Improving Ankle and Knee Joint Stability

Proprioceptive Balancefit Discs Drills

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To Ambra-Cezara, Cătălina, Ștefan, Florin and Ioana-Ilinca
DISCLAIMER

The drills presented in this book should be performed only under strict supervision of a professional trainer. The reader should be cautioned that there is an inherent risk assumed by the participant with any form of physical activity. With that in mind, those participating in this kind of exercises should check with their physician prior to initiating such activities. Anyone participating in these activities should understand that such training initiatives may be dangerous if performed incorrectly. The authors assume no liability for injury; this is purely an educational guide for those already proficient with the demands of such physical exercises.
ILLUSTRATIONS

**Chapter 1:** Figures 1 and 5—Wikipedia.org (http://en.wikipedia.org/wiki/Ankle_joint); Figure 6—www.foot-care.org/ankle-sprains.php; Figures 2, 3, 4, 7, 8, 9, 10, 11, 12, 13, 14—20th U.S. edition of *Gray’s Anatomy of the Human Body, 1918* (http://www.bartleby.com/107/)

**Chapter 2:** Figure 15—http://www.yatego.com/johannis-apotheke/p,46b33c21d119b,457011a4efb675_2,sissel-balance-fit-blau?sid=14Y1280300672Y14bb4d74cc1748f82f

**Chapters 2, 3, 4, 5:** Figures 16 to 76—Photographs by Alexandru Acsinte, Alexandra Milon, Bogdan Milon, Ovidiu Bondăreț, Lucian Lupescu
In this book we tried to capture some of the most important aspects of stability development in the ankle and knee joints, as well as an improvement in proprioception, with the help of Balancefit discs (also known as Balance discs, Bobbled Balance Discs, Core Discs, or Stability Discs).

Why Balancefit discs?
Mainly, the joint stability can be improved using tools such as Bosu, wobble board, balance board etc.

But we think that the Balancefit discs, in this case, are most appropriate for the drills we proposed.

The advantage of Balancefit discs, from the point of view of an increased effectiveness over the anatomical/physiological and biomechanical characteristics of different motor acts, is that they allow a lot more strain to be put on the muscles and ligaments, regarding the plans and axis of the movements we are trying to train.

In comparison with the balance boards and the wobble boards that have a flat and hard foot contact surface, the Balancefit discs strain the plantar surface of the foot right through that mobile and flexible contact area.

Hence, the stress found in the ankle joint is not reduced to controlled and limited eversions and inversions, dorsiflexions and plantar flexions, but there are also tendencies to slide back and forward, and all of these movements can be combined. The complexity of the exercises can be directed and controlled also through the degree of inflation of the discs.

Another great advantage of using Balancefit discs is that many of the drills presented in this book can be adapted for a multitude of athletic disciplines, from sportive playing games to winter sports.

Also, we must emphasize that the Balancefit discs can be used in the Physical Education lesson, as well as during any sportive recreational activity, where they can be important and great fun means of developing the
coordination and static and dynamic balance, starting with children even as young as four.

All in all, we hope you find our book useful and enjoyable. Good luck with your training programme!

The Authors
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One of the best classifications and definitions of joints can be found in Michael J. Altser’s massive reference work *Science of Flexibility (Third Edition)*, Human Kinetics, 2004, pp. 15-16):

The junction of two or more bones is an articulation, commonly known as a joint. Joints are classified according to the amount of movement they allow and according to their structural composition. The simpler classification is the one based on the amount of gross movement. According to this classification, synarthroses are immovable joints, amphiarthroses are slightly movable joints, and diarthroses are freely movable joints.

Articulating bones of diarthroses have a variety of shapes. The classification based on structural composition has six different types of joints.

- **Ball-and-socket joints.** These joints provide the greatest amount and range of motion (ROM), allowing movement in three directions. In this type of joint, a bone with a more or less rounded head (ball) lies in a cuplike or bowl-shaped cavity (socket). The hip is a ball-and-socket joint.
- **Condyloid or ellipsoid joints.** This type of joint permits movement in two directions: flexion-extension and abduction-adduction. The surface of the articulation is oval shaped, with an elliptical cavity on one bone receiving the other bone. The wrist joint between the radius and carpal bones is such a joint.
- **Hinge joints.** This type of joint allows angular movement in only one plane. Therefore, motion is limited to flexion and extension. This
movement is similar to a door on a hinge, hence the name. The ankle, elbow, and knee are hinge joints.

- **Pivot joints.** These joints permit only a rotary movement in one axis. A ring rotates around a pivot, or a pivotlike process rotates within a ring that is formed of bone and connective tissue. This kind of joint occurs between the first and second cervical vertebrae (atlas and axis, respectively), where head rotation occurs on the neck, and between the radius and ulna, where forearm pronation and supination take place.

- **Plane or gliding joints.** This type of joint permits gliding movements only. The facet joints of the vertebrae in the spine and the intercarpal joints of the hand are such joints. In this type of joint, the articular surfaces are nearly flat, or one surface may be slightly convex and the other slightly concave.

- **Saddle joints.** This joint resembles a saddle on a horse’s back. The surface of each bone is concave in one direction but convex in the perpendicular direction. This joint allows movement in two directions: flexion-extension and abduction-adduction. The best example of a saddle joint is the carpometacarpal joint at the base of the thumb.

### 1.1. The Ankle Joint

Article partially taken from Wikipedia.org
(http://en.wikipedia.org/wiki/Ankle_joint
and http://en.wikipedia.org/wiki/Ankle_sprain):

The ankle joint is formed where the foot and the leg meet. This joint is primarily responsible for the upwards and downwards movement from our legs down to our feet. The ankle also holds responsibility for the flexibility of movement when we sidestep or commit ourselves to lateral movements (www.foot-care.org/ankle-sprains.php).

The ankle, or talocrural joint, is a synovial hinge joint that connects the distal ends of the tibia and fibula in the lower limb with the proximal end of the talus bone in the foot. The articulation between the tibia and the talus bears more weight than between the smaller fibula and the talus.
The lateral malleolus of the fibula and the medial malleolus of the tibia along with the inferior surface of the distal tibia articulate with three facets of the talus. These surfaces are covered by cartilage.

The ankle joint is bound by the strong deltoid ligament and three lateral ligaments: the anterior talofibular ligament, the posterior talofibular ligament, and the calcaneofibular ligament.

The deltoid ligament supports the medial side of the joint, and is attached at the medial malleolus of the tibia and connects in four places to the sustentaculum tali of the calcaneus, calcaneonavicular ligament, the navicular tuberosity, and to the medial surface of the talus.

The anterior and posterior talofibular ligaments support the lateral side of the joint from the lateral malleolus of the fibula to the dorsal and ventral ends of the talus.

The calcaneofibular ligament is attached at the lateral malleolus and to the lateral surface of the calcaneus.

*Figure 1.* Lateral view of the human ankle
Figure 2. Ligaments of the medial aspect of the foot

Figure 3. Ligaments of the foot from the lateral aspect
The joint is most stable in dorsiflexion and a sprained ankle is more likely to occur when the foot is plantar flexed. This type of injury more frequently occurs at the anterior talofibular ligament.

Figure 4. Capsule of left talocrural articulation (distended)

1.1.1. Disorders and injury

Most traumatic incidents involving the ankle result in ankle sprains. Being a joint between the bones tibia, fibula and the talus, the ankle is a part of the human anatomy that handles much of the strain from the feet and the legs. More often than not, athletes are the ones who always experience ankle sprains. They often utilize their bodies and at some times prove to overtax their limits and thus result in the getting sprained foot. Continuous jumping and running takes its toll upon the ankle and the muscles within. Aside from athletes, many other people experience sprains. This may not be the result of serious physical activity or regular exercise, sprains may also occur among people who live their normal run-of-the-mill lives, where walking the dog or pushing the cart down a grocery lane are among the most strenuous forms of exercise (www.foot-care.org/ankle-sprains.php).

Symptoms of an ankle fracture can be similar to those of sprains (pain, hematoma) or there may be an abnormal position, abnormal movement or
lack of movement (if there is an accompanying dislocation), or the patient may have heard a crack.

![Bimalleolar fracture and right ankle dislocation on X-ray (anteroposterior). Both the end of the fibula (1) and the tibia (2) are broken and the malleolar fragments (arrow: medial malleolus, arrowhead: lateral malleolus) are displaced.](image)

**Figure 5.** Bimalleolar fracture and right ankle dislocation on X-ray (anteroposterior). Both the end of the fibula (1) and the tibia (2) are broken and the malleolar fragments (arrow: medial malleolus, arrowhead: lateral malleolus) are displaced.

A sprained ankle, also known as an ankle sprain, or as twisted ankle, rolled ankle, ankle injury or ankle ligament injury, is a common medical condition where one or more of the ligaments of the ankle is torn or partially torn. The anterior talofibular ligament is one of the most commonly involved ligaments. Sprains to the lateral aspect of the ankle account for 85% of ankle sprains.

Sprains happen when the foot is rolled or turned beyond motions that are considered normal for the ankle. When an ankle is placed on uneven surface or experiences a large force when landing the ligaments can be stretched into an abnormal position. The ligaments of the ankle hold the ankle bones and joint in position. They protect the ankle joint from abnormal movements-especially twisting, turning, and rolling of the foot.

Most sprains occur during shifting after the foot has been planted. In most cases the ankle will roll out as the foot turns towards the inside of the body. Ligaments then stretch or tear depending on the amount of force that was placed on it. This can occur during the fast motions of sports or simply while walking on an uneven surface.
Classification

Ankle sprains are classified as grade 1, 2, and 3 (Moreira V, Antunes F., 2008), according to the severity of damage. Some of the most common causes of ankle injuries are: lack of conditioning, lack of warming up and stretching properly, previous history of an ankle sprain, inadequate shoes, and uneven ground (www.sprainankle.net). Depending on the amount of damage or the number of ligaments that are damaged, each sprain is classified from mild to severe. The amount of force that is placed on the ankle helps classify which grade of sprain is suffered. A mild sprain or one that causes slight stretching with minimal damage to the fibres in the ligament is considered a Grade 1 sprain. When there is some tearing of the ligament and the ankle joint moves in abnormal ways, it is noted to be a Grade 2 sprain. The final classification is Grade 3 sprain and includes severe injuries. These are ones where complete tears of a ligament and the presence of instability is experienced. Usually bruising will occur around the ankle but this can be prevented by putting ice on it and not putting it into hot water.

Diagnosis

It is important to either rule out a fracture clinically or radiologically. A sudden movement or twist often when the foot rolls in can overstretch the supporting ligaments, causing ligament tears and bleeding around the joint. This is known as a sprain. This type of injury occurs most frequently in activities that require running, skipping, jumping and change of direction (such as Basketball, Netball, Football/Soccer, or Team Handball). Some people are particularly prone to recurring ankle sprains.

Sprain, strain or break?

Sprains are stretched or torn ligaments that are injured when the ankle is twisted or rolled, but what is the difference between this and a strain or a bone fracture? With a strain, there is a twist or tear of the tendons in the ankle that connect the muscle with the bones, while a break is a complete fracture or splinter of the bone itself. Sprains are caused by trauma, strains are caused by over stretching or pulling the muscle or tendon, and breaks by excessive force to the area.
Symptoms

Knowing the symptoms that can be experienced with a sprain is important in determining that the injury is not really a break in the bone. When a sprain occurs, blood vessels will leak fluid into the tissue that surrounds the joint. White blood cells responsible for inflammation migrate to the area, and blood flow increases as well (Ankle Sprains Symptoms—eMedicineHealth.com). Along with this inflammation, swelling from the fluid and pain is experienced. The nerves in the area become more sensitive when the injury is suffered, so pain is felt as throbbing and will worsen if there is pressure placed on the area. Warmth and redness are also seen as blood flow is increased.

Rehabilitation

If an ankle sprain does not heal properly, the joint may become unstable and may develop chronic pain (Sprained Ankle Overview—Webmd.com). Receiving proper treatment and performing exercises that promote ankle function is important to strengthen the ankle and prevent further injury.

It is okay to begin approved exercises not too long after the injury is suffered. The amount of therapy that a person can handle will depend on their level of pain and the grade of sprain they experienced. It is not recommended to return to sports or extreme physical activities until hopping on the ankle is achieved without pain. Wearing high-top tennis shoes may also help prevent ankle sprains if your shoes are laced snugly and if you also tape your ankle.
with a wide, nonelastic adhesive tape (Ankle Sprains: Healing and Preventing Injury—Family doctor.org).

**Ankle exercises**

To prevent sprains or re-injury from occurring, the following exercises can be used to strengthen the ankle. Ankle circles are performed by stretching the legs in front of the body and sliding the ankles up and down, side to side, or rotating the joint in a circle. Another common exercise is using the toes to draw the letters of the alphabet in the air. This promotes flexibility and stretches the ligaments in the ankle. Flexing and pointing the toes repeatedly is also effective. Balance and stability training is especially important to retrain the ankle muscles to work together to support the joint (Sprained Ankle: Treatment and Drugs—Mayo clinic.com). This includes exercises that are performed by standing on one leg and using the injured ankle to lift the body onto its toes.

**1.2. The Knee Joint**


The knee joint binds the thigh with the leg and consists of two articulations: one between the femur and tibia, and one between the femur and patella (knee+joint at eMedicine Dictionary), being the largest joint in the human body. The knee is a mobile trocho-ginglymus (i.e. a pivotal hinge joint), which permits flexion and extension as well as a slight medial and lateral rotation. Since in humans the knee supports nearly the whole weight of the body, it is the joint most vulnerable to both acute injury and the development of osteoarthritis.
Figure 7. Capsule of right knee-joint (distended). Lateral aspect

It is often grouped into tibiofemoral and patellofemoral components (Rytter S, Egund N, Jensen LK, Bonde JP, 2009; Gill TJ, Van de Velde SK, Wing DW, Oh LS, Hosseini A, Li G, 2009).
The knee is a complex, compound, condyloid variety of a synovial joint. It actually comprises three functional compartments: the femoropatellar articulation consists of the patella, or “kneecap”, and the patellar groove on the front of the femur through which it slides; and the medial and lateral femorotibial articulations linking the femur, or thigh bone, with the tibia, the main bone of the lower leg (Burgener, 2002, p 390). The joint is bathed in synovial fluid which is contained inside the synovial membrane called the joint capsule.

The articular bodies of the femur are its lateral and medial condyles. These diverge slightly distally and posteriorly, with the lateral condyle being wider in front than at the back while the medial condyle is of more constant width (Platzer, 2004, p 206). The radius of the condyles’ curvature in the sagittal plane becomes smaller toward the back. This diminishing radius produces a series of involute midpoints (i.e. located on a spiral). The resulting series of transverse axes permit the sliding and rolling motion in the flexing
knee while ensuring the collateral ligaments are sufficiently lax to permit the rotation associated with the curvature of the medial condyle about a vertical axis (Platzer, 2004, pp 194-195).

Figure 9. Right knee-joint. Anterior view
The pair of tibial condyles are separated by the intercondylar eminence (Platzer, 2004, p 206) composed of a lateral and a medial tubercle, (Platzer, 2004, p 202).

The patella is inserted into the thin anterior wall of the joint capsule (Platzer, 2004, p 206). On its posterior surface is a lateral and a medial articular surface (Platzer, 2004, pp 194-195), both of which communicate...
with the patellar surface which unites the two femoral condyles on the anterior side of the bone’s distal end (Platzer, 2004, p 192).

Figure 11. Right knee-joint, from the front, showing interior ligaments
The knee permits flexion and extension about a virtually transversal axis, as well as a slight medial and lateral rotation about the axis of the lower leg in the flexed position. The knee joint is called “mobile” because the femur and menisci move over the tibia during rotation, while the femur rolls and glides over the menisci during extension-flexion (Platzer, 2004, pp 212-213).
The centre of the transverse axis of the extension/flexion movements is located where both collateral ligaments and both cruciate ligaments intersect. This centre moves upward and backward during flexion, while the distance between the centre and the articular surfaces of the femur changes dynamically with the decreasing curvature of the femoral condyles. The total range of motion is dependent of several parameters such as soft-tissue restraints, active insufficiency, and hamstring tightness (Thieme Atlas of Anatomy, 2006, pp 398-399).
Extended position

With the knee extended both the lateral and medial collateral ligaments, as well as the anterior part of the anterior cruciate ligament, are taut. During extension, the femoral condyles glide into a position which causes the complete unfolding of the tibial collateral ligament. During the last 10° of extension, an obligatory terminal rotation is triggered in which the knee is rotated medially 5°. The final rotation is produced by a lateral rotation of the
tibia in the non-weight-bearing leg, and by a medial rotation of the femur in the weight-bearing leg. This terminal rotation is made possible by the shape of the medial femoral condyle, assisted by the iliotibial tract and is caused by the stretching of the anterior cruciate ligament. Both cruciate ligaments are slightly unwound and both lateral ligaments become taut (Platzer, 2004, pp 212-213).

**Flexed position**

In the flexed position, the collateral ligaments are relaxed while the cruciate ligaments are taut. Rotation is controlled by the twisted cruciate ligaments; the two ligaments get twisted around each other during medial rotation of the tibia—which reduces the amount of rotation possible—while they become unwound during lateral rotation of the tibia. Because of the oblique position of the cruciate ligaments at least a part of one of them is always tense and these ligaments control the joint as the collateral ligaments are relaxed. Furthermore, the dorsal fibres of the tibial collateral ligament become tensed during extreme medial rotation and the ligament also reduces the lateral rotation to 45-60° (Platzer, 2004, pp 212-213).

### 1.2.1. Disorders and injury

Knee pain is caused by trauma, misalignment, and degeneration as well as by conditions like arthritis. The most common knee disorder is generally known as patellofemoral syndrome. The majority of minor cases of knee pain can be treated at home with rest, ice but more serious injuries do require surgical care (http://www.kneeanatomy.net/).

One form of patellofemoral syndrome involves a tissue-related problem that creates pressure and irritation in the knee between the patella and the trochlea (patellar compression syndrome), which causes pain. The second major class of knee disorder involves a tear, slippage, or dislocation that impairs the structural ability of the knee to balance the leg (patellofemoral instability syndrome). Patellofemoral instability syndrome may cause pain, a sense of poor balance, or both (Afra R. and Schepsis A., May 28, 2008).

Age also contributes to disorders of the knee. Particularly in older people, knee pain frequently arises due to osteoarthritis. In addition, weakening of tissues around the knee may contribute to the problem (Pill SG, Khoury LD, Chin GC et al., October 29, 2008). Patellofemoral instability may relate to hip abnormalities or to tightness of surrounding ligaments (Afra R. and Schepsis A., May 28, 2008).
Cartilage lesions can be caused by:

- Accidents (fractures)
- Injuries
- The removal of a meniscus
- Anterior cruciate ligament injury
- Posterior cruciate ligament injury
- Considerable strain on the knee.

Any kind of work during which the knees undergo heavy stress may also be detrimental to cartilage. This is especially the case in professions in which people frequently have to walk, lift, or squat. Other causes of pain may be excessive on, and wear of, the knees, in combination with such things as muscle weakness and overweight.

Common complaints:

- A painful, blocked, locked or swollen knee.
- Sufferers sometimes feel as if their knees are about to give way, or may feel uncertain about their movement.

The pain felt by people with cartilage injury does not come from the cartilage itself, but from the irritated tissue surrounding the cartilage, or from pieces of cartilage that have come loose. If cartilage injury goes untreated, the layer of cartilage will continue to gradually wear away, causing arthrosis and gradual immobility.

**Overall fitness and knee injury**

Physical fitness is related integrally to the development of knee problems. The same activity such as climbing stairs may cause pain from patellofemoral compression for someone who is physically unfit, but not for someone else (or even for that person at a different time). Obesity is another major contributor to knee pain. For instance, a 30-year-old woman who weighed 120 lb at age 18 years, before her three pregnancies, and now weighs 285 lb, had added 660 lb of force across her patellofemoral joint with each step (Andrish JT., May 8, 2009).

**Common injuries due to physical activity**

In sports that place great pressure on the knees, especially with twisting forces, it is common to tear one or more ligaments or cartilages.
**Anterior cruciate ligament injury**

ACL is the most commonly injured ligament of the knee. The injury is common during sports. Twisting of the knee is a common cause of over-stretching or tearing the ACL. When the ACL is injured one may hear a popping sound and the leg may suddenly give out. Besides swelling and pain, walking may be painful and the knee will feel unstable. Minor tears of the anterior cruciate ligament may heal over time, but a torn ACL requires surgery. After surgery, recovery is prolonged and low impact exercises are recommended to strengthen the joint (http://sportsmedicine.about.com/od/kneepainandinjuries/Knee_Pain_and_Injuries.htm).

**Torn meniscus injury**

The menisci act as shock absorbers and separate the two ends of bone in the knee joint. There are two menisci in the knee, the medial (inner) and the lateral (outer). When there is torn cartilage, it means that the meniscus has been injured. Meniscus tears occur during sports often when the knee is twisted. Menisci injury may be innocuous and one may be able to walk after a tear, but soon swelling and pain set in. Sometimes the knee will lock while bending. Pain often occurs when one squats. Small meniscus tears are treated conservatively but most large tears require surgery (Tandeter, Howard B.).

**Fractures**

Knee fractures are rare but do occur, especially as a result of motor vehicle accidents. There is usually immediate pain; swelling and one may not be able to stand on the leg. The muscles go into spasm and even the slightest movements are painful. X-rays can easily confirm the injury and surgery depends on the degree of displacement and type of fracture.

**Ruptured tendon**

Tendons usually attach muscle to bone. In the knee the quadriceps and patellar tendon can sometimes tear. The injuries to these tendons occur when there is forceful contraction of the knee. If the tendon is completely torn, bending or extending the leg is impossible. A completely torn tendon requires surgery but a partially torn tendon can be treated with leg immobilization followed by physical therapy.
**Overuse**

Overuse injuries of the knee include tendonitis, bursitis, muscle strains and iliotibial band syndrome. These injuries often develop slowly over weeks or months. Activities that induce pain usually delay healing. Rest, ice and compression do help in most cases. Once the swelling has diminished, heat packs can increase blood supply and promote healing. Most overuse injuries subside with time but can flare up if the activities are quickly resumed (http://www.nlm.nih.gov/medlineplus/kneeinjuriesanddisorders.html). To prevent overuse injuries, warm up prior to exercise, limit high impact activities and keep your weight under control (http://www.bigkneepain.com/knee_injuries.html).

1.3. Proprioception

Proprioception is the body’s ability to get information to the brain in response to a stimulus arising within the body; it also refers to the body’s ability to sense the position of its limbs at any moment. For example, an athlete who has gone airborne and then lands on an opponent’s foot may injure his/her ankle if his/her brain does not sense that he/she is landing on someone’s shoe and not the floor. Without proper proprioception, the body may not get the right muscles to fire at the right time to protect a joint. Because an athlete may have deficient proprioception due to an injury, many Athletic Trainers believe that proprioception should be addressed in the early stages of a therapeutic exercise program, and thus many rehabilitation programs emphasize early proprioceptive training.

Proprioception training can be started early in a therapeutic exercise program by doing such things as balance or coordination exercises (Lorin A. Cartwright, William A. Pitney, 2005).

**Basis of proprioceptive sense**

The initiation of proprioception is the activation of a proprio receptor in the periphery (Sherrington CS, 1907). The proprioceptive sense is believed to be composed of information from sensory neurons located in the inner ear (motion and orientation) and in the stretch receptors located in the muscles and the joint-supporting ligaments (stance). There are specific nerve receptors for this form of perception termed “proprioceptors,” just as there are specific receptors for pressure, light, temperature, sound, and other sensory experiences. Proprioceptors are sometimes known as adequate stimuli receptors.
Although it was known that finger kinaesthesia relies on skin sensation, recent research has found that kinaesthesia-based haptic perception relies strongly on the forces experienced during touch (Robles-De-La-Torre G, Hayward V, 2001). This research allows the creation of “virtual”, illusory haptic shapes with different perceived qualities (http://www.technologyreview.com/read_article.aspx?id=17363&ch=biotech &sc=&pg=1). (http://en.wikipedia.org/wiki/Proprioception)

Human beings “train” for proprioception in the quest for efficient everyday movements. Proprioception is unconscious initially, but can be enhanced with training, according to Greg Niederlander, an exercise physiologist. Specialized sensory receptors in the muscles, joints and connective tissues enable the body to process information from a variety of stimuli, and turn that information into action.

“Through conscious appreciation and cognitive processing of the body’s position in space, the central nervous system and sensory receptors can be conditioned to be more responsive to length and tension in the muscles and tendons,” says Niederlander. Additionally, the skin, palms of the hands, soles of the feet and other senses collaborate to communicate with the brain about muscle tension, weight shifts, load and range of motion.

“There is a fine line between proprioception and kinaesthetic awareness,” says Paul Chek, founder of the CHEK Institute in Encinitas, Calif. “Improving one often improves the other. For example, performing any functional exercise that requires you [to] maintain your centre of gravity over your base of support will contribute to improvement of kinaesthetic awareness (a sense of one’s whole body), as well as proprioception.” Chek uses an example of skiing at high speed, which requires reflexive movement intelligence: “When skiing down a mountain at high speed, all at once you must be able to sense the position of your limbs relative to the rest of your body, the position of your body relative to the earth and gravity, and interaction with the skis and terrain.” Your body automatically coordinates with stimuli obtained from the immediate experience and turns them into physical action.

The key to creating what Chek refers to as movement intelligence involves individuals becoming consciously aware of their movements, and of the information their bodies are absorbing. To do this, stimuli is created to elicit a movement reaction through a variety of tasks or exercises. As skill improves, more stimuli are needed to continue improvement. This type of exercise planning involves integration of the mind and body, combining balance, strength and quickness. The result is the person’s heightened ability to make spur-of-the-moment decisions about what their capabilities are in any given situation.
A common example of loss of proprioception can be seen in any athlete who is required to use the arms and shoulders with precision, such as shooters, boxers, throwers (baseball), archers, and even people who throw darts in the bar or shoot pool, says Chek. For instance, he says, “After an injury to the shoulder joint, I have seen many people complain of a loss of accuracy and performance, which I have corrected using exercises to improve proprioception.” (http://www.coachr.org/proprio.htm)

The proprioceptive sense can be sharpened through study of many disciplines. Examples are the Feldenkrais method and the Alexander Technique. Juggling trains reaction time, spatial location, and efficient movement. Standing on a wobble board, balance board, or Balancefit disc is often used to retrain or increase proprioception abilities, particularly as physical therapy for ankle or knee injuries. Standing on one leg (stork standing) and various other body-position challenges are also used in such disciplines as Yoga, Wing Chun and Tai Chi. Several studies have shown that the efficacy of these types of training is challenged by closing the eyes, because the eyes give invaluable feedback to establishing the moment-to-moment information of balance. There are even specific devices designed for proprioception training, such as the exercise ball, which works on balancing the abdominal and back muscles (http://en.wikipedia.org/wiki/Proprioception).

It has been seen that temporary loss or impairment of proprioception may happen periodically during growth, mostly during adolescence. Growth that might also influence this would be large increases or drops in bodyweight/size due to fluctuations of fat (liposuction, rapid fat loss or gain) and/or muscle content (bodybuilding, anabolic steroids, catabolisis/starvation). It can also occur in those that gain new levels of flexibility, stretching, and contortion. A limb’s being in a new range of motion never experienced (or at least, not for a long time since youth perhaps) can disrupt one’s sense of location of that limb. Possible experiences include suddenly feeling that feet or legs are missing from one’s mental self-image; needing to look down at one’s limbs to be sure they are still there; and falling down while walking, especially when attention is focused upon something other than the act of walking.

Proprioception is occasionally impaired spontaneously, especially when one is tired. One’s body may appear too large or too small, or parts of the body may appear distorted in size. Similar effects can sometimes occur during epilepsy or migraine auras. These effects are presumed to arise from abnormal stimulation of the part of the parietal cortex of the brain involved with integrating information from different parts of the body (Ehrsson H, Kito T, Sadato N, Passingham R, Naito E., 2005).

The proprioceptive sense is often unnoticed because humans will adapt to a continuously-present stimulus; this is called habituation, desensitization, or adaptation. The effect is that proprioceptive sensory impressions disappear,
just as a scent can disappear over time. One practical advantage of this is that unnoticed actions or sensation continue in the background while an individual’s attention can move to another concern. The Alexander Technique addresses these issues.

People that have a limb amputated may still have a confused sense of that limb existence on their body, known as phantom limb syndrome. Phantom sensations can occur as passive proprioceptive sensations of the limb’s presence, or more active sensations such as perceived movement, pressure, pain, itching, or temperature. The etiology of the phantom limb phenomenon was disputed in 2006, but some consensus existed in favour of neurological (e.g., neural signal bleed across a preexisting sensory map, as posited by V.S. Ramachandran) over psychological explanations. Phantom sensations and phantom pain may also occur after the removal of body parts other than the limbs, such as after amputation of the breast, extraction of a tooth (phantom tooth pain), or removal of an eye (phantom eye syndrome).

Temporary impairment of proprioception has also been known to occur from an overdose of vitamin B6 (pyridoxine and pyridoxamine). Most of the impaired function returns to normal shortly after the intake of vitamins returns to normal. Impairment can also be caused by cytotoxic factors such as chemotherapy.

It has been proposed that even common tinnitus and the attendant hearing frequency-gaps masked by the perceived sounds may cause erroneous proprioceptive information to the balance and comprehension centers of the brain, precipitating mild confusion.

Proprioception is permanently impaired in patients that suffer from joint hypermobility or Ehlers-Danlos Syndrome (a genetic condition that results in weak connective tissue throughout the body). It can also be permanently impaired from viral infections as reported by Sacks. The catastrophic effect of major proprioceptive loss is reviewed by Robles-De-La-Torre (2006).

Proprioception is what allows someone to learn to walk in complete darkness without losing balance. During the learning of any new skill, sport, or art, it is usually necessary to become familiar with some proprioceptive tasks specific to that activity. Without the appropriate integration of proprioceptive input, an artist would not be able to brush paint onto a canvas without looking at the hand as it moved the brush over the canvas; it would be impossible to drive an automobile because a motorist would not be able to steer or use the foot pedals while looking at the road ahead; a person could not touch type or perform ballet; and people would not even be able to walk without watching where they put their feet.

Oliver Sacks once reported the case of a young woman who lost her proprioception due to a viral infection of her spinal cord (Sacks, O.. “The Disembodied Lady”, in *The Man Who Mistook His Wife for a Hat* and his
autobiographical case study *A Leg to Stand On*). At first she was not able to move properly at all or even control her tone of voice (as voice modulation is primarily proprioceptive). Later she relearned by using her sight (watching her feet) and inner ear only for movement while using hearing to judge voice modulation. She eventually acquired a stiff and slow movement and nearly normal speech, which is believed to be the best possible in the absence of this sense. She could not judge effort involved in picking up objects and would grip them painfully to be sure she did not drop them (http://en.wikipedia.org/wiki/Proprioception).

**Proprioception and kinaesthesia**
(http://en.wikipedia.org/wiki/Proprioception)

Kinaesthesia is another term that is often used interchangeably with proprioception, though use of the term “kinaesthesia” can place a greater emphasis on motion (eMedicine Dictionary)

Some differentiate the kinaesthetic sense from proprioception by excluding the sense of equilibrium or balance from kinaesthesia. An inner ear infection, for example, might degrade the sense of balance. This would degrade the proprioceptive sense, but not the kinaesthetic sense. The affected individual would be able to walk, but only by using the sense of sight to maintain balance; the person would be unable to walk with eyes closed.

Proprioception and kinaesthesia are seen as interrelated and there is considerable disagreement regarding the definition of these terms. Some of this difficulty stems from Sherrington’s original description of joint position sense (or the ability to determine exactly where a particular body part is in space) and kinaesthesia (or the sensation that the body part has moved) under a more general heading of proprioception. Clinical aspects of proprioception are measured in tests that measure a subject’s ability to detect an externally imposed passive movement, or the ability to reposition a joint to a predetermined position. Often it is assumed that the ability of one of these aspects will be related to another; however, experimental evidence suggests there is no strong relation between these two aspects. This suggests that, while these components may well be related in a cognitive manner, they seem to be separate physiologically.

Much of the foregoing work is dependent on the notion that proprioception is, in essence, a feedback mechanism; that is, the body moves (or is moved) and then the information about this is returned to the brain, whereby subsequent adjustments could be made. More recent work into the mechanism of ankle sprains suggests that the role of reflexes may be more limited due to their long latencies (even at the spinal cord level), as ankle sprain events occur in perhaps 100 msec or less. In accordance, a model
has been proposed to include a ‘feedforward’ component of proprioception, whereby the subject will also have central information about the body’s position prior to attaining it.

Kinaesthesia is a key component in muscle memory and hand-eye coordination, and training can improve this sense (see blind contour drawing). The ability to swing a golf club or to catch a ball requires a finely-tuned sense of the position of the joints. This sense needs to become automatic through training to enable a person to concentrate on other aspects of performance, such as maintaining motivation or seeing where other people are.

**Conscious and unconscious proprioception**
(http://en.wikipedia.org/wiki/Proprioception)

In humans, a distinction is made between conscious proprioception and unconscious proprioception:

Conscious proprioception is communicated by the posterior column-medial lemniscus pathway to the cerebrum (Fix, James D., 2002)

Unconscious proprioception is communicated primarily via the dorsal spinocerebellar tract, (http://www.dartmouth.edu/~rswagen/NeuroSci/chapter_7A.html#Unconscious_sensation) to the cerebellum.

Such an unconscious reaction is seen in the human proprioceptive reflex. This remarkable proprioceptive reflex (Law of Righting), in the event that the body tilts in any direction, will cock the head back to level the eyes against the horizon (http://erikdalton.com/NewslettersOnline/Feb06Newsletter.htm). This is seen even in infants as soon as they gain control of their neck muscles. This control comes from the cerebellum, the part of the brain affecting balance.
CHAPTER 2

Walking Drills

The drills in this book are presented as isolated structures of exercises. They can be collected in a succession of exercises, depending on the objectives of the coach/trainer/athlete, as well as depending on the sports branch the athlete is training for. We recommend the balance position to be maintained between 5-10 seconds, but, of course, the time can vary, depending on the individual’s anatomy, his/her motor experience, sports branch, as well as the period in the competition calendar of each athlete and/or sport. These exercises will prove their effectiveness and will have an impact on the athletes’ motor skills if they are used and applied appropriately.

The tools used in creating the drills presented in this book are Balancefit discs. The Balancefit is a multifunctional training device used to improve the sense of balance, physical coordination, strength and circulation.

Figure 15. Balancefit disc
It has several features:

- Specially shaped nodules in two different thicknesses on the standing surface increase the body’s perceptive ability. You are constantly presented with a slightly unstable and ever changing surface thus utilising stabiliser muscles and improving your proprioception system.
- Larger knobs on the bottom side stimulate and increase the body’s perceptive ability
- Needle-valve for individual pressure regulation
- Size: ~ 13.4 in (340 mm diameter) (they can be found also in larger sizes, but this is the one we used for the drills presented in this book).

Colour could vary.

(*NOTE: In the following chapters we will use the abbreviation “BF” for Balancefit.*

Considering the fact that the drills presented in this chapter have a relatively simple motor structure (from the point of view of the complexity of the knee and ankle joints motor and biomechanical stress), they are recommended in the following situations:

- During warm-up;
- For increasing the stability of the ankle and knee ligaments;
- During rehabilitation sessions after 1st, 2nd and 3rd degree ankle sprains; the lunge walking drills are recommended for the 3rd degree ankle sprains only under strict medical supervision.
- For individuals with ankle joint laxity.

All the drills in this chapter can be very well combined with the exercises presented in the other chapters, to be used in prophylactic, warm-up, proprioceptive education and sensory-motor control programs.

The walking drills significantly influence the joint stability if they are coupled with lunge drills, in order to prevent injuries that can appear during great stress on the anterior-posterior direction (sudden stops from a speedy movement, or backwards movements in a linear trajectory).

The lunge walking drills are recommended both for the post-traumatic rehabilitation period and warm-ups. Also, for strengthening the patellar tendon; they can be combined with walking drills and 90 degrees thigh lifting drills. These exercises can be used also during the rehabilitation program for the Achilles tendon injuries, only under strict specialist supervision.
This kind of exercises should be introduced as a part of physical training programmes for different sports branches, in order to familiarize the athletes with the particularities of Balancefit tools, their shape, elasticity, reactivity when stress is applied from different directions etc.

The drills presented in this chapter can be a part of any kind of core stabilization, proprioception and agility programmes, in order to enhance performance and to prevent lower limb injuries in sports, and/or as means of familiarizing athletes with complex structures of exercises, using helping tools.
A. Walking forward with one foot on the BF disc and one on the floor (Figures 16a-16f)
B. The same movements as in the drill before (A), but walking with the other leg on the BF disc. (Figures 17a-17b)
C. Walking backwards with one foot on the BF disc and one on the floor (Figures 18a-18d). Same exercise using the other leg on the BF disc.
D. Walking forward on the BF discs, positioned in a zigzag pattern (Figures 19a-19d)

Figure 19a

Figure 19b
E. The same movements as in the previous drill (D), only walking backwards (Figures 20a-20d).

Figure 20a

Figure 20b
Figure 20c

Figure 20d
F. Walking forward, with a step on each of the BF discs (Figures 21a-21d).
Figure 21c

Figure 21d
G. Walking forward on the BF discs, but stepping over one BF disc each time (Figures 22a-22d).
H. Walking forward on each BF disc, but at each step the subject maintains his/her thigh lifted at an approximately 90 degrees angle (Figures 23a-23f). We recommend each lifting of the thigh to be maintained for at least 3 seconds.

Figure 23a

Figure 23b
Figure 23e

Figure 23f
I. The same movements as in the previous drill (H), only backwards (Figures 24a-24f).
Figure 24c

Figure 24d
J. Walking with a forward lunge at every step (Figures 25a-25d).
NOTE: The length of the lunged step can be adapted to each individual’s anatomy.
K. Walking with a side lunge at every step (BF discs placed in a zigzag pattern) (figures 26a-26d).
NOTE: We recommend each lunge to be maintained for at least 2 seconds. Also, this drill can be performed backwards.
CHAPTER 3

Lunge Drills

This chapter presents simple drills, as far as the structure and complexity are concerned, but recommended for warm up and for introducing the athletes to the Balancefit characteristics. These drills can be introduced in the beginning, as well as at the end of training sessions, alternating with simple stretching exercises for the anterior thigh muscle groups (sartorius and quadriceps femoris), and for the adductor and hamstrings muscles.

These drills are performed at floor level, and on heightened surfaces—a bench, in our case, but you can use Step Reebok tools, wooden cubes of different sizes, or any other tools you consider to be appropriate for your training programme. We recommend the floor level drills to be performed by individuals having a weaker elasticity of the adductor muscle groups and hamstrings.

Also, the weight exchanges, from one leg to another, passing through a lunging position, should be performed by individuals with a considerable motor experience, because these exercises put a stress on the sense of balance, as well as on the complex muscle contraction coordination.

Combined with the BF walking drills, these lunges can influence considerably the ankle and knee stability, and can train the two joints for complex stress specific to different sports branches, during training and/or official games.

As you can see in this book, the BF lunges can be continued (or preceded) by complex structures of exercises, such as BF jumps, or other variants considered useful by the specialists. Thus, you can use also Bosu-type tools, in order to increase the complexity of the drills and their influence on the body.
3.1. Lunges at floor level

The lunging exercises will be performed with each leg.

A. Forward lunge. The leg in front stands on the floor, while the back foot is on a BF disc (Figure 27).

B. The same movement as in the previous drill (A), but the lunge is forward-obliquely right (Figure 28).
C. The same movement as in the previous drills (A, B), but the lunge is forward-obliquely left (Figure 29).

![Figure 29](image)

D. The same movement as in the previous drills (A, B, C), but the lunge is sideways-right (Figure 30).

![Figure 30](image)
E. The same movement as in the previous drills (A, B, C, D), but the lunge is sideways-left (Figure 31).

F. The same movement as in the previous drills (A, B, C, D, E), but the lunge is backwards. For this exercise, we recommend that the foot on the BF disc is straightened forwards (Figure 32).
G. Forward lunges, the back foot alternating position from one BF disc to another, while the other leg remains stationary. (Figures 33a-33c)
H. The same movement as in the previous drill (G), but this time the front leg is the one changing position on each BF disc (Figures 34a-34c).
Improving Ankle and Knee Joint Stability

Figure 34b

Figure 34c
I. The BF discs are positioned on the floor as shown in Figures 35a-35c. The lunges will be performed forward, on each of the three BF discs, in no particular order.
Figure 35c
J. The same movement as in the previous drill (I), but the lunges will be performed backwards, on each of the three BF discs (Figures 36a-36c).
K. The same movement as in the previous drills (I, J), but the lunges will be performed sideways, on each of the three BF discs (37a-37c).
L. The BF discs are positioned as shown in Figures 38a-38d. Alternating forward lunges on each of the BF discs. We recommend the exercises to be performed from right to left or vice versa, in order to put a gradual stress on the ligaments and joints.

Figure 38a

Figure 38b
Figure 38c

Figure 38d
M. NOTE: In the case of the successions presented in Figures 39a-39f, the drills can be performed in different ways:

- the lunges are performed in all directions, having one foot on the middle BF disc, or
- the exercises are performed obliquely—forward—right, sideways right, obliquely—backward—right, having the right leg lunged, and the left leg as a fixed landmark, then vice versa, performing the drills with the left leg.

Figure 39a

Figure 39b
Improving Ankle and Knee Joint Stability

Figure 39c

Figure 39d
In the case of the drills presented in Figures 40a-40c they can be performed with a lunged leg, while the foot of the elongated leg is, alternatively, on lateral BF discs. We recommend these exercises to be performed by previously trained athletes.

Also, these exercises can be turned into alternate switches of body weight from one leg to another, maintaining a good balance throughout the performance.
Figure 40c
3.2. Lunges on heightened surfaces

A. Forward-right side lunge on the bench; both feet are on the BF discs (Figures 41a-41c).

Figure 41a  Figure 41b

Figure 41c
B. The same movement as in the previous drill (A), but the lunge is just forward (Figures 42a-42d).
C. Side lunge on the bench; both feet are on BF discs (Figures 43a-43b).
D. The same movement as in the previous drill (C), but the lunge is performed on the middle BF disc. The exercise will be repeated also on the back BF disc (Figures 44a-44c). The order in which the three lunges are performed is chosen by the athlete or by the coach/trainer.

Figure 44a  Figure 44b  Figure 44c
E. Forward lunge on the bench. The lunged leg is on the BF disc, whereas the other one on the floor (Figure 45).

F. The same movement as in the previous drill (E), but the lunge is forward-obliquely right (Figure 46).
G. The same movement as in the previous drills (E, F), but the lunge is forward-obliquely left.

NOTE: This exercise can be performed having the foot straightened in the direction of the lunge (Figure 47a) or forwards (Figure 47b). This is also recommended for the drills presented in Figures 41a-42d (foot on the BF disc, on the floor).

Figure 47a

Figure 47b
H. Lateral lunge on the bench. The lunged leg is on the BF disc, whereas the other one on the floor (Figure 48).

I. From a standing position in front of the BF discs, the subject performs a counterclockwise jump on the discs; the athlete then maintains a balanced position for 3-5 seconds, then he/she lunges forward on the bench. (Figures 49a-49m)
Figure 49d

Figure 49e
Improving Ankle and Knee Joint Stability

Figure 49h

Figure 49i
NOTE: This drill (Figures 49a-49m) could also be performed without any rotation, the person facing the BF and simply jumping forward, on the BF.
CHAPTER 4

Jumping Drills

In this chapter we present a few complex drills that put a considerable stress on all of the articular components, as well as on the athlete’s abilities, from the point of view of the static and dynamic balance (space-time orientation and coordination), body scheme, ideomotor representations, and complex coordination during various movements.

Hence, we recommend these drills to be introduced as a part of complex programmes for influencing the articular components, during advanced stages of athletic training. The drills concerning lateral jumps or alternate jumps, on the floor and on the BF, put stress especially on the deltoid ligament of the ankle, the collateral ligaments of the knee, and on the menisci.

The 180 degrees twist jumps are recommended especially for strengthening the cruciate ligaments. As presented in this chapter, all the drills concerning jumps in different directions are recommended generally for players of Team Handball, Volleyball, Football/Soccer, Badminton, Basketball, Ice or Field Hockey, Rugby, or other similar sports. Also, the drills containing jumping and body twisting on the BF, on heightened surfaces, are recommended for the athletes practicing playing games, and are especially effective during warm-up for the diving events, for snowboarders, skateboarders, and/or any other sports that use mobile moving surfaces during the actual performance.

We do not recommend the 180 degrees twist drills to be performed during post-traumatic rehabilitation programs.

The jumping drills give the best results if combined with complex structures of proprioceptive development, sensory-motor control, improving agility and strength in training sessions (especially in hip-knee-ankle alignment targets, coordination and body balance).
4.1. Jumps at floor level

A. Side jumps using both legs on the BF discs (Figures 50a-50f).

Figure 50a

Figure 50b
Figure 50c

Figure 50d
Figure 50e

Figure 50f
B. Side jumps on the BF discs (positioned as shown in Figures 51a-51d)

Figure 51a

Figure 51b
Improving Ankle and Knee Joint Stability

Figure 51c

Figure 51d
C. The same movement as in the previous drill (B), but the legs are at one disc distance from each other (Figures 52a-52d).
Improving Ankle and Knee Joint Stability

Figure 52c

Figure 52d
D. As shown in Figures 53a-53d, the length of the jump can vary, from 1 BF length to 2-3 BF.
Figure 53c

Figure 53d
E. Side jumps, with a 180 degrees body twist. The twists in the air are performed alternatively clockwise and counterclockwise (Figures 54a-54g).
Improving Ankle and Knee Joint Stability

Figure 54c

Figure 54d
F. Forward jump, using both legs, on BF discs, and backward jump in the starting position (Figures 55a-55b).
G. The BF discs and the feet are positioned as shown in Figure 56a. The athlete jumps on the BF discs. The subject maintains position for at least 3 seconds, after which he/she returns to the starting position (Figures 56a-56e).

Figure 56a

Figure 56b
H. Side jumps from one foot to another, on the BF discs positioned as shown in Figures 57a-57f.
Figure 57c

Figure 57d
I. The same drill as the previous (H) can be performed trying to maintain a balanced position on one foot for at least 5 seconds, as shown in Figures 58a-58f.
Figure 58c

Figure 58d
Figure 58e

Figure 58f
J. Both feet on the same BF disc. The athlete jumps in a zigzag pattern on each of the BF discs (Figures 59a-59e)
Figure 59c

Figure 59d
Figure 59e
K. Each foot on a BF disc, forward jumps on the next discs (Figures 60a-60c).

Figure 60a

Figure 60b
Figure 60c
L. The same movement as in the previous drill (K), only backwards (Figures 61a-61c).
Improving Ankle and Knee Joint Stability

Figure 61c
M. Forward jump on the BF, then another forward jump, on the floor. The drill continues with a backward jump on the BF, then a side jump to the athlete’s right, on the floor. Afterwards, a side jump, back on the BF, then another side jump, to the athlete’s left, on the floor. The athlete performs again a side jump and gets back on the BF, then another backward jump, on the floor (Figures 62a-62q).
Improving Ankle and Knee Joint Stability

Figure 62c

Figure 62d

Figure 62e

Figure 62f
Improving Ankle and Knee Joint Stability

Figure 62k

Figure 62l

Figure 62m

Figure 62n
N. The same movements as in the previous drill (M), but using only one leg (Figures 63a-63o). This drill can be repeated using the other leg.
Improving Ankle and Knee Joint Stability

Figure 63o

Figure 63p

Figure 63q
The BF discs are positioned as shown in Figure 64a. The athlete is standing on the first two BF, then jumps forward on the singular BF in front of him, landing on both feet. The drill continues with another forward jump, on the other two BF discs, in front of the singular BF. These movements are repeated until the end of the BF row (Figures 64a-64k).
Improving Ankle and Knee Joint Stability

Figure 64e

Figure 64f

Figure 64g

Figure 64h
Figure 64i

Figure 64j

Figure 64k
P. Similar movements as in the previous drill (O), but this time landing on one leg when jumping on the singular BF (Figures 65a-65o).
Figure 65i

Figure 65j

Figure 65k

Figure 65l
4.2. Jumps on heightened surfaces

A. The athlete jumps from the two BF discs on the floor to the bench, and from the bench, to the floor again, on the BF discs. (See Figures 66a-66e)
B. The same movements as in the previous drill (A), only backwards (Figures 67a-67g).

Figure 67a

Figure 67b
Figure 67c

Figure 67d
Figure 67g

Figure 67h
C. Forward jumps, from the floor on the BF discs in front, then on the BF discs on the bench. The exercise continues forwards, jumping on the floor BF discs, then on the floor. (Figures 68a-68h)
Figure 68c

Figure 68d
D. The same movements as in the previous drill (C), only backwards (Figures 69a-69h).
Improving Ankle and Knee Joint Stability

Figure 69e

Figure 69f

Figure 69g

Figure 69h
E. Forward-side jumps, one leg on the bench while the other one is on the BF disc on the floor. During the jump, the floor leg goes up on the bench, while the leg on the bench goes down, on the BF disc (Figures 70a-70j).

Figure 70a

Figure 70b
Figure 70g
Figure 70h
Figure 70i
Figure 70j
F. The athlete jumps from the discs using both legs, on the bench, then jumps on the next BF discs. The exercise is performed across the length of the bench (Figures 71a-71e).
G. The BF discs are positioned as shown in Figure 72a. The starting position is one leg on the bench and one on the floor. Both feet are on the BF discs. The athlete changes position through a side jump. The foot that was on the floor is now on the bench, while the one that was on the bench is now on the floor. The drill continues across the whole length of the bench, taking into account that the BF discs on the bench are positioned at a small distance from each other (Figures 72a-72l).
H. Each foot on a BF disc, as shown in Figure 73a, forward jumps using both legs, on the BF disc on the bench. Then we continue the exercise as shown in Figures 73a-73t.
Figure 73i

Figure 73j

Figure 73k

Figure 73l
Improving Ankle and Knee Joint Stability

Figure 73q

Figure 73r

Figure 73s

Figure 73t
I. Standing, having the BF discs in the back, the athlete performs a jump with a 180 degrees twist and lands on the BF discs (Figures 74a-74c).

Figure 74a

Figure 74b
NOTE: This drill (Figures 74a-74c) can be continued with a forward jump on the BF on the bench.
J. Standing on the BF discs on the bench, the athlete performs jumps with 180 twists in the air, as shown in Figures 75a-75i.

NOTE: The twists in the air are done, alternatively, clockwise and counterclockwise.

Figure 75a

Figure 75b
Improving Ankle and Knee Joint Stability

Figure 75c

Figure 75d
Figure 75e

Figure 75f
Figure 75i

Figure 75j
K. The same jumps with twists in the air can be performed also from the bench, each foot on a BF disc, one disc distance between them. (Figures 76a-76h)

Figure 76a

Figure 76b
Figure 76e

Figure 76f
CHAPTER 5

Other Uses for Balancefit Discs

The drills presented in this book to be used during training programmes can be approached also from different perspectives. The biochemical and physiological aspects have a determining role for a successful athletic technical performance, even if, apparently, their influences are insignificant (Alexandru Acsinte, 2004).

Thus, the ideomotor representations, the body scheme, the self confidence, all viewed through the theories expressed in *Imagery in Sport*, can lead to the following aspects.

If we consider the simplest performance using the BF, that is standing in a balanced position with both feet on two BF (Figure 77a), apparently this does not strain too much the individual’s abilities, no matter the personal motor experience, or sports branch they are currently practicing. But when this drill is performed with eyes closed (Figure 77b), things get a little complicated. In this kind of situation, different components spring into action for maintaining the body in balance, and other analyzers are strained, such as the vestibular analyzer and the proprioceptive elements, not just the eyesight.
NOTE: The drills seen in Figures 77a and 77b can be performed also standing on one leg (see Figure 78):

![Figure 78](image)

It may seem weird, but during performances with eyes closed, even hearing appears to have an important role in maintaining balance, especially when the drill is performed in the company of other team-mates, or partners.

Repeating this kind of drills alternatively with eyes opened and closed, leads to the creation of ideomotor schemes that help the athlete to get faster into a balanced position, in both circumstances (Alexandru Acsinte, Eftene Alexandru, Alexandra Milon, 2009).

The studies we conducted on Team Handball goalkeepers have shown that even simple dynamic drills (e.g. jumps from the floor on the BF discs) can be performed with eyes closed, after these drills had been internalized and became automatic during normal training conditions.

Why do we need these drills to be performed with eyes closed? Mainly to increase the accuracy and quality of the performances. As mentioned by specialists (Schmidt, quoted by Tony Morris, Michael Spittle, Anthony P. Watt, 2005, page 128), the professional athletes receive and process large quantities of information quickly and accurately, in order to monitor and adjust their performances. The same authors (Morris, Spittle, Watt, 2005) mention that “visual imagery” is “seeing” the performance, or being instructed to
picture yourself the performance. As a consequence, the kinaesthetic and proprioceptive information (position of the body, the degree of contraction of certain body segments, the trajectory of the performances, even the relation with certain objects) received by the athletes are of real use to them in accomplishing top-notch performances.

If we take into account the perspectives from which the *Imagery in Sport* can be approached, Internal and External Imagery, respectively, then things can get complicated or simple, depending on the psycho-physiological potential of each athlete. In our case, the researches conducted on professional Team Handball players proved that the specific Internal Imagery representations, in goalkeepers, had a significant influence, especially during the 7-meter throws.

In the case of court players, several effects stood out:

- For the 9-meter line players (Left Back, Right Back and Central Back), the External Imagery proved to be more effective in making the game more fluent in attack.
- For the 6-meter line players (Left Wing, Right Wing and Pivot), the Internal Imagery influenced in a positive way their performance during attack, and especially the wings’ performance during fast-break.

These aspects encourage the use of technical drills during special conditions in various specific structures of certain sports branches, the above-mentioned successes contributing to a boost in the athletes’ self-confidence and to a stimulation of their personal motivation (Rainer Martens, 2004, Tony Morris, Michael Spittle, Anthony P. Watt, 2005.) Particularized to Team Handball, these facts have proven their applicability from multiple specific coaching points of view (A. Acsinte, 2009).

All these drills (stimulating proprioception in special conditions—on mobile surfaces, BF, Wobble board, balance board etc.), performed in a particular manner (with eyes closed), can contribute to an increase in the quality of athletic performance, especially during game situations with a high psychological stress (the end of a match, a tie-in, the team/athlete being qualified for a superior phase in a competition, numerical inferiority situations etc.), as well as during situations demanding technical performances in unnatural body positions (unbalances in the air, passes, throws, hitting the ball from a fall determined by a rough action from the opponent etc.) (A. Acsinte et al., 2004, A. Acsinte, E. Alexandru, 2007).

As a conclusion, we recommend that at least the simple drills (the walk, the lunges and the simple jumps using both legs) presented in this book to be performed with eyes closed.
We hope that these drills will represent a start in the creation of much more complex structures of exercises, adapted to the particularities of different physical activities, regardless of the context in which they manifest.

As mentioned in the Preface, BF drills can be performed by children as young as four, whereas the oldest age of performance depends on each person, individually.

Many of the drills presented in this book can be coupled with or introduced in Pilates programmes or improving core stability programmes, adapted to the specifics of each sport.

With the hope of succeeding in challenging your abilities and motor skills, as a coach, athlete, or just a fan of physical exercise, we are open to any suggestions that might improve the content of this book.

You can send your suggestions and/or comments here:
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1. Acsinte Alexandru—*Biochemical and physiological changes in handball players during a specific high intensity training programme*, Periodical for Coaches, Referees and Lecturers, No. 1 / 2004, European Handball Federation, Vienna, ISSN: 1560-3067;
5. Acsinte Alexandru, Alexandru Eftene, Milon Alexandra.—*Playing games motor skills development through aid exercises*, oral presentation, The 5th FIEP European Congress, Nis, Serbia, 23-26. 09. 2009, University of Nis, Faculty of Sport and Physical Education;


47. www.nlm.nih.gov/medlineplus/kneeinjuriesanddisorders.html