~paw/
3 – Justin Howse and Shirley Hancock; *Dance Technique and Injury Prevention*; copyright 1988; A&C Black (Publishers) Ltd; page 74
4 – *idem;* page 173

Bibliography and Information Sources

1. Jack Anderson – *Ballet and Modern Dance: A concise history, second edition* – copyright ©1992 by Princeton Book Company, Publishers
2. Ulrich Betz, Christian Heel, Antje Hüter-Becker – *Das Neue Denkmodell in der Physiotherapie Band 1:Bewegungssystem* – copyright ©2002, 2006 Georg Thieme Verlag, D-70469 Stuttgart
3. Georgette Bordier – *Anatomie Appliquée à la Danse: Le corps humain instrument de la danse* – edition 1985 – copyright ©1975 éditions Amphora S.A.
4. Blandine Calais-Germain – *Anatomie der Bewegung: Einführung in die Bewegungsanalyse* – copyright ©1984 B. Calais-Germain, copyright 1989 Editions DesIris, copyright der deutschen Ausgabe: fourierverlag GmbH, Wiesbaden
5. Blandine Calais-Germain – *Anatomie pour le mouvement tome II: bases d'exercices* – copyright ©1990 Michel Mirale, Editeur: Editions DesIris
6. Kevin Conley – *Pointe Counterpointe:* Ballerinas wage a backstage battle over the proper toe shoe – The New Yorker, December 9, 2002
7. Barbara Eichenberger-Wiezel und Barbara Rust Weber – *Bewegungsqualität und Verletzungsprophylaxe* – Spiraldynamik® International AG dance news
8. Moshe Feldenkreis – *Awareness through Movement* – Livrary of Congress Cataloging-in-Publication Data – copyright © 1972,1977 by Moshe Feldenkreis
9. Gerald Gabriel, *Hans Selye: The discovery of Stress* – www.brainconnection.com/topics/?main-fa/selye
10. Arthur C. Guyton, M.D. – *Anatomy and Physiology* – copyright © 1985 by CBS College Publishing
11. Justin Howse and Shirley Hancock – *Dance Technique and Injury Prevention* – A & C Black (Publishers) Ltd, London WCIR 4JH, copyright ©1988
12. Joseph S. Huwyler, M.D. – *The Dancer'sBody: a medical perspective on dance and dance training* – translated into English by Tess Blundell from the German edition: *Der Tänzer und sein Körper: Aspekte des Tanzens aus ärtzlicher Sicht* – D-72336 Balingen, 2nd rev. edition 1995 – copyright ©1999, 2002 Joseph S. Huwyler
13. Wynn Kapit and Lawrence M. Elson – *The Anatomy Coloring Book; second edtion* – HarpersCollins College Publishers New York, New York 10022 – copyright ©1993
14. Dr. med. Christian Larsen – *Spiraldynamik - Die zwölf Grade der Freiheit: Kunst und Wissenschaft menschlicher Bewegungskoordination* – 2. Auflage Verlag Via Nova, D-36100 Petersberg, copyright © 2001
15. Caroline Moseley – *A dancer's Doctor- Orthopedist William Hamilton '54 sees to feet, legs and hips*- http://www.princton.edu/~paw/
16. Werner Platzer – *Taschenatlas der Anatomie in 3 Bänden: Band 1-Bewegungsapparat* – Georg Thieme Verlag , D-70469 Stuttgart, copyright © 1975, 1999
17. Ellen Saltonstall – *Kinetic Awareness: discovering your Bodymind* – Publishing Center for Cultural Resources – copyright ©1988
18. Gabriela Schärer-Jenk – *Vermittlung klassischer Tanztechnik heute* – Diplomarbeit, Nachdiplomstudium TanzKultur 2002-2004 an der Universität Bern

19. Andrea Stocklin – *Das en déhors as physiotherapeutischer Sicht – ein Untersuchung von Tänzerinnen und Tänzern des Stadttheaters Luzern (Teil 1)* – Zeitschrift für Physiotherapeuten, 2001 Aug; Jg. 53(8): 1359-74
20. Klaus-Peter Valerius, Astrid Frank, Bernard C. Kloster, Martin C. Hirsch, Christine Hamilton, Enrique A. Lafont – *Das Muskelbuch: Funktionelle Darstellung der Muskeln des Bewegungsapparates* – Hippokrates Verlag in MVS Medizinverlage Stuttgart GmbH & Co. KG, copyright © 2002 KVM Dr. Kolster und Co. Produktions und Verlags-GmbH, Marburg
21. L.M.Vincent, M.D. – *The Dancer's Book of Health* – Andrews and McMeel, Inc. a Universal Press Syndicate Company – copyright © 1978