

Chapter 1

Introduction

The present book, ‘Enhancing Performance and Reducing Stress in Sports: Technological Advances’ is designed to help athletes and individuals interested in high sports performance in their journey towards the perfection of human sports abilities and achievements, with two main goals: (i) accelerating the acquisition of motor skills and (ii) preparing and vigilantly reducing the recovery time after training and competition. The methods proposed in this book are based on state-of-the-art science and natural principles mixed with ancient knowledge.

1.1 Modern Technologies in Sports Treatments and Therapies: Diamond Sports Protocol

The Diamond Sports Protocol is based on results from the research and collaborative work of Dr. Tijana Ivancevic (a world-class expert in Complex Sports Dynamics from the Institute for Sports Medicine, Belgrade, Serbia) in association with Mr. Ronald and Mrs. Helen Greenberg (CEOs of Diamond International Incorporated) and Prof. Leon Lukman (from the Sports Academy and Institute for Sports Medicine, Belgrade, Serbia, see Fig. 1.1).

Prof. Leon Lukman is a former elite pole-vault Champion, who dedicated his life to developing optimal sports abilities in a natural way (see Figs. 1.2 and 1.3).

The elite athletes of the ‘Red Star Belgrade’, a famous European Sports Club, were tested using Omega M sports performance technology, led by Prof. Aleksandar Lukman and performed after a series of treatments with Diamond Sports Technology (including the Sports Wave, Turbo Sports and Oxy Sports, see Fig. 1.6). Their results demonstrated that the general functional condition of an athlete improves by around 10% with short-term Diamond treatments. In particular, the following parameters were shown to have increased: adaptation level, vegetative regulatory parameter, central regulatory parameter, as well as a general reduction in stress-level (see Fig. 1.4).

In recent papers (see [CAT13] and the references therein), physicists have discovered that muscles act as *metamaterials*, or materials which cannot be found in



Fig. 1.1 Sports Academy Belgrade, Prof. Leon Lukman, Head, with Atma Ivancevic, Australian student

Fig. 1.2 Ex-elite athlete:
Leon Lukman, Pole Vault



nature. It is also known that the most important physical abilities of elite athletes in a large range of sports are various types of muscular strength combined with extraordinary speed in their essential movements (which partly depends on the type of muscle fibres inherited genetically and partly on the training process [[ERO11](#)]) and



Fig. 1.3 Ex-elite athlete: Leon Lukman, Pole Vault



Fig. 1.4 Preparation for testing with the Omega M, with Prof. L. Lukman, Prof. T. Ivancevic and Assistant J. Vracar at the Institute of Sports Medicine, Belgrade. <http://www.lido-zel.ru/techno-omega.htm>

high accuracy/precision of their execution. All of this resulted in the development of the current Diamond Sports Wave neuromuscular electro stimulation (NMES) technology.

In practical terms, this means that appropriate training is essential for every sports discipline, with specific methods and exercise required for a particular sport and desired skill. For example, one should not practise exercises for the development of slow-twitch muscle fibers in the arms if one is a javelin thrower or tennis player,

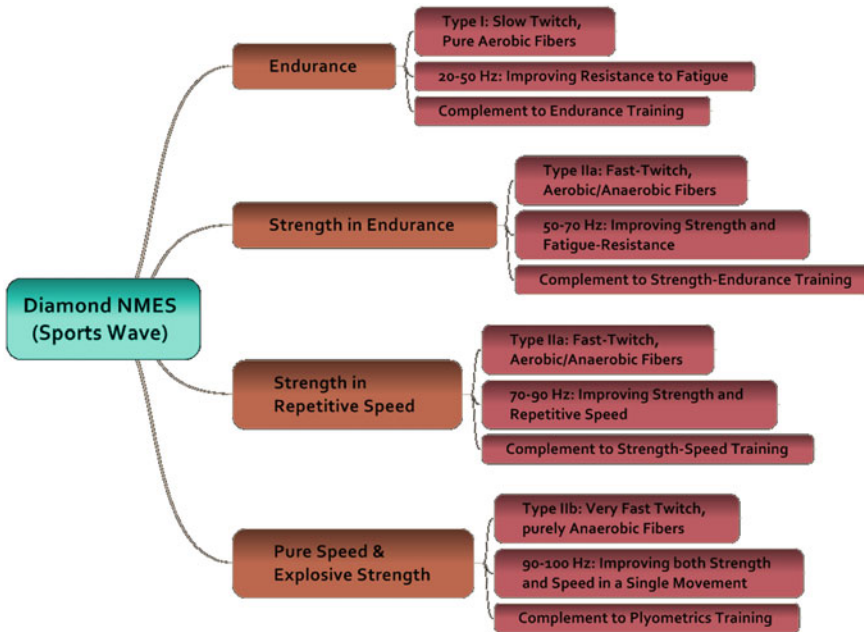


Fig. 1.5 Diamond sports wave machine as a universal training complement

because for a fast throw or serve, it is essential to have the strength of fast-twitch muscle fibers.

The Diamond Sports Wave NMES system, based on the above scientific facts and fundamental biomechanical principles, can be used for developing pure aerobic endurance, strength in endurance, strength in repetitive speed, explosive strength and pure speed (see Figs. 1.5, 1.6, 1.7 and 1.8).

In particular, it is well known that efficient strengthening of abdominal and back muscles is very time consuming. With the Diamond Sports Wave, this time can be significantly shortened by using NMES in several different modes, alternating between the 50–70 Hz mode designed for strength in endurance, to modes of 70–90 Hz for repetitive strength and 90–100 Hz for explosive strength. For example, 1 h on the machine stimulating the Quadriceps Femoris muscle is approximately equal to around 100 squats with weights, but without any pressure on the joints. This could save time for athletes and instead leave them with more time for developing particular techniques (see Fig. 1.9). For the basic NMES physiology and common practices for improving the performance of the Quadriceps Femoris muscle (see e.g. [SMD07] and references therein).

As suggested before, the Sports Wave NMES system can be used for strengthening the back muscles (especially small intervertebral muscles along the spine) as well as



Fig. 1.6 Three diamond state-of-the art technologies: sports wave, Turbo sports and Oxy sports



Fig. 1.7 Diamond sports wave is a unique neuromuscular electro stimulator (NMES)

the Latissimus Dorsi and Gluteus Maximus muscles to prevent sport injuries (see Figs. 1.10 and 1.11).

It is a common fact that in all sports in which athletes wear shoes with spikes, like athletic sprints as well as all forms of football (including soccer, rugby, US and AU football), the most common injury is a Hamstrings strain. The reason for this injury is usually three-fold, as follows:

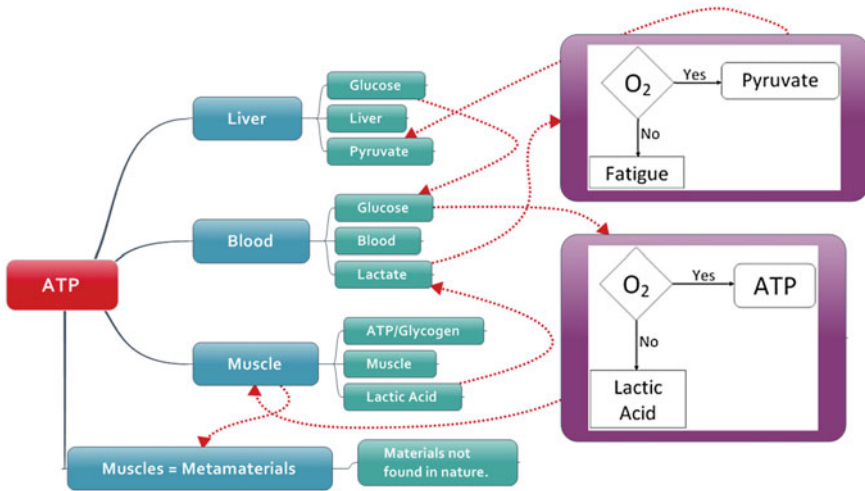


Fig. 1.8 General dynamics of the *Adenosine Triphosphate* (ATP) cycle in the human body. The concentration of oxygen in the muscles during exercise determines whether the pyruvate from muscular glycogen will transform into ATP or lactic acid. If there is enough of oxygen in the blood, the lactic from the blood transforms into pyruvate; if there is not enough oxygen in the blood, the blood will be filled with lactic acid, which results in fatigue



Fig. 1.9 Muscles strengthening, Elite athlete Gavra Gavrilov, weightlifter

- Quadriceps Femoris, the knee extensor muscle, is naturally, without any kind of training, several times stronger than the Hamstring (and Gastrocnemius), the knee flexor muscles, simply because its natural function is antigravitational. In



Fig. 1.10 Diamond sports wave machine, back strengthening treatment, Elite athlete Ivan Marovic with assistants Jelena Vracar and Nebojsa Djukic

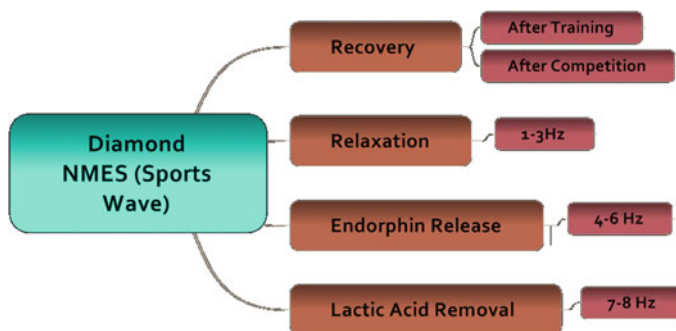


Fig. 1.11 Diamond sports wave machine as a universal recuperation complement

addition, for developing essential jumping abilities, the Quadriceps are usually heavily trained, using the plyometrics method as well as all kinds of squats with weights (while similar methods do not exist for training of the knee flexor muscles). In this way, the Quadriceps become many times stronger than the Hamstrings. This means that, for someone to have a good take-off ability, there is usually a significant imbalance between their Quadriceps and Hamstrings muscles.

- Running while wearing the shoes with spikes represents a form of *cat-like grabbing motion* which puts a lots of stress on the knee flexors, the Hamstrings (and Gastrocnemius). This is quite different from running in ordinary sports shoes, where running/sprinting is just a series of successive jumps, performed by the kinetic chain of leg extensors (Soleus, Quadriceps and Gluteus). If the spikes are included, then the knee flexor muscles (Hamstrings and Gastrocnemius) also become involved,

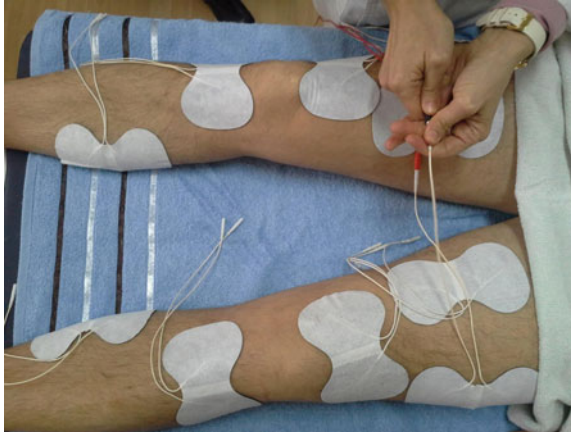


Fig. 1.12 Strengthening the kinetic chain of leg extensor muscles in basketball player Vuk Radivojevic

and since they are much weaker than the extensors (especially in the case of good jumpers), this often results in injury.

- Combining these two common sports conditions with fatigue, (e.g., repetitive sprints in shoes with spikes, while fatigued) results in a high risk for Hamstring muscle injuries.

Here, the Sports Wave NMES technology can be of great help, for appropriate strengthening of the knee flexor muscles (see Figs. 1.12, 1.13 and 1.14).

The Sports Wave NMES system can similarly be used for strengthening ligaments and tendons, by improving local circulation and reducing inflammation in surrounding tissues (see Figs. 1.15 and 1.16).

NMES technology can further be used before competitions and training sessions for fast-twitch muscle activation, using 50–90 Hz programs with 24-carat gold rollers (see Fig. 1.17). With the same 24-carat gold rollers and the Diamond Sports Wave, accumulated lactic acid in the body can be cleaned with Iontophoresis treatments (see Fig. 1.18), which are followed by an infusion of Magnesium and/or Oxygen with the galvanic infusion current.

In addition, the NMES programs with various higher frequencies and the 24-carat gold accessories can perform fast general lactic acid cleaning after training and competitions (see Fig. 1.17).

The Diamond Sports Wave also contains a Nano-current, which produces delta waves in the brain and sends them to the treated area. This gentle and relaxing treatment can be used for accelerated healing and as a form of relaxation after training sessions and competitions. It is performed with the 24-carat accessories (see Fig. 1.19).



Fig. 1.13 Strengthening the kinetic chain of leg extensor muscles in basketball player Vuk Radivojevic with Profs. Leon Lukman and Tijana Ivancevic



Fig. 1.14 Strengthening the kinetic chain of leg extensor muscles in basketball player Vuk Radivojevic with Profs. Leon Lukman and Tijana Ivancevic

The Sports Wave NMES system, combined with Oxy Sports and Turbo Sports technologies, act as a *universal recuperator* after training sessions and competitions; for general recovery, relaxation, endorphin release and lactic acid removal (see Figs. 1.6 and 1.11).



Fig. 1.15 Diamond sports medilift, knee injury prevention treatment, red star player Vuk Radivojevic



Fig. 1.16 Red star basketball player Vuk Radivojevic in action

The Diamond Sports Oxygen Infusion uses specially-developed, stabilized or aerobic Oxygen, with the same molecular form as a natural Oxygen (see Fig. 1.8). Both the Oxygen Infusion liquid and the Oxygen dietary drops are enriched with essential minerals. The Oxygen infusion treatment can be used every day (especially before training and competition) for superior energy production, as there are no any contra-indications. As an essential component of *Adenosine Triphosphate* (ATP), the concentration of Oxygen in the blood is vital for providing glycogen for ATP production in the muscles and at the same time, more efficiently removing lactic acid from the blood. It also helps prevent fatigue in cases of heavy sports activities. Supplying the brain with enough Oxygen is further crucial for clear decision-making



Fig. 1.17 Fast-twitch muscles activation using big 24-carat gold rollers



Fig. 1.18 Magnesium and Oxygen infusion with galvanic current using 24-carat gold rollers

in sport, especially in sports games where fast thinking and reaction times are an important part of the game (see Figs. 1.20 and 1.21).

Another use of Oxygen infusion is after training sessions and competitions, straight after the lymphatic treatment. These two superb treatments can quickly and easily clean the body from accumulated lactic acid in the blood and also refill the blood plasma with a new Oxygen supply. This refreshes the body and results in an extra fast recovery time for athletes (see Figs. 1.22 and 1.23).

The unit for Oxygen concentration is part per million (ppm). In tap water (which is highly acidic and thus not recommended), the concentration of Oxygen is only 9–12 ppm. The Diamond Sports Oxygen concentration is around 250,000 ppm in infusions and 55,000 ppm in Oxygen drops (see Figs. 1.24, 1.25, 1.26 and 1.27, 1.28, 1.29).

This concentration is antiviral, antifungal and antibacterial on contact, so it is strongly recommended for use during competition preparation, for strengthening

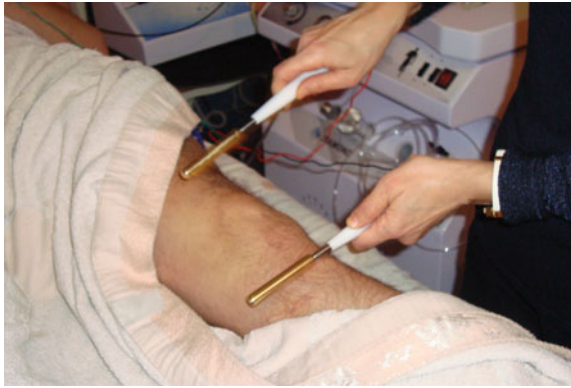


Fig. 1.19 Diamond Nano-current treatment for healing of old knee injury



Fig. 1.20 Diamond Oxygen Infusion treatment before competition, elite basketball player Vuk Radivojevic, with Profs. Leon Lukman and Tijana Ivancevic

the immune system and illness prevention. Now, pH (parts of Hydrogen, measures acidity or alkalinity through the formula: $pH = -\log_{10} c$, where $c = \text{Hydrogen}$) is defined to be 7 if neutral, more than 7 if alkaline and less than 7 if acidic. The human blood, saliva and spinal fluid have the pH values of around 7.4. The pH of the stabilized Oxygen is alkaline with a value of 12.5, so after infusion or oral intake through dietary drops, the stabilized Oxygen quickly enters the blood plasma.



Fig. 1.21 Red-star basketball player Vuk Radivojevic in action

With intensive training or competition, the building of lactic acid in the blood in athletes causes pH imbalance, becoming too acidic. Prolonged acidic pH in saliva can cause tooth decay and prolonged acidic pH of the blood can cause breathing difficulties. But fast recoveries and return to an ideal homeostatic state are essential for athletes. With the Oxygen Infusion treatment of the Diamond Oxy Sports, this recovery can be greatly accelerated.

Diamond Turbo Sports technology is based on the ancient healing principles of cupping. It affects the lymphatic system, particularly the extracellular matrix, and treats stagnation in tissues and fluids, or in some cases, calcification (see [IJG13] and the references therein). It differs from the classical cupping method in that it does not only treat local areas and instead is based on the turbulence method.

The Turbo Sports system starts locally, but then spreads the wave through the whole lymphatic system, which results in cleaning the lymph from toxins and, for athletes, from lactic acid. Stagnation in the lymph, blood, *extracellular matrix* (ECM) and surrounding tissues can be easily detected by the color of the area being treated, which ranges from light red and dark red to dark purple, and even bruises in the case of *calcified stagnation*, where there is no Oxygen in the environment.

The Turbo Sports treatment is especially important after competitions and training sessions, because (like Oxygen Infusions), it can accelerate the recovery time of athletes dramatically (see Figs. 1.30, 1.31, 1.32, 1.33 and 1.34). Furthermore, it can be performed on the whole body or specifically on the parts which have the highest concentration of toxins and lactic acid.

The Diamond Turbo Sports system is especially effective as training or competition preparation if performed together with the Oxygen Infusion and NMES (see Fig. 1.35). It can also be used after training sessions, with the treatment starting from the feet and then slowly moving to upper parts of the body (see Figs. 1.36 and 1.37).

For more efficient Turbo Sports treatments, a specially-designed organic chocolate gel (a product of Diamond International) is used. Chocolate Gel, made from



Fig. 1.22 Diamond oxygen infusion treatment after competition, elite basketball player Igor Rakocvic, with Prof. Tijana Ivancevic

raw organic cacao, contains phytochemical theobromine, which has stimulating but relaxing effects because (unlike caffeine) it does not affect the *central nervous system* (CNS). It can also lower blood pressure by dilating the blood vessels. It is a very powerful diuretic and activates neurotransmitter Anadamine, named after the Sanskrit word 'Ananda' which means 'Bliss'. Anadamine is produced by enzymes in parts of the brain responsible for higher thinking and memory as well as in the area for movement control, which is important for every athlete (see Fig. 1.38).

Finally, the Diamond Turbo Sports can be used for the treatment of inflammation on any parts of the body and as a general energy booster (see Figs. 1.39 and 1.40). It comes with a variety of cup sizes and cupping intensities, specifically designed for athletes (see Fig. 1.41).



Fig. 1.23 Red star basketball player Igor Rakocevic in action



Fig. 1.24 Diamond oxy sports with stabilized oxygen 250,000 ppm



Fig. 1.25 Desincrustation (a deep, DC-based cleaning and drawing treatment) with galvanic current

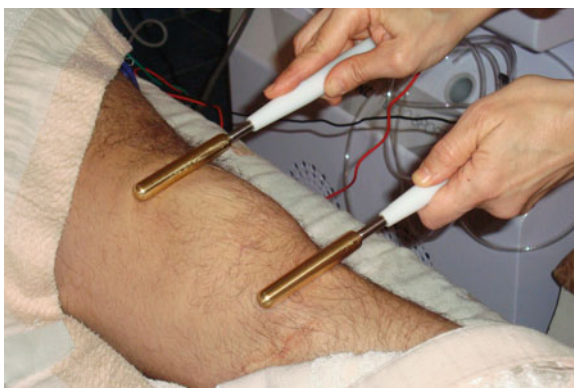


Fig. 1.26 Nano current treatment for rehabilitation of an old knee injury



Fig. 1.27 Oxygen, Q10, minerals and magnesium infusion with galvanic current



Fig. 1.28 Cleaning lactic acid and lymphatic drainage with diamond turbo sports, Elite athlete Gavra Gavrilov, weightlifter

1.2 The Goal: Outstanding Sports Performance

1.2.1 Football Case Study: Spain, the Soccer World Champion, and Its Total Football

Spain, the current (2010) World Cup Champion, was two years before that the 2008 European Champion. Spain is also the current (2012) European Champion. This suggests that the current success of Spanish national football (or, soccer) has not come by accident, but rather by design, performed through the development of the FK Barcelona in the last three decades (Figs. 1.42 and 1.43).

How did a nation with no significant national-team football reputation become world number one? Of course, since the 1950s there has always been the great Real Madrid, the most successful football club ever; but its game has always been based



Fig. 1.29 Diamond sports wave machine, back strengthening treatment, Elite athlete Ivan Marovic

on expensive foreign players. When it came to national performance, Spain was not really able to deliver the highest-level game. Not until 2008. So what happened to so radically improve Spain's national football performance?

Our story goes decades back, to another time and another place. It is the story of one name and one game.

1.2.1.1 One Name

This is the story of a person who was, according to many football experts, the greatest football player ever not to win the World Championship. That person was the real architect of Spain's current national football performance and international success.

His name is *Johan Cruyff*. A legendary Dutch footballer from the 1970s, he was the first player to win the prestigious *Ballon d'Or* three times (1971–1974); was voted European Player of the Century (in an election held by the IFFHS); and came second behind *Edson Pelé* in their World Player of the Century poll (ahead of *Diego Maradona*), while according to *Ballon d'Or*, Maradona was second and Cruyff was third player of the 20th Century.

As a player, Cruyff was in many ways similar to Pelé and Maradona: a virtuoso with the ball, a creative full-speed dribbler and shooter, with such a strong personality that he was capable of single-handedly deciding the outcome of any football match, at any competition level. But he was even more than that. Like *Franz Beckenbauer*, European player number two of the 20th Century, Cruyff was also the “brain” on the



Fig. 1.30 Assistant Jelena Vracar performing a Turbo sports treatment on red star basketball player Igor Rakocevic



Fig. 1.31 Assistant Jelena Vracar performing a Turbo Sports lymphatic treatment on red star basketball player Igor Rakocevic



Fig. 1.32 Dr. Tijana Ivancevic performing a diamond turbo sports treatment on red star basketball player Igor Rakocevic



Fig. 1.33 Diamond turbo sports lymphatic drainage, with red star basketball player Igor Rakocevic



Fig. 1.34 Red star basketball player Igor Rakocevic in action



Fig. 1.35 Diamond turbo sports treatment combined with oxygen infusion and NMES treatments as a preparation for competition, red star player Vuk Radivojevic with assistant Jelena Vracar and Profs. Leon Lukman and Tijana Ivancevic



Fig. 1.36 Diamond combined treatments as preparation for competition, red star player Vuk Radivojevic with assistant Jelena Vracar and Profs. Leon Lukman and Tijana Ivancevic



Fig. 1.37 Assistant Jelena Vracar performing a Turbo sports foot treatment on red star player Vuk Radivojevic

court, the main chess-player pulling the strings of the whole team, all the time, over the whole surface of the court.

In addition, Cruyff has been the only footballer to have a special football movement named after him: the famous '*Cruyff's turn movement*', one of the frequently used dribbling tricks in today's football (most attractively executed by Real Madrid's Superstar *Cristiano Ronaldo*). To execute his famous move, Cruyff would perform a fake pass or cross; but then, instead of kicking the ball, he would drag it by rolling



Fig. 1.38 Red star player Vuk Radivojevic having a diamond Turbo sports treatment with chocolate gel



Fig. 1.39 Elite martial arts athlete Ivan Marovic having a diamond Turbo sports treatment after competition, with assistant Jelena Vracar and Dr. Tijana Ivancevic

it backwards, then pivot 180° and immediately accelerate away from the opponent, leaving the defender completely confused.

However, unlike Pelé, Maradona and Beckenbauer, Cruyff was never a World Champion. While Beckenbauer was World Champion both as a player and coach,



Fig. 1.40 Elite martial arts athlete Ivan Marovic having a diamond Turbo sports treatment after competition, with assistants Jelena Vracar, Nebojsa Djukic and Dr. Tijana Ivancevic



Fig. 1.41 Elite martial arts athlete Ivan Marovic having a diamond Turbo sports back treatment with Dr. Tijana Ivancevic

Cruyff was none of that, and naturally he wanted to prove to the world that he was not only a better player, but also a better coach. So he devoted his life to an even higher goal: improving the football game as a whole, regardless of the team/nation that he was playing for or coaching. And the recent developments in Spanish football are a living demonstration of his work.

Cruyff's overall influence upon the football game has been recently summarized by Shimon Peres, the President of the State of Israel, who said that Cruyff "gave football a social content" and "made it an educational process". Cruyff himself says: "Football is simple. But the hardest thing is to play football in a simple way."



Fig. 1.42 Diamond sports wave (NMES, nano-delta and iontophoresis) and diamond Turbo sports machines



Fig. 1.43 Diamond Turbo sports knee treatment

Cruyff's football game was called "*Cruyff's Total Football*," a highly-dynamical game where any outfield player could take over the role of any other player in the team. It was invented jointly by Cruyff and his coach and friend *Rinus Michels*, who was, for the sake of his "Total Football" philosophy, named "coach of the century" by FIFA in 1999—in their native club Ajax FC, Amsterdam. From a team with no international reputation, Ajax suddenly became the fifth most successful European club of the 20th century. According to many football experts, the main reason for Ajax's sudden success was this "Total Football." While Michels was the brain behind the total-football scene, Cruyff was the on-field "conductor" and "team orchestrator". One coach, Michels, and one player, Cruyff, invented such a powerful



Fig. 1.44 Red star Volleyball match

football machinery that they were able to win European Club Championship in 1971, 1972, 1973, and in the process knock down Beckenbauer's Bayern Munich (4-0).

After the end of the 1973 season, Cruyff moved to FC Barcelona (Catalonia, Spain), with an attempt to make a new Real Madrid. Then came the World Cup of 1974. Already being a Spanish club player, Cruyff led the Holland team to a runners-up medal in the 1974 World Cup and was named player of the tournament. The Dutch team coasted all the way to the finals, demonstrating the power of "Total Football" while knocking out Argentina (4-0) and Brazil (2-0), the defending champion. In the finals, Holland was, after a heavy struggle, defeated by the West Germany team (2-1), who were able to successfully immobilize Cruyff's orchestra with heavily defensive tactics on the domestic court.

Johan is now in Barcelona (commonly known as 'Barça'), trying to demonstrate to the football world the superiority of *Cruyff's Total Football*. This would be achieved by dominating the decades-old supremacy of Real Madrid. In the first and second seasons of his playing there (1973–1974), Barça won La Liga (for the first time since 1960; along the way defeating Real Madrid 5-0 at their home ground, Santiago Bernabéu) and Cruyff was both times named European Footballer of the Year (the first time, he won it in Ajax Amsterdam).

After his retirement from playing in 1984, Cruyff became a successful coach, manager and advisor, first of Ajax and later of FC Barcelona. He inaugurated two of the most respected football youth academies in the world: "La Masia" of FC Barcelona (with the help of J.L. Núñez) and the "Toekomst" of Ajax.

In 1988, Cruyff returned to Barcelona as a manager, re-establishing his "Total Football" game within his "Dream Team" with young Pep Guardiola (Barça's manager-to-be from 2007; currently in charge of Bayern Munich) as a pivot. Barcelona won four consecutive La Liga titles (1991–1994). They also won a Copa del Rey in 1990, the European Super Cup in 1992, and three Supercopa de España.

With 11 trophies, Cruyff became the club's most successful manager. The foundation for the great team had been established.

In the following years, FC Barcelona won the European Championship four times (the same as Ajax Amsterdam did before). In this way, a Champion club other than Real Madrid was born in Spain. And consequently, most of younger La Liga players naturally adopted "Total Football". As a coach and advisor, Cruyff influenced a number of great football players, including his successors as three-times winners of the Ballon d'Or, Dutch *Marco Van Basten* (ranked sixth in the FIFA Player of the Century) and Argentinean *Lionel Messi*, the top footballer of the 21st Century (slightly ahead of current Real's *Cristiano Ronaldo*, previous Real's *Zinedine Zidane* and two Brazilians, *Ronaldo* and *Ronaldinho*). In the words of Graham Hunter, "without him there would be no Lionel Messi, Xavi, Iniesta or Pep Guardiola—Barcelona's modern success is thanks to Dutch legend Johan Cruyff. From player to coach to advisor, Cruyff is a Barça legend in all three roles". (Fig. 1.44)

After his retirement from coaching, Cruyff initiated the Cruyff Foundation, Cruyff Institute, Cruyff Classics, Cruyff Football and Cruyff Library. The Cruyff Foundation in particular has been initiating the construction of Cruyff Courts, by supporting sports projects for children with a disability and through the organization of unique sports events for the youth. Today, one of the most influential sport institutions in the whole of Spain is the "Johan Cruyff Institute for Sports Studies", the university-level sports institution that "was created by athletes, is fully sports-oriented, and aims to become a reference center in the sport world."

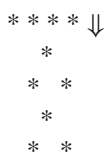
It is a widely accepted opinion that, in a multitude of ways, Cruyff inspired the current generation of Spanish national team players to shift from a classical Latin football style to the modern Spanish version of his "Total Football", locally known as "Tiki-Taka". This was effectively displayed by a recent game (on 29/11/2010); Barça's repeat of their 1974 victory over Real Madrid (5-0) in Madrid, as well as a similar victory of 6-2 in the same place in May 2009. This time, Guardiola's Barça team was superbly led by *Lionel Messi*. However, right between these two superb games, at the 2010 FIFA World Cup, whilst leading his own national team under the (pure) guidance of Diego Maradona, Messi (who has been called "the next Maradona," by Maradona himself) was unable to prevent Argentina's debacle. Argentina was knocked out by Germany in the quarter-finals by 4-0. Apparently, the *Maradona-Messi tandem* didn't work well, which is not surprising if we consider that Messi is the product of *Cruyff's Total Football* school, while Maradona was such a unique football talent who did everything himself alone without a need for other players or for any kind of a football school at all.

And just for the record, during their superb winning series in the 2010 World Cup Finals, the young German team was also effectively playing "Total Football"—as long as they had enough psycho-physical strength for it—then they simply crashed. Similarly, the two finalist teams, Spain (the champion) and Holland (the runner up), were both demonstrating many elements of "Total Football" as well.

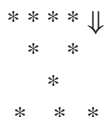
1.2.1.2 One Game

Now, we have to describe this “Total Football” in some more detail. As already mentioned, in Total Football, a player who moves out of his position is immediately replaced by another one. In this way, the team’s organizational structure is preserved, while no outfield player is fixed in a nominal role: every player needs to be able to play as an attacker, a midfielder and a defender. The realization of this fluent tactic depends heavily on the player’s ability to quickly switch positions depending on the situation, so it is very demanding both physically and mentally. Only the strongest personalities could successfully play such a game. Apparently, both Cruyff and Lionel Messi are such personalities.

Now, let’s explain the famous *Cruyff’s (4-3-3) Diamond* formation and the ‘*false no. 9*’ (or, ‘*false center-forward*’) concept. Guardiola’s Barça won the 2009 Champions League playing essentially within the 4-3-3 formation. Messi played the role of the ‘false no. 9’, or ‘deep no. 9’ (that is, an unconventional, withdrawn, lone striker, who drops deep into midfield, positioned behind two wide strikers)—as Cruyff himself played in the 1974 World Cup (for Holland) and before that in 1971–1973 (for Ajax FC, wearing his peculiar no. 14). Today, Messi is the world’s best ‘false no. 9’ in much the same way that Cruyff was in the 1970s. This was Cruyff’s (4-3-3) Diamond:



The formation 4-3-3 represents the basic team structure which is maintained throughout the game. Its quick, short-term variation is 4-2-4:



where another attacker is temporarily added to the attack formation, for the purpose of penetrating the opponent’s defense. As soon as the attack is executed (either successfully or unsuccessfully), the team is responsible for returning to its basic 4-3-3 formation. Any player, be it attacker, mid-fielder, or defender, has a chance to briefly become the fourth attacker (within the quick 4-2-4 formation), as long as they still hold the full responsibility of fulfilling their own defense task. The main purpose of putting this attacking pressure on the opponent is so that, as soon as the ball is lost, it can be returned while still on the opponents half of the court, so as to immediately strike again. So, while *Cruyff’s Total Football* tactics may look extremely offensive, every player remains fully responsible for their defense as well, including Cruyff in the 1970s and Messi today.

In addition, the continuous position-switching among players within the “Total Football” game represents a precise tactical maneuver, with the following three objectives:

- To disturb the formation of the opponents defense;
- To make optimal conditions for a ball pass in any direction; and
- To create an empty space on the field for the efficient passage of team-mates during their attack execution.

During the 1970s, Cruyff’s teammates were adapting themselves around his movements, flexibly switching positions so that the tactical roles in the team were always maintained. In recent years, Guardiola has been applying the same tactics around Messi; as a result, Barça has become the Europe Club Champion.

And Spain’s national team, although lacking Messi as a pivot player, has become both the 2010 World Cup Champion and double European National Champion, by effectively adopting their “*Tiki-Taka modification*” of Cruyff’s *Total Football*.

1.2.2 Basketball Case Study: How to Become an NBA Superstar

In this section, we will try to answer the question: What are the most essential abilities, both physical and mental, of all NBA superstars?

1.2.2.1 The Magnificent Dozen of the NBA League in the Last Half-Century

In this review, we briefly present the main sports achievements of a dozen of most successful NBA superstars of the last half-a-century. Notwithstanding the greatness of old masters (such as forward Bob Pettit, the very first recipient of the NBA’s Most Valuable Player (NBA-MVP) Award, as well as guard Bob Cousy, the second MVP-recipient, called “the Houdini of the hardwood”), we are starting our list of NBA superstars from the year 1960. Similarly, we fully acknowledge the greatness of two outstanding talents of the 20th Century: point-guard Pete Maravich (one of the best College players ever, called “the best ball-handler of all time”) and guard John Havlicek (widely considered to be one of the greatest players in basketball history); and two greats of the 21st Century: Canadian point-guard Steve Nash (double NBA-MVP recipient and double WCC Player of the Year), and center Shaquille O’Neal (an NBA-MVP recipient and one of the top centers in the NBA-league). However, we are restricted here to a dozen of NBA’s overall most successful players of the last five decades. As such, we apologize to all other great players who are not mentioned in this short review. The following list of 12 players is given in chronological order.

Bill Russell

The first African American player to become an official NBA superstar was *Bill Russell*. This legendary NBA center, of listed height 208 cm and weight 98 kg, played for the Boston Celtics from 1956–1969. He was 11 times NBA champion (1957, 1959–1966, 1968–1969), five times NBA-MVP recipient, and 12 times NBA All-Star player (1958–1969). Russell was the pivot of the team’s defense: his main strengths were shot-blocking, man-to-man defense and rebounding, which heavily contributed to the NBA success of the Boston Celtics. His match-up with Wilt Chamberlain became one of the greatest NBA rivalries.

Wilt Chamberlain

Soon after Bill Russell, the NBA league received their great rival on the court, *Wilt Chamberlain*; who was (together with Michael Jordan and Kareem Abdul-Jabbar) widely considered to be one of the three greatest basketball players ever, and still holds a number of NBA all-time records (in scoring, blocking, rebounding and durability). This center player of listed height 216 cm and weight 125 kg was, in contrast to Russell, the pivot of the team’s offense. Chamberlain, “the Giant”, is the only player to score 100 points in a single NBA game (at Hershey, Pennsylvania, in March 1962), the most points in a half-game (59 in the 2nd half vs. the New York Kinks on March 2, 1962), and three NBA Records for most points average in a season (50.4 in the 1961–1962 season; 44.8 in 1962–1963; 38.4 in 1960–1961). For most of his records, second place is held by Michael Jordan. Unlike Russell, Chamberlain played for several clubs: he started (and traveled around the world) with the Harlem Globetrotters; then from 1959–1965 he played for the Philadelphia/San Francisco Warriors; 1965–1968 he played for the Philadelphia 76ers; and 1968–1973 he played for the LA Lakers. He was one of only two players to win the Rookie of the Year and the MVP awards in the same year. He was four times NBA-MVP recipient. He had the sheer strength to block a dunk. As long as he was playing, he was totally dominating the NBA-league; he seemed capable of scoring and rebounding at will, despite all the tactics that opponent teams tried on him. His sports achievements are quite well summarized in the Chamberlain’s *NBA Encyclopedia* biography, with the following sentence: “He was basketball’s unstoppable force, the most awesome offensive force the game has ever seen”. He was an idol for his great successors; Kareem Abdul-Jabbar said, “Wilt was one of the greatest ever, and we will never see another one like him”, while Michael Jordan said, “His legacy as one of the NBA’s greatest players and his achievements will stand for all time”. Off the court, he published several controversial books, participated in the Dean Martin “Variety Show” in Las Vegas and acted in Arnold Schwarzenegger’s movie “Conan the Destroyer” (as a fighting opponent to Arnold, i.e. Conan).

Kareem Abdul-Jabbar

This center-player of listed height 218 cm and weight 102 kg, *Kareem Abdul-Jabbar*, was a young lion that came to the NBA league after Chamberlain. Another one of the greatest trio, he was the one that was successful in matching Chamberlain with points, slam-dunks, blocks, and rebounds, though not with power but rather with agility and finesse. In addition, he brought with himself another set of all-time NBA records, which include: six times NBA-MVP recipient, a 19-time NBA All-Star participation, a 15-time All-NBA selection, and an 11-time NBA All-Defensive Team member. After starting as an NBA Rookie of the Year (1970) while playing with the Milwaukee Bucks (1969–1975), he was later a six times NBA-champion and twice NBA Finals MVP, while playing for LA Lakers (1975–1989). He was born as Lew Alcindor, and became famous straight away as a College basketball player; in particular, as an extraordinary slam-dunker. Because of his frequent dunking, the dunk-shot was banned in College basketball for almost a decade (1967–1976), while Alcindor's 1963–1964 team was named the no. 1 high school team of the Century. Alcindor changed his name to Kareem Abdul-Jabbar in 1971, when he was 24, on the day he won his first NBA championship. At that time he played against the ten-year-old Chamberlain; his Milwaukee Bucks defeated Chamberlain's LA Lakers and it was clear that Kareem had become the best center in the league (as admitted by Chamberlain while losing that match). Abdul-Jabbar is the all-time leading scorer in the NBA league, most of the time using his unstoppable trademark 'skyhook' shot. He is also ranked 3rd of all-time in both rebounds and blocks. No other NBA player has ever scored more points, blocked more shots, won more MVP Awards, played in more All-Star Games or logged more seasons. Both his individual and team successes are still unmatched in the NBA league. He retired in 1989 after 20 seasons in NBA. Abdul-Jabbar tried to match Chamberlain both on and off the court: he acted in a unique fighting sequence against Bruce Lee in Bruce's last film, "The Game of Death". In 2012, he was selected by Hillary Clinton to be a U.S. global cultural ambassador.

Julius Erving, 'Dr. J.'

Then to the NBA league came *Julius Erving*, 'Dr. J.', the most attractive and spectacular player ever, an innovator who changed the way the game was played and is today called "Michael Jordan before Michael Jordan". This guard/forward player of listed height 201 cm and weight 95 kg came to NBA to change the style of the game and make a show out of it—while still winning three championships, four MVP Awards, and three scoring titles with the ABA's Virginia Squires and New York Nets (now the NBA's Brooklyn Nets) and the NBA's Philadelphia 76ers. Erving helped legitimize the American Basketball Association (ABA), and was the best-known player in that league when it merged with the NBA after the 1975–1976 season. Alongside being the fifth-highest scorer in ABA/NBA history, Erving was a true ambassador of the game and wizard with the ball, performing feats never before

seen (like midair spins and whirls punctuated by powerful slam dunks). He launched a modern style of play that emphasized *high-leaping* and play above the rim; while others played the game of basketball on the ground, Dr. J. performed above it. At that time, he looked like an alien: it was a common impression among the elite NBA players that when Erving went up in the air, he stayed there for longer-than-normal periods of time as he improvised various acrobatic maneuvers. He explains it as, “When I get a chance to *power jump off both legs*, I can lean, twist, change directions and decide whether to dunk the ball or pass it to an open man.” And he performed his outstanding *air maneuvers* right in front of his greatest opponents. One of his most memorable plays occurred during the 1980 NBA Finals, when he executed a seemingly impossible finger-roll behind the backboard. He drove past Lakers forward Landsberger on the right baseline and went in for a layup, when the tallest center and hardest blocker, Kareem Abdul-Jabbar, crossed his way, blocking the route to the rim and forcing him outwards. While in midair it was clear that Erving would land behind the backboard; however, he managed to reach over and score on a right-handed layup, in spite of the fact that his whole body, including his left shoulder, was already behind the hoop. This move was called the “flying reverse lay-up”, and has become one of the signature events of his career, along with his free-throw line dunk. His successor in gravity-defying and free-throw line dunking was Michael Jordan. His most famous dunk, usually regarded as the greatest dunk of all time, has a special name: “Rock the Baby”. With this move, Dr. J. slung the ball around behind his head and dunked over a ducking Lakers’ top defensive player Michael Cooper.

Moses Malone

This power-forward/center player of listed height 208 cm and weight 118 kg, with the nickname “Chairman of the Boards”, was Dr. J’s fellow player in both ABA and NBA leagues. Malone was three times NBA-MVP recipient (1979, 1982–1983), two times ABA All-Star (1975–1976) and 12 times NBA All-Star (1978–1989) participant. In 1983, he was both the NBA champion and NBA Finals MVP. He was the most successful prep-to-pro player of his era (going straight from Petersburg High to a 21-year career in pro-basketball). He played for a number of clubs in both leagues, including the Milwaukee Bucks, Philadelphia 76ers and San Antonio Spurs.

Larry Bird

This forward-player of listed height 206 cm and weight 100 kg was three times in a row NBA-MVP recipient (1984–1986), twice NBA Finals MVP (1984, 1986) and three times NBA champion (1981, 1984, 1986). Starting in 1980 as an NBA Rookie of the Year and a member of the NBA All-Rookie First Team, while playing for the Boston Celtics, Bird became 12 times NBA All-Star (1980–1988, 1990–1992) participant and NBA All-Star Game MVP in 1982. In addition, he was three times a 3-point Shootout champion (1986–1988), an AP Athlete of the Year (1986) and

Olympic Champion in 1992. After retiring as a player, he became first a head coach of the Indiana Pacers in 1997 and recently their president of basketball operations. Bird is the only person in NBA history to be named MVP, Coach of the Year, and Executive of the Year.

Earvin “Magic” Johnson

This point-guard player of listed height 206 cm and weight 100 kg was three times NBA-MVP recipient (1987, 1989–1990), three times NBA Finals MVP (1980, 1982, 1987) and twice NBA All-Star Game MVP (1990, 1992). Starting in 1980 as a member of the NBA All-Rookie First Team, while playing for the LA Lakers, he became five times NBA champion (1980, 1982, 1985, 1987–1988), 12 times NBA All-Star (1980, 1982–1992) participant, nine times All-NBA First Team (1983–1991) member and Olympic Champion in 1992.

Michael Jordan

This shooting-guard player of listed height 198 cm and weight 98 kg has been proclaimed by the NBA as the “greatest player of all time”, while media called him “The King”. *Michael Jordan* is a five times NBA MVP (1988, 1991–1992, 1996, 1998) and six times NBA Finals MVP (1991–1993, 1996–1998) recipient. He started in 1985 as an NBA Rookie of the Year and an NBA All-Rookie First Team member, while playing for the Chicago Bulls, and quickly emerged as a star of the NBA league, entertaining crowds with his prolific scoring. His *leaping ability* was similar to Dr. J’s, illustrated by outstanding *air maneuvers*, as well as performing slam dunks from the free-throw line at Slam Dunk Contests; he was twice NBA Slam Dunk Contest champion (1987–1988, witnessed by Erving) which earned him the nickname “Air Jordan” and “His Airness”. He also gained a reputation as one of the best defensive players in NBA. In 1991, he won his first NBA championship with the Bulls, and followed that achievement with titles in 1992 and 1993, securing a “three-peat”. Though Jordan abruptly left the NBA at the beginning of the 1993–1994 NBA season to pursue a career in baseball, he rejoined the Bulls in 1995 and led them to three additional championships (1996, 1997, and 1998) as well as an NBA-record 72 regular season wins in the 1995–1996 season. Jordan retired for a second time in 1999, but he returned for two more NBA seasons in 2001 as a member of the Washington Wizards. According to his teammates, Jordan was every day trying to prove that he was a winner. They also say that no one ever dominated the game as Michael did. His individual accolades and accomplishments include ten All-NBA First Team designations, nine All-Defensive First Team honors, fourteen NBA All-Star Game appearances and three All-Star MVP, ten scoring titles, three steals titles, six NBA Finals MVP awards, and the 1988 NBA Defensive Player of the Year Award. He is the Chicago Bulls all-time leading scorer and holds the NBA record for highest career regular season scoring average with 30.1 points per game, as well as averaging

a record 33.4 points per game in the playoffs. He was double Olympic Champion in both 1984 and the 1992 Summer Olympics. Jordan was twice voted USA Basketball Male Athlete of the Year (1983–1984). In 1999, he was named the greatest North American athlete of the 20th century by ESPN.

Karl Malone

This power-forward player of listed height 206 cm and weight 117 kg was twice NBA-MVP recipient (1997, 1999) and twice NBA All-Star Game MVP (1989, 1993). Starting in 1986 as a member of NBA All-Rookie Team, while playing for Utah Jazz (from 2003 he played for the LA Lakers), he became 14 times a member of the NBA All-Star (1988–1998, 2000–2002), 11 times All-NBA First Team (1989–1999) member and Olympic Champion in 1992.

Tim Duncan

This power-forward/center player of listed height 211 cm and weight 113 kg was twice NBA-MVP recipient (2002–2003), three times NBA Finals MVP (1999, 2003, 2005) and NBA All-Star Game MVP (2000) recipient. Starting in 1998 as an NBA Rookie of the Year and a member of NBA All-Rookie First Team, while playing for San Antonio Spurs, Duncan became four times NBA champion (1999, 2003, 2005, 2007), 14 times NBA All-Star member (1998, 2000–2011, 2013), an NBA Shooting Stars champion (2008) and 10 times member of the All-NBA First Team (1998–2005, 2007, 2013). Duncan was USA Basketball Male Athlete of the Year (2003) and Consensus National Player of the Year (1997).

Kobe Bryant

This shooting-guard player of listed height 198 cm and weight 93 kg was an NBA-MVP recipient in 2008 and twice NBA Finals MVP (2009–2010) recipient. Starting in 1997 as NBA All-Rookie Second Team member and NBA Slam Dunk Contest champion, while playing for the LA Lakers, Bryant became five times NBA champion (2000–2002, 2009–2010), 16 times NBA All-Star member (1998, 2000–2014), 11 times All-NBA First Team member (2002–2004, 2006–2013), four times NBA All-Star Game MVP recipient (2002, 2007, 2009, 2011) and twice NBA scoring champion (2006–2007). He is the LA Lakers all-time leading scorer. He is the second best shooter ever (in 2006, he scored a career-high 81 points against the Toronto Raptors, the second most points scored in a single game in NBA history, after Chamberlain's 100-point game in 1962) and double Olympic Champion in 2008 and the 2012 Summer Olympics.

LeBron James

This forward-player of listed height 203 cm and weight 113 kg is arguably the best NBA league player today. James is a four times NBA-MVP recipient (2009–2010, 2012–2013) and twice NBA Finals MVP recipient (2012–2013). Starting in 2004 as an NBA Rookie of the Year and NBA All-Rookie First-Team member, while playing for the Cleveland Cavaliers (since 2010 he plays for Miami Heat), he became twice NBA champion (2012–2013), ten times NBA All-Star member (2005–2014) and seven times All-NBA First Team member (2006, 2008–2013) and NBA scoring champion (2008). He was NBA scoring champion (2008), the Cleveland Cavaliers all-time leading scorer, USA Basketball Male Athlete of the Year (2012) and AP Athlete of the Year (2013).

NBA's Future: New Kids are Coming

In this subsection we will introduce only two among a number of promising future NBA superstars. One of them is already a champion, the other is still only a talent. They are both power-forwards, both of the same age (25) and both of very similar body height and weight. Yet, they have completely different mental and physical structures, which makes their game styles completely different from each other. These two players are:

- Kevin Durant, a slim, highly technical and versatile player, currently (according to all the experts) the most promising future NBA superstar; and
- Blake Griffin, physically the fittest player in the NBA league (although with some hard-healed knee injuries) and the most powerful slam-dunker today. Due to a lack of maturity as a player, he is not considered to be a future NBA superstar; however, we are giving him the benefit of the doubt, on the basis of his outstanding physical abilities.

It will be interesting to watch these two players, in some ways so similar and in other ways so different, to see which one of them may become the real NBA superstar. We remark that most the experts would put Durant way ahead of Griffin in their predictions, simply because these two players are of the same age, yet Durant has (so far) achieved much more as an accomplished NBA player. However, we are not so sure that this fact matters so much for future predictions. Their respective sporting futures will effectively answer the old question: What is the most important quality in modern basketball (and in all modern sport, in general); is it the technique, or the physical power?

Kevin Durant This power-forward/small-forward player of listed height 206 cm and weight 109 kg has been playing in the NBA league, for Oklahoma City Thunder, since 2007. For only six years as a professional, he has achieved enormous success. First, in 2008, he was the NBA Rookie of the Year. As early as of 2010, he became FIBA World Championship MVP and USA Basketball Male Athlete of the Year. In

2012 he won the Olympic gold medal and the NBA All-Star Game MVP. Currently, he is the overall no. 2 NBA player, after LeBron James. He has won four NBA scoring titles and was five times NBA All-Star player (2010–2014).

Blake Griffin As already mentioned, this power-forward player of listed height 208 cm and weight 114 kg is, both physically and mentally, a total contrast to Kevin Durant. After an unsuccessful start in 2009 (due to a kneecap fracture, and missing the entire season), he effectively started playing in the NBA league, for the LA Clippers, in 2011 and immediately won both the NBA Rookie of the Year and the NBA Slam Dunk Contest. With outstanding physical strength and jumping abilities, he has quickly become one of the best slam-dunkers of all times, following in Wilt Chamberlain's footsteps. He uses every possible opportunity to dunk the ball into the rim, so although he's only played three seasons with the NBA, he has already got the nickname "King of the rim". He has yet to become a complete player, though; most importantly, he has to master his jump-shot from a distance. If he succeeds in this, he could become a future NBA superstar.

1.2.2.2 The Model of a Basketball Champion

Based on the review of past NBA superstars, we will now attempt to sketch a psycho-physical model of the hypothetic future NBA superstar. We start with body height: only two of the reviewed superstars were under 200 cm (just), albeit one of them is the greatest: Michael Jordan. Like Dr. J. before him, Michael showed that the most important quality for an *NBA superstar model* is not extraordinary height, but rather:

- Extraordinary athletic abilities, focused around the highest possible leap (so that he can touch the rim with his head); and
- *Speed of movement*, combined with a vast array or better, a 'wizardry' of ball-skills (including precision in a jump shot, a variety of jump shots with both hands, and finesse and speed in dribbling).

Regarding his mental profile, the Champion in any sport (including NBA league) must have indomitable will power, combining a permanent will to be a winner (within strict ethical limits), with the will to transcend himself in every aspect. In addition, the Champion needs to be a "total pack": a high-score shooter, efficient defender (blocker and rebounder), and charismatic team-leader.

Such a player would be the perfect ambassador of his sport.

1.2.3 The Fastest Man on Earth

While talking about football and basketball superstars, we also need to mention the fastest men on the planet. Looking through the history of athletics, we usually first think of Jesse Owens (four-time Olympic gold medalist in the 1936 Berlin Olympics)

and Carl Lewis (nine-time Olympic gold medalist, widely considered the best athlete ever).

However, this is all really history. Today, there is a young and tall man in Jamaica who has shown the world that ‘lightning’ can indeed strike more than once (in the same place). His name is Usain Bolt, and he is by far the fastest man on the planet, with astonishing world records in both the 100 and 200 m dash. When he set the current world record on 100 m in the 2009 World Championships in Athletics in Berlin (Germany), the second place was won by Tyson Gay (9.71 s). While Tyson also set a new US record that day, it was only to see Bolt beat him by 2 m, as commented by the great Michael Johnson (ex world-record holder on 200–400 m dash).

Bolt is the only man who has ever held electronic world records at both the 100 and 200 m sprints. And what kind of world records are these? Both current world records (9.58 s on 100 m and 19.19 s on 200 m dash) were set in the 2009 World Championships in Athletics in Berlin. These historic records, which according to many experts (including Michael Johnson) will stay for decades, came right between the 2008 Summer Olympic Games in Beijing, where he broke three world records (for the first time) and won gold medals in 100 m dash, 200 m dash and 4,100 m relay; and the 2012 Summer Olympics Games in London, where he defended his three Beijing gold medals. To make a balance between the Olympics and World Championships, most recently, Bolt repeated his three Berlin gold medals in the 2013 World Championships in Athletics in Moscow: with the second fastest time ever in the 100 m dash (9.63 s, the current Olympic record) and (his own) third fastest time ever in the 200 m dash (19.32 s), while breaking the world record in the 4,100 m relay (36.84 s).

Running at a speed well over 40 km/h, Bolt is the true embodiment of the *extraordinary speed of human movement*.

1.3 Human Body and Its Environment

The human body is always in a state of *homeokinesis*, or *dynamic equilibrium* with its environment. Both the structural (anatomical) and functional (physiological) integrity of a human organism is determined by a variety of metabolic processes, in synchronization with the processes of their higher neural control and neuro-endocrine self-regulation. Self-regulation of the internal environment of the organism in its interaction with external factors, as well as self-tuning to the most efficient mode of operation, are implemented based on holistic principles; that is, depending on the properties of the whole, which are difficult to differentiate (see [DK05]).

The authors would like to conclude that this book does not provide an alternative to current medical treatments, but rather a complement which can help ensure good health, injury prevention and rehabilitation in the athletic world and more.

1.3.1 Remark on Notation Used (Both Anatomical and Mathematical)

Regarding the *anatomical notation*, the shortcut “m.” means “muscle”, “mm.” means “muscles”, “n.” means “nerve”, “nn.” means “nerves”. Also, biomechanically, “DOF” means “*degrees-of-freedom*”.

The *mathematical notation* is intentionally kept to a necessary minimum and it starts with the Sect. 2.7 on Computational Biomechanics. However, when it is present, the *overdot* means the rate-of-change with respect to time (e.g., $\dot{x} = dx/dt$), which is computationally (in the Sect. 2.7) replaced by the *dash* (e.g., $q'[t] = dq[t]/dt$). Also, “ODE” means “ordinary differential equation”, and “PDE” means “partial differential equation”.

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