

Modern Strength and Conditioning for Tennis

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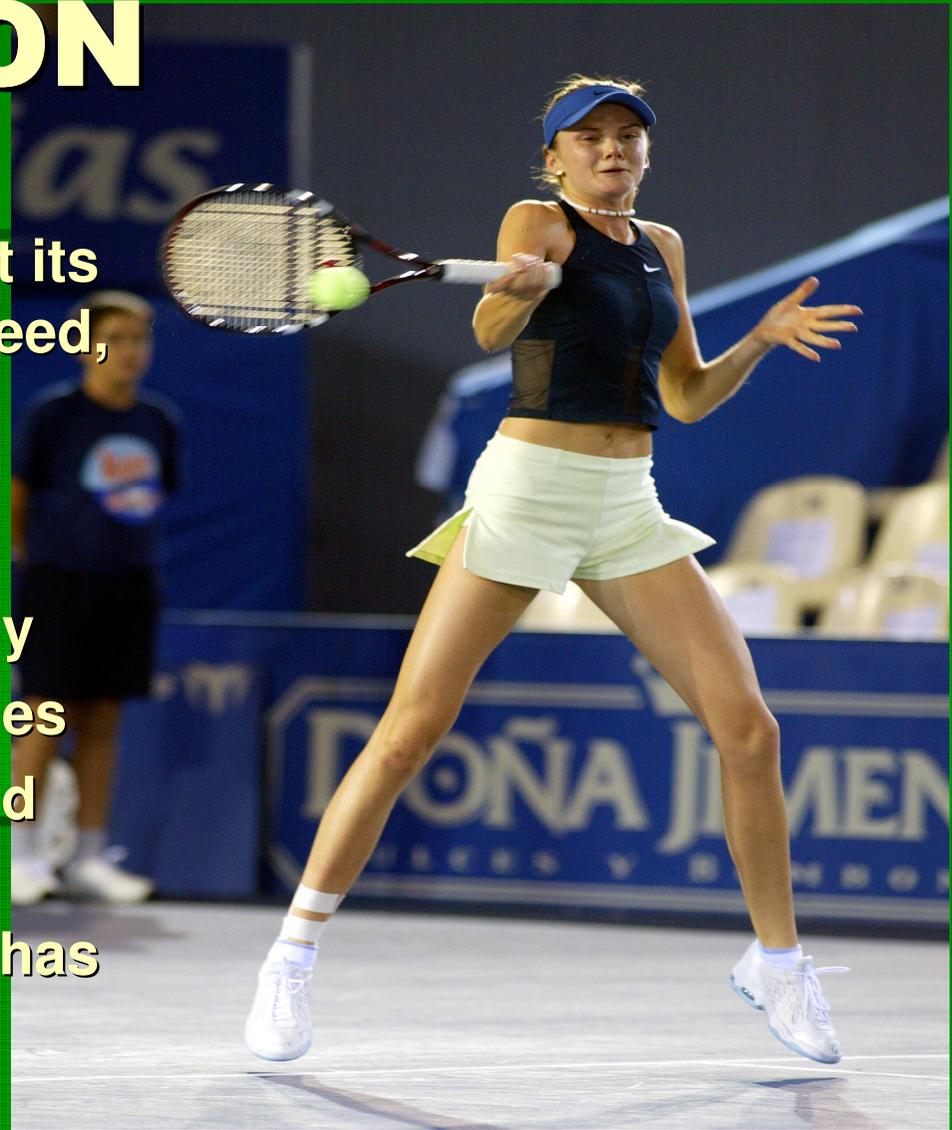
PURPOSE

- Examine some recent developments in tennis-specific athlete preparation
- Determine their implications for players and coaches.
- Discuss advances in the screening and fitness testing of players
- Comment on the training of physical capacities and qualities



INTRODUCTION

- Tennis play requires that its competitors possess speed, strength, coordination, flexibility, power and endurance
- Developed systematically
- Sound scientific principles
- Players bigger, faster and stronger
- Way the game is played has changed as a result.



Specialised physical training: a decisive factor

- Well-planned
- Selects and prioritises training tasks related to the demands of competition:
 - coordinative,
 - biomechanical,
 - bio-energetic



Variable	Main characteristics
Workload	Acyclic, short time intermittent workloads
Work phases	Mainly extensive and partly intensive
Energetic rates	Submaximal
Energy supply	Adenosine-tri-phosphate (ATP), Creatine phosphate (CP) and oxidation of carbohydrates and lipids. ≈ 70 to 80% of the energy supplied by carbohydrates.
Caloric cost Kcal/hour	Males (80 kg.): 600 kilocalories / hour. Females (65 kg.): 450 kilocalories / hour.
Average blood lactate concentrations	Low (between 1.8 and 2.8 mmol/l), rising only (by ≈ 0.5 to 1.0 mmol/l) in real tournament conditions Only 10% of measurements lead to anaerobic peaks with blood lactate levels between 5 and 8 mmol/
Rest and regeneration	Usually sufficient time between rallies and changeovers for regeneration of CP and ATP stores.
Rally length	Women's singles matches: Avg 7.1 secs/rally. Men's singles matches: Avg 5.2 secs/rally.
Actual playing time	Clay court: 20 to 30% of total playing time. Fast court: 10 to 15% of total playing time.
Game situation (clay)	Baseline: 60% of actual playing time (APT). Serve/return: 32%, Volleys: ≈ 5% Other ≈ 3%.
% baseline rallies/surface	Clay: 51% of points, Australian Open: 46% of points, US Open: 35% of points Grass: 19% of points.
Number of strokes	80% of points, play < 4 strokes (short rallies). Play > 8 strokes in less than 3% of rallies (long rallies).
Running distances	Less than three metres per shot.
Running under pressure	Players hit 10% of all strokes without a proper standstill (i.e. sliding) and having run ≈ 4 to 6 metres. 10% of all baseline strokes are played during a full sprint or they are not reached at all.
Time pressure	Players are under time pressure during the execution of ≈ 20% of all strokes.

CHARACTERISTICS OF THE GAME



SCREENING

- **Medical:**

- Comprehensive medical examination (general health and injury risk)
- Performed by a Sports medicine practitioner.
- Includes the trunk/spine, shoulder girdle, elbow and forearm, wrist and hand, pelvic girdle, hip and thigh, knee and shank, and ankle and foot.

- **Musculoskeletal:**

- Comprehensive examination of the musculoskeletal system (posture, flexibility, strength and stability)
- Performed by a sports physiotherapist.
- Includes standardised physiologic, epidermic, neurologic and systemic examinations.

- General postural overview: Identify anatomical, compensatory and adaptive postural factors predisponent to injury or affecting performance

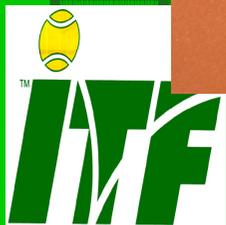
- Questionnaire: general health, family medical history, injury history and nutrition



(Quinn and Reid, 2003).



COMPONENT	FIELD TESTS	LAB TESTS
ANTHROPOMETRICS	Height Weight	Height and weight Sum of 7 skinfolds
FLEXIBILITY	In musculoskeletal screening	In musculoskeletal screening
AEROBIC ENDURANCE	Multistage Fitness Test, Cooper 12 minute run, 1½ mile run	Max VO ₂ Staged Track Test
ANAEROBIC ENDURANCE	Tennis Specific Agility Endurance Test	Field test with Electronic Timing Gates, Tennis specific endurance test (German)
STRENGTH Relative Strength Test	Push up test, Grip Strength Test, Max body weight (bw) dips Maximum bw chin-ups, 3RM Squat or Bench Press divided by body weight.	
UPPER BODY POWER	Overhead Medicine Ball Throw Sidearm Medicine Ball Throw – right and left	Service Speed Racquet Velocity in groundstroke production
LEG POWER	Vertical Jump – both legs, right leg, and left leg Vertical Jump with Three Step run-up Standing long jump/hop	Elastic potential (from force platform data)
SPEED	5, 10 and 20 metre sprint	5 or 10 metre sprint with electronic timing gates
AGILITY/ MOVEMENT COORDINATION	Movement to the forehand side, backhand side, backwards Movement, planned Agility Test. The Hexagon Test General Coordination Test	Same with electronic timing gates Specific Coordination Test



TESTING

COORDINATION, SPEED AND AGILITY

- Coordination is the most important factor (Schonborn, 1998).
 - Orientation
 - Rhythm
 - Reaction
 - Differentiation
 - Balance (Bourquin, 2003)
- Fun and varied exercises
- Speed:
 - Importance of reaction speed (Moreau et al., 2003)
 - Acceleration ability with coordination drills with varying degrees of complexity
- Agility:
 - Ability to execute a movement efficiently using minimal muscular energy
 - Combined and varied exercises that are both specific and suitably challenging



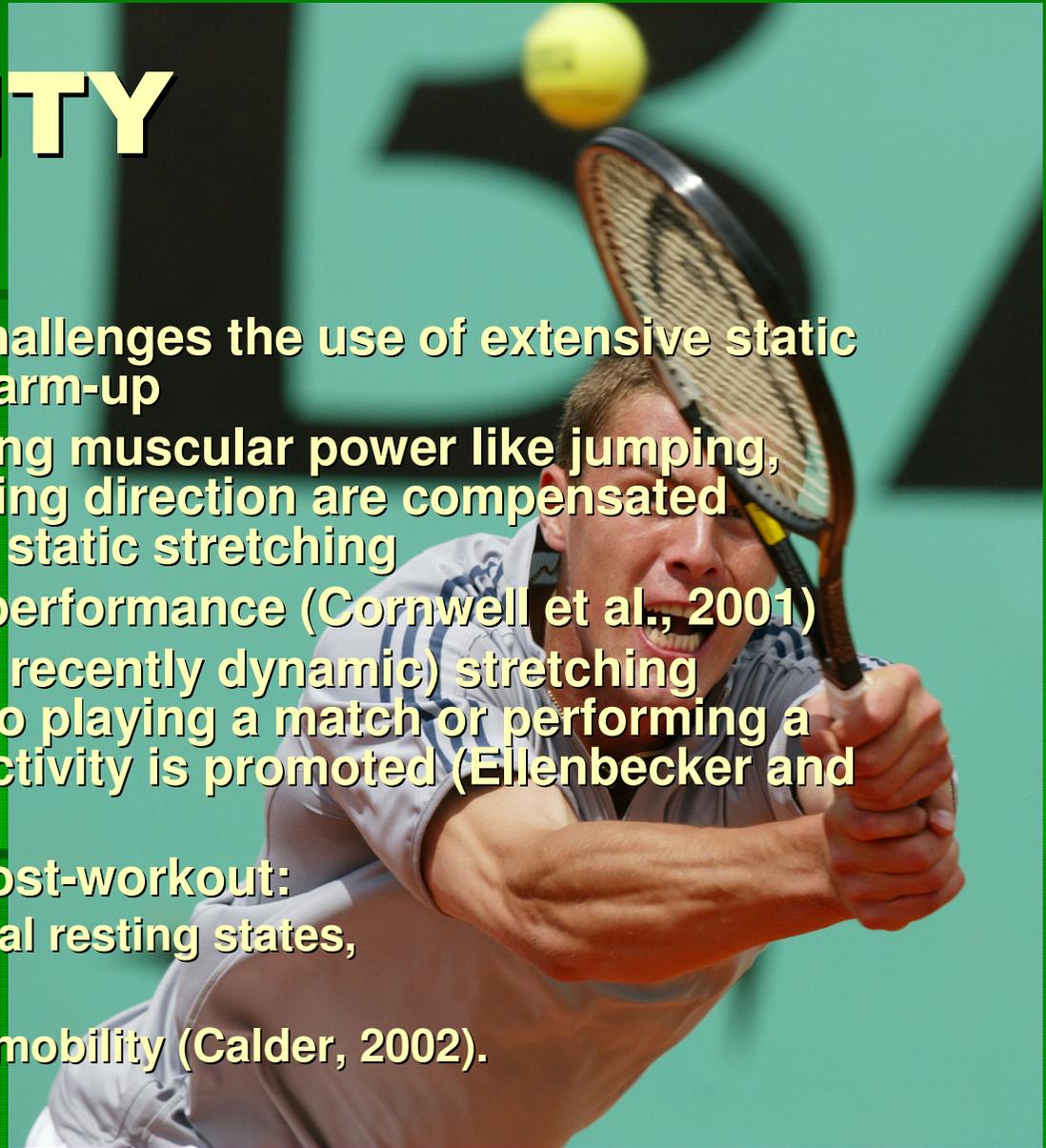
FLEXIBILITY

- Functional component of movement
- Refers to the range of movement (ROM) around a joint
- Usually developed through a variety of stretching techniques:
 - ballistic stretching exercises,
 - static stretching exercises,
 - passive stretching exercises,
 - proprioceptive neuromuscular facilitation,
 - neural glides - desensitising exercises,
 - postural stretching exercises.
- At ATP level all players perform static stretching exercises but only 75% do so more than once per day. 75% of male professional players use passive stretching exercises (PNF) (Reque, 2002)



FLEXIBILITY

- Recent research challenges the use of extensive static stretching in the warm-up
- Movements requiring muscular power like jumping, lunging and changing direction are compensated following a bout of static stretching
- 20% decreases in performance (Cornwell et al., 2001)
- Ballistic (and more recently dynamic) stretching immediately prior to playing a match or performing a maximal training activity is promoted (Ellenbecker and Roetert, 2001)
- Static stretching post-workout:
 - Recovering normal resting states,
 - Muscle lengths
 - Functional joint mobility (Calder, 2002).



ENDURANCE

- Aerobic and anaerobic endurance are the second most important conditional factors after speed and agility by tennis coaches (Ferrauti et al., 2002).
- Influential in clay court tennis and baseline players (Weber and Hollmann, 1984).
- A high fatigue resistance in specific musculature (stroke arm) is essential as well as physical stress tolerance and strength of will (Weber et al., 2002).



ENDURANCE

- Drills replicate submax- max demands of matchplay (Ferrautti et al., 2003):

- Aer. endur drills: High density work / sub-max intensity. (i.e. *Crossct rally drill changing directions after each 2- 3 str*).

- Aer/anaer endur drills: Playing points from the baseline with no SV-RT. (i.e. *Coach puts ball into play and players play the point*).

- Anaer endur drills: Intermittent work at max metabolic intensity (i.e. 6-10 strokes on the run and under time pressure plus active recovery over 30-45 secs).

- High intensity anaer endur drills: Often do not correspond to the demands of matchplay. Prescribed cautiously with at least 2 days to recover and not during short-term tournament preparation.



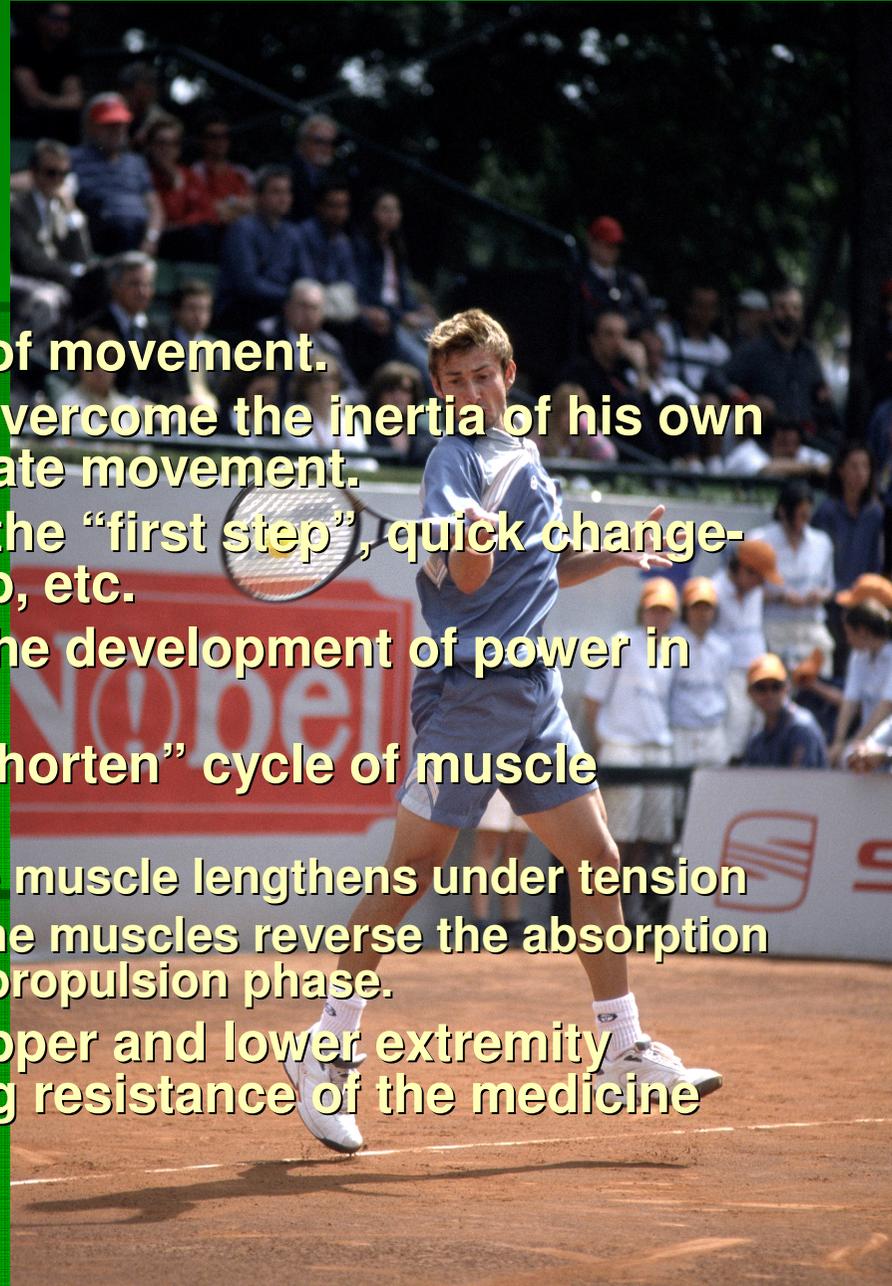
STRENGTH

- Ability to apply force to overcome resistance
- In tennis:
 - Generate speed, power and endurance.
 - Quickness, anaerobic energy system development
 - Flexibility
- Training programmes adapted to court surface demands:
 - Hard-court: Elastic/reactive strength, acceleration and deceleration
 - Clay: Combination of stabilization, isometric and eccentric strength,
 - Grass: Range of motion isometric holds, and adynamic, limited range of motion style of training.



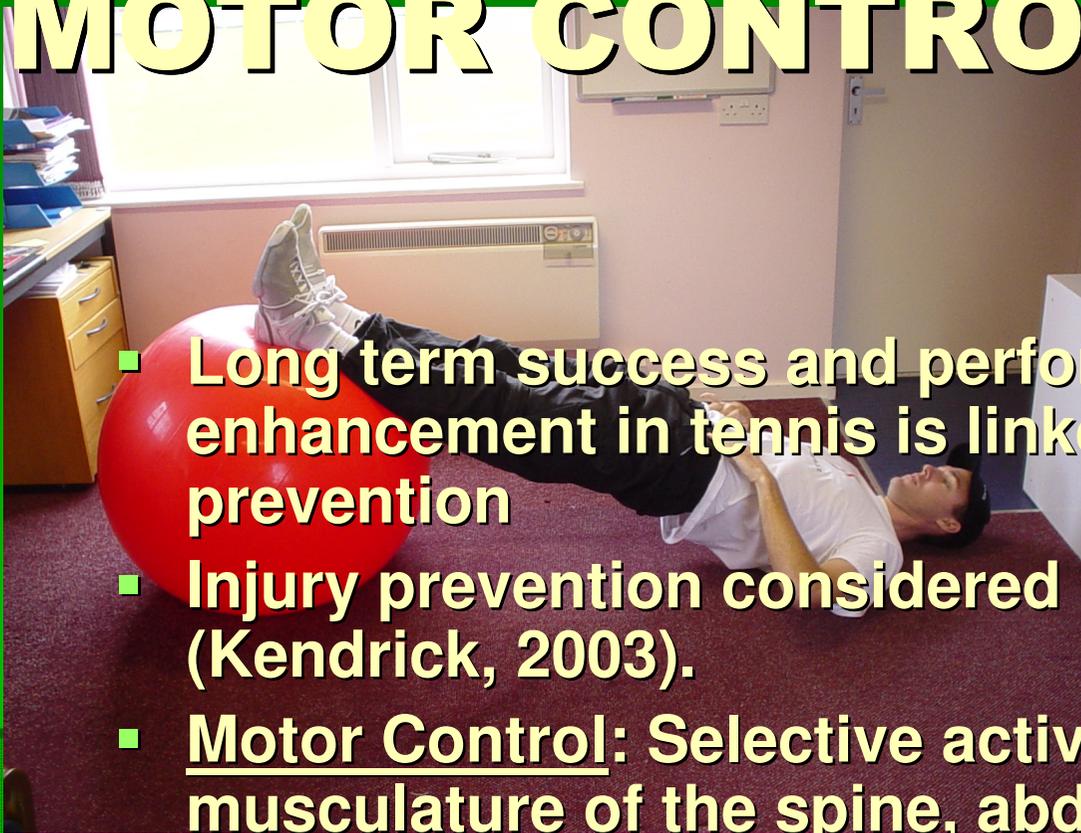
POWER

- Associated with speed of movement.
- Ability of the player to overcome the inertia of his own body weight and to initiate movement.
- In tennis: emphasis on the “first step”, quick change-of-direction, early set-up, etc.
- Plyometrics facilitates the development of power in athletes (Chu, 1998).
- Based on the “stretch-shorten” cycle of muscle activity:
 - Eccentric strength: the muscle lengthens under tension
 - Concentric strength: the muscles reverse the absorption phase and initiate the propulsion phase.
- For the tennis player: upper and lower extremity plyometrics also adding resistance of the medicine ball (Chu, 2003).



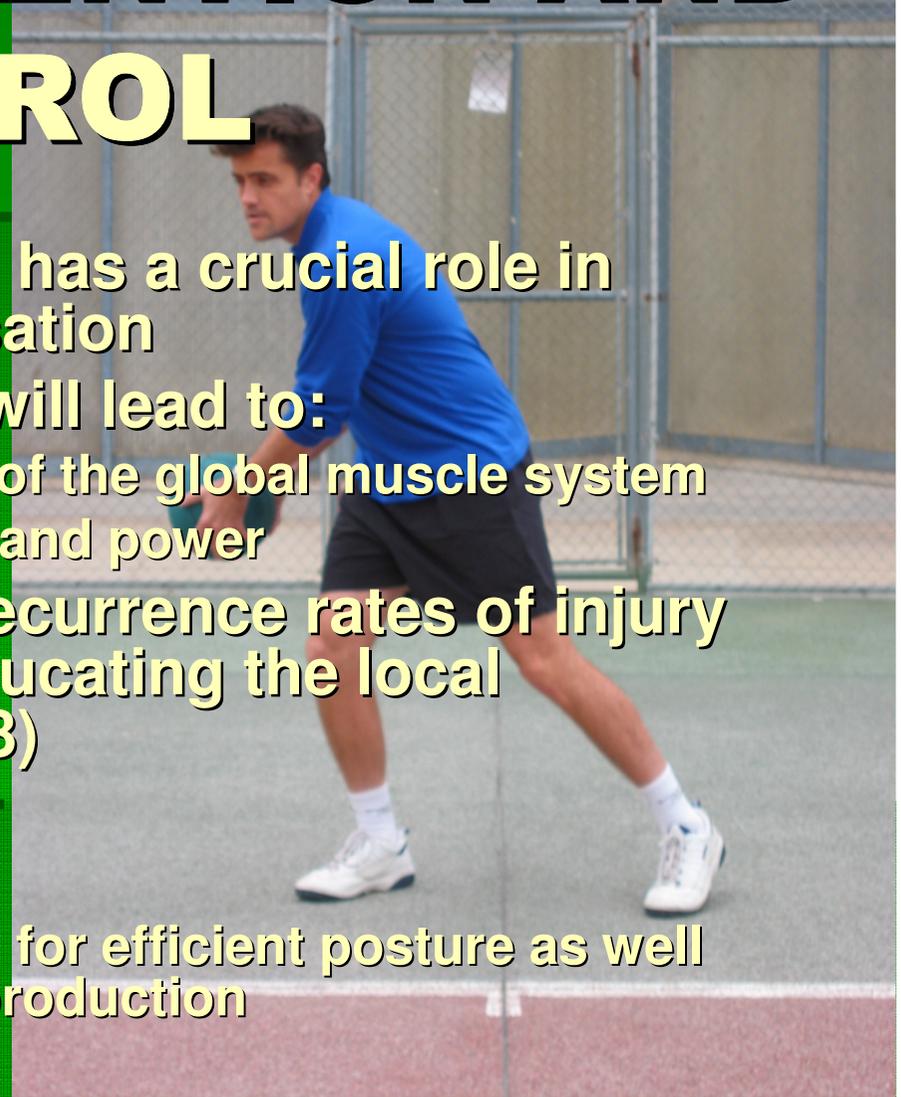
INJURY PREVENTION AND MOTOR CONTROL

- Long term success and performance enhancement in tennis is linked to injury prevention
- Injury prevention considered holistically (Kendrick, 2003).
- Motor Control: Selective activation of the deep musculature of the spine, abdomen, pelvis, hip, knee and shoulder girdle
- MC, Stabilisation Strength or Core Stability: Prominent in most athletic training and injury prevention (prehab) programmes of players



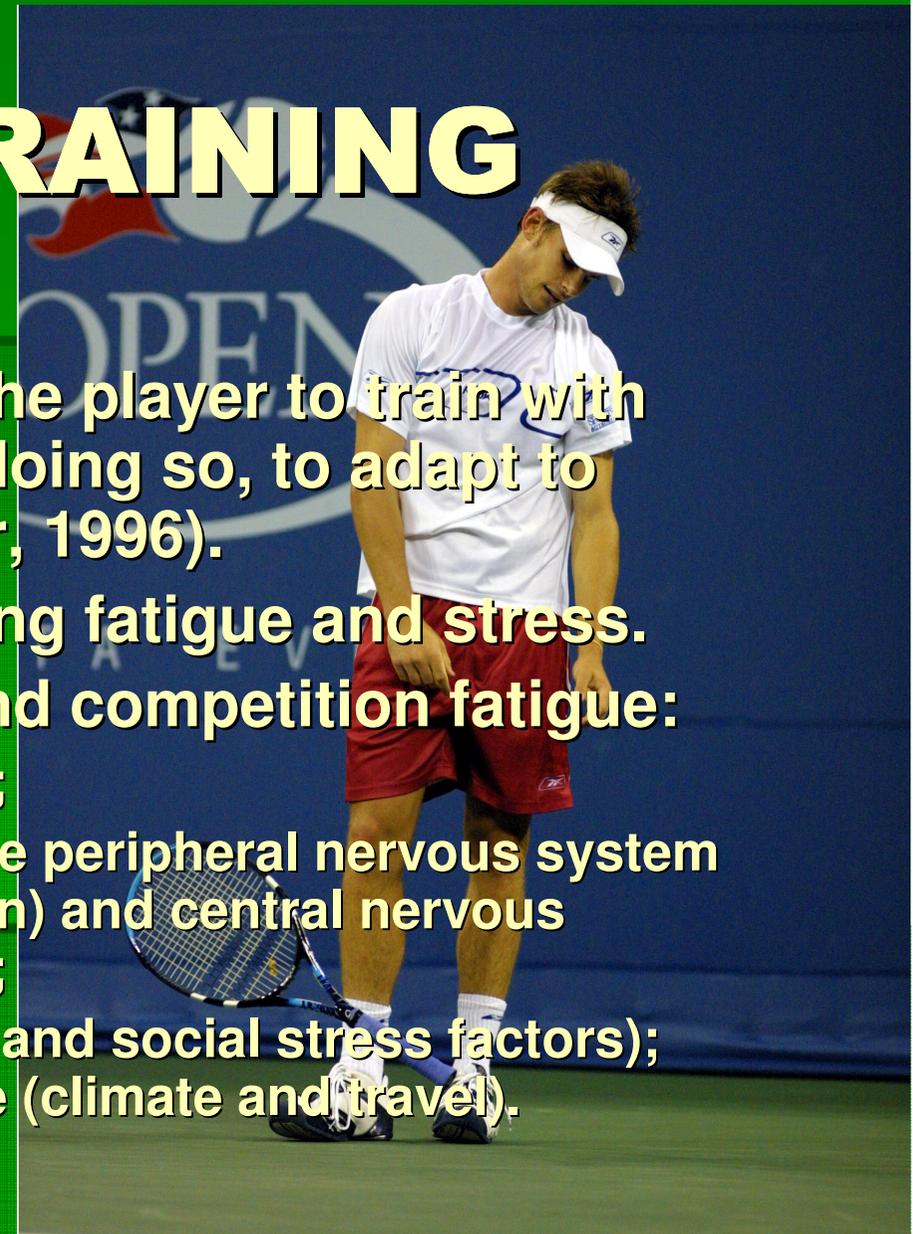
INJURY PREVENTION AND MOTOR CONTROL

- The local muscle system has a crucial role in spinal segmental stabilisation
- Enhanced joint stability will lead to:
 - More efficient functioning of the global muscle system
 - Improvements in strength and power
- Dramatic reductions in recurrence rates of injury can be obtained by re-educating the local muscles (Cresswell, 1993)
- Deep muscles perform:
 - Little movement
 - A stabilising role essential for efficient posture as well as movement and stroke production



RECOVERY TRAINING

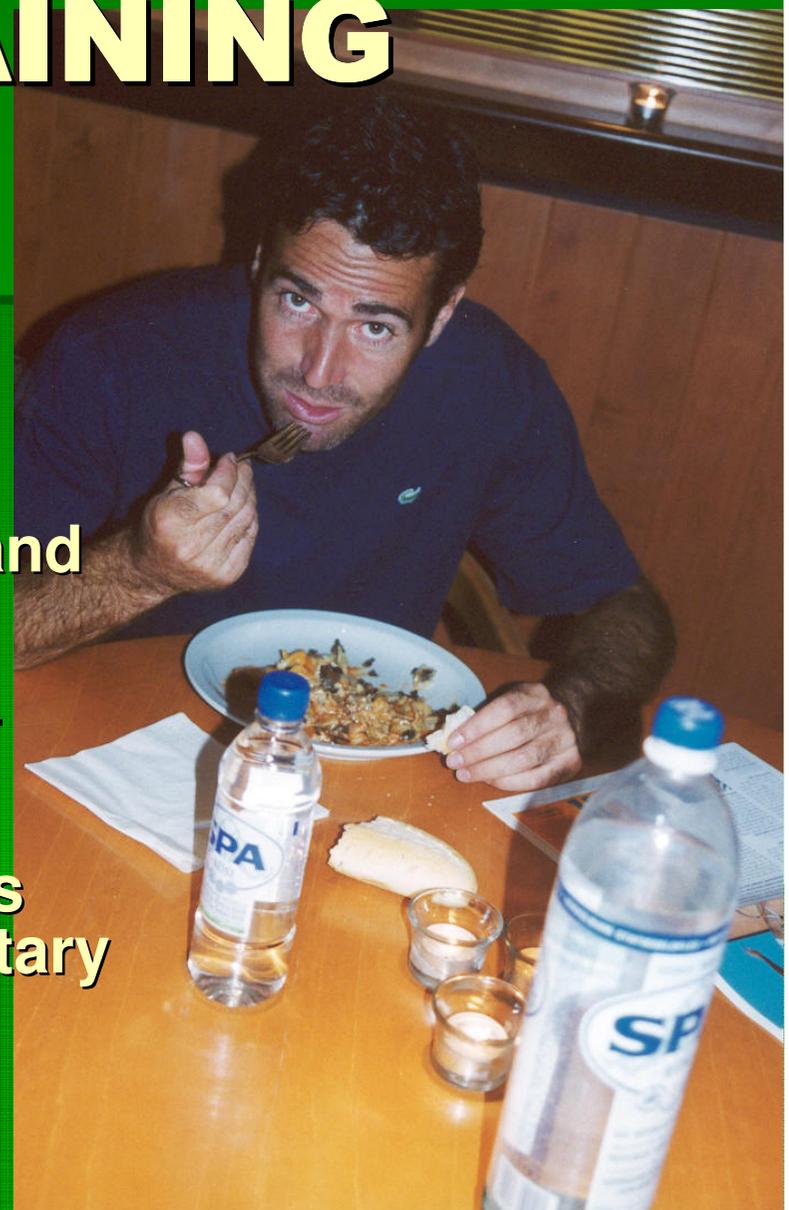
- **Main objective:** Enable the player to train with minimal fatigue and, in doing so, to adapt to workloads faster (Calder, 1996).
- **Reducing residual training fatigue and stress.**
- **Main types of training and competition fatigue:**
 - Metabolic (energy stores);
 - Neural of either or both the peripheral nervous system (localised force production) and central nervous system (drive/motivation);
 - Psychological (emotional and social stress factors); and environmental fatigue (climate and travel).



RECOVERY TRAINING

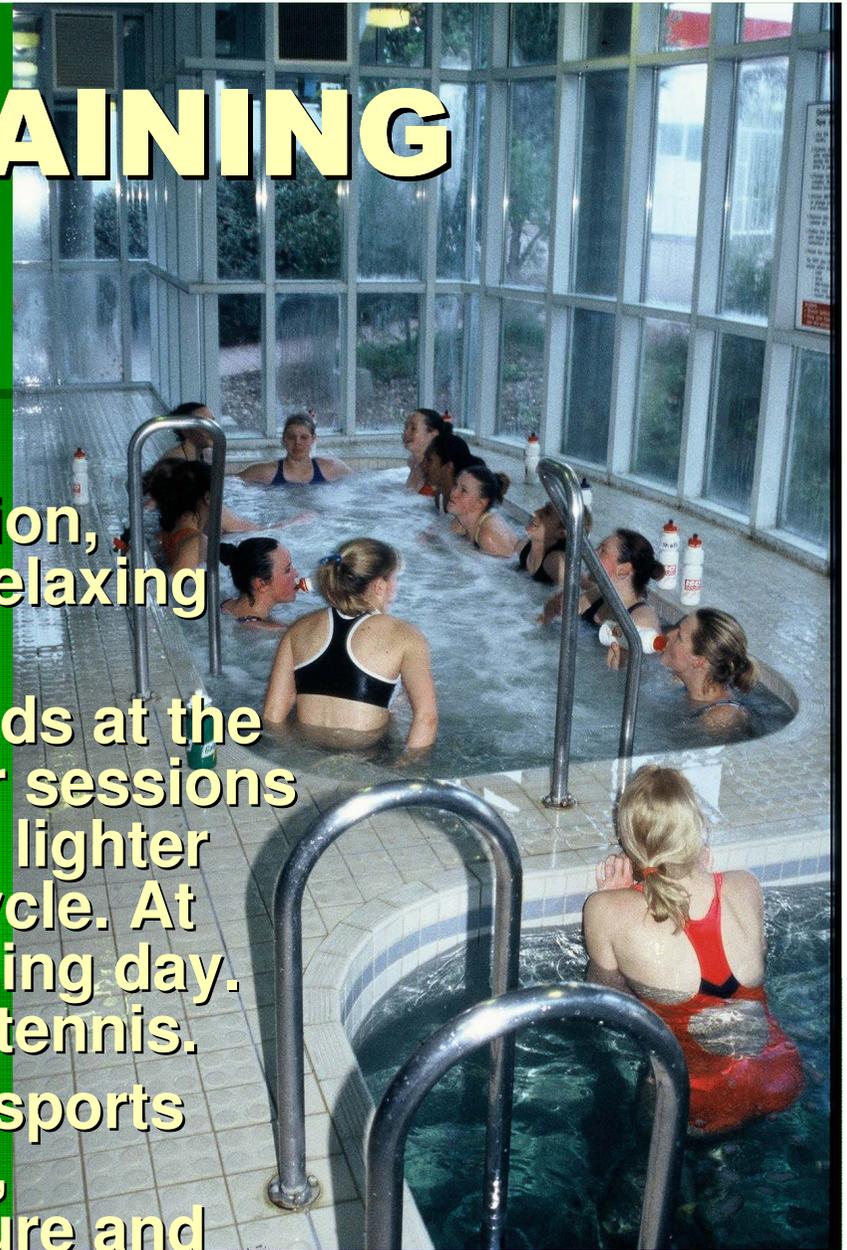
Areas

- **Nutrition:**
 - Fluid balance: monitored through urine checks and weighing the player pre- and post-training.
 - Minerals / trace elements: Important for muscle regeneration.
 - Extra intake may not be as effective as increased dietary sources.



RECOVERY TRAINING Areas

- **Physical therapies:**
 - **Passive:** Sleep, meditation, reading or listening to relaxing music.
 - **Active:** Lighter work loads at the end of a session, lighter sessions within a microcycle and lighter weeks within a macrocycle. At least 1 day/wk non-training day. Other interests outside tennis.
 - **Other:** Hydrotherapies, sports massage, self-massage, acupressure, acupuncture and Hyperbaric Oxygenation Therapy (Clews, 1990)



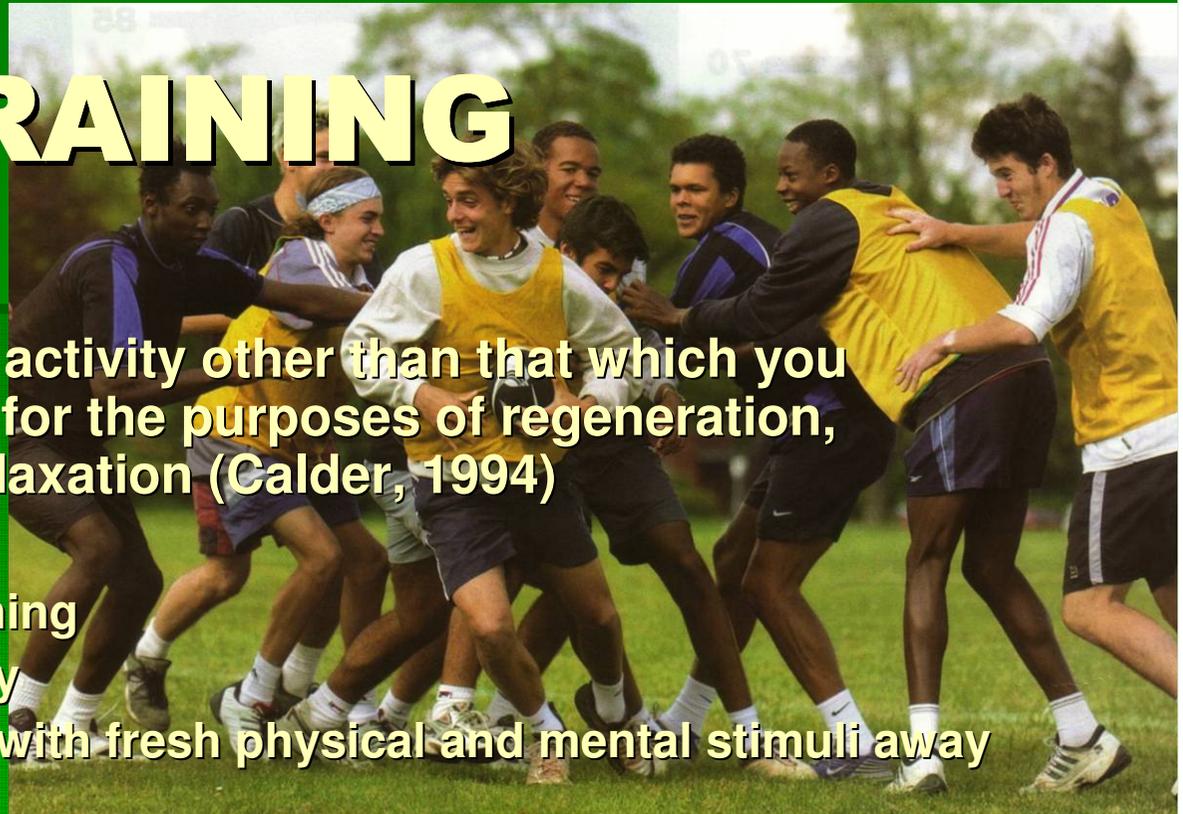
RECOVERY TRAINING Areas

- Psychological (Hogg, 2002), (Loehr, 1992):
 - Debriefing: Evaluates performance by focusing on process rather than outcomes
 - Mental toughness: Biofeedback, positive self-talk and body language
 - Relaxation: Meditation, progressive muscle relaxation (PMR), imagery and visualisation, breathing exercises, flotation and music.



CROSS TRAINING

- Participation in an activity other than that which you primarily compete for the purposes of regeneration, recovery and/or relaxation (Calder, 1994)
- Goals:
 - Prevent overtraining
 - Promote recovery
 - Provide athletes with fresh physical and mental stimuli away from the sport
- Vital for the tennis player from physical, psychological and social developmental points of view
- Initiatives: Touch rugby or gridiron, soccer, frisbee, boxing, athletics, yoga, netball, swimming and pool work, bike-riding, Pilates, Tai Chi, basketball, squash, racquetball, and gymnastics (Reid et al., 2003).



Récré. Jeux de balle pour les jeunes tennismen du pôle France à l'Insep pour travailler réflexes, vitesse et coordination.



CONCLUSION

- Tennis places unique physical demands on its exponents
- In return it requires a unique set of physical qualities and capacities for accomplished and successful performance
- The modern professional tennis player needs to be a complete athlete
- Strength and conditioning has also endured considerable changes over time
- Sport science has led this evolution and demonstrated the effectiveness and practical application of a variety of training mediums
- The challenge remains for the coach or trainer to blend these mediums into a well-planned, individualised and specific training plan such that they are used to greatest effect

