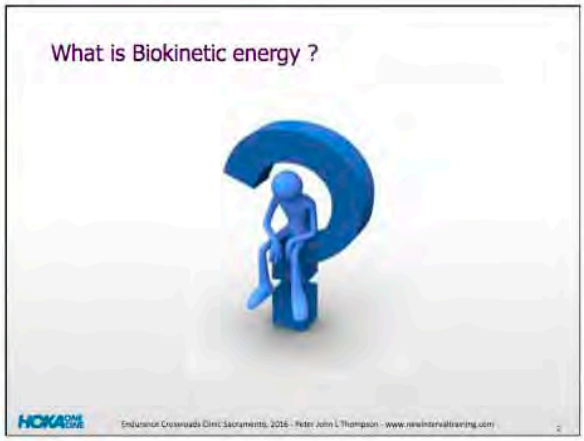
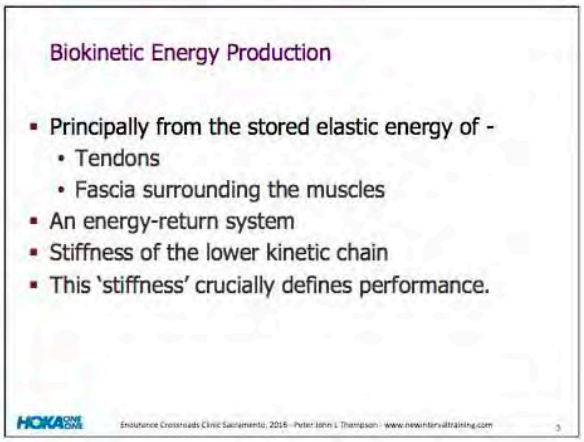
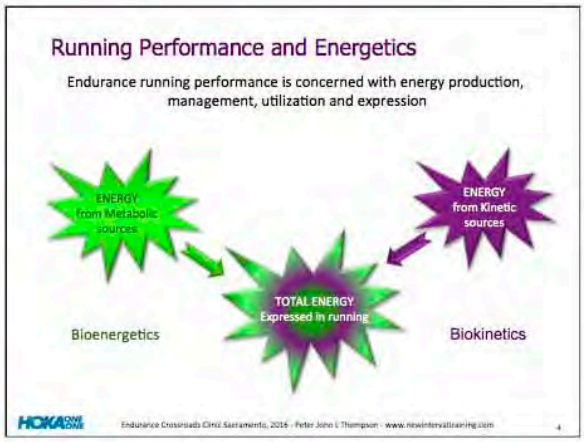
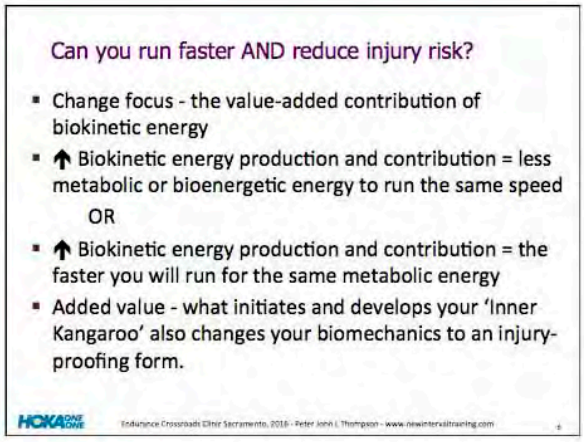
# Growing Pains - the Effects of the Adolescent Growth Spurt on Biokinetic Energy Production and Running Performance






Presented by HOKA ONE ONE

# Growing Pains - the Effects of the Adolescent Growth Spurt on Biokinetic Energy Production and Running Performance

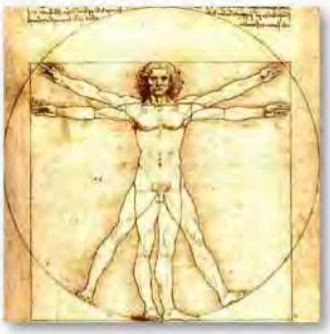
"What is the effect or potential effect of the adolescent growth spurt on stiffness and biokinetic energy production?"



## What is the adolescent growth spurt ?

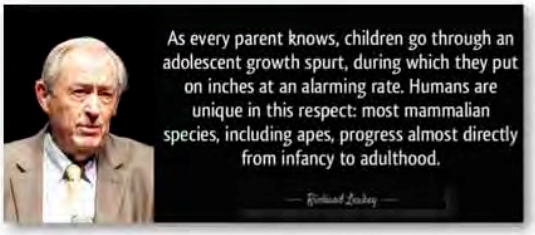


## Proportions throughout life?





## Richard Leakey's insight .....





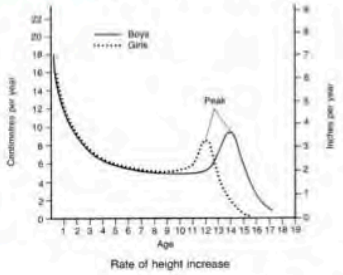

## Adolescent Growth Spurt - AGS

- The adolescent growth spurt - AGS
- Varies by gender - different timing of onset and rates of growth
- Girls between 10 and 15 will grow
  13 inches and gain up to 38 lbs (incl. sedentary)
- Boys between 12 and 17 will grow
  14.5 inches gaining up to 48 lbs (incl. sedentary).



## The Growth Spurt

- The adolescent growth spurt occurs at puberty.



# Growing Pains - the Effects of the Adolescent Growth Spurt on Biokinetic Energy Production and Running Performance

## Girl's Development

- First sign of puberty in girls occurs at 10½ years of age with breast development
- The first period or menarche is at an average age of 12-13 years and usually occurs about two years after puberty begins
- This coincides with their peak in height velocity - the adolescent growth spurt - AGS.



## Girl's Development

- Once the ovaries are mature legs have generally finished growing
- Any increase in height after periods have begun comes just from the torso as the spine grows
- Development continues and a child will have reached her final adult height about two years after menarche
- Lastly the bones of the pelvis widen and become smooth in preparation for childbirth
- This can occur occur to the age of 18 or even later.



## Boy's Development

- Puberty on average at 12 years of age
- They undergo their AGS about 2-3 years later than girls.



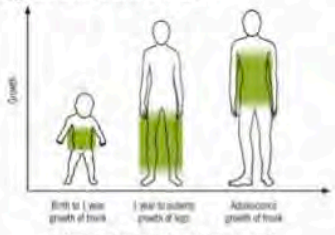
## The AGS in Action

- The AGS begins at the distal areas - enlargement of the hands and feet
- Followed proximally - legs and arms
- Then trunk and chest/shoulders for boys - hips for girls
- Distal to proximal progression within the limbs:
  - Shin bones lengthening before the thigh bones
  - Forearms before the upper arms
- Bones grow ahead of muscles, tendons and fascia
- Effects coordination, skill and stiffness.



## How is Growth Taking Place?

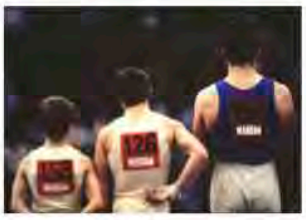
- The body grows by different body segments growing at different times.




Areas of growth from birth to adult



## Individual Variation



Three Youth athletes – all 14 years of age

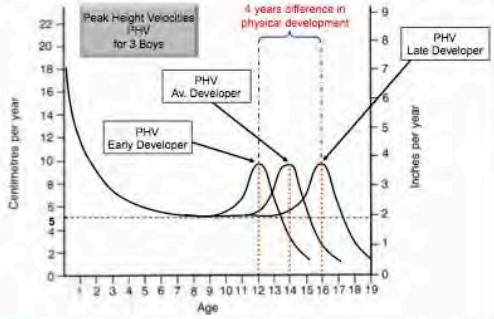
Photo: I. Belyi, LTAD Implications for coaches and parents, NCTC Coaching Conference, UK 2005



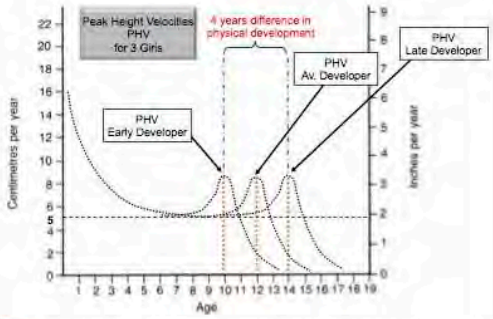
Presented by

# Growing Pains - the Effects of the Adolescent Growth Spurt on Biokinetic Energy Production and Running Performance

## Early and Late Developers - Boys




## Early and Late Developers - Girls




## Timing of the AGS

- For 95% of population the AGS takes place in a range of
  - 9 to 17 years of age for girls and
  - 11 to 19 years of age for boys.


## Gender Differences

- Boys have a performance advantage through puberty since they gain height and muscle mass and testosterone stimulates greater production of haemoglobin leading to an increased oxygen-carrying capacity
- Girls gain height but also a relatively higher percentage of body fat.

## The AGS - Summary of Average Development

| Girls | Boys |
|---|---|
| ▪ Growth Spurt starts age 10 | ▪ Growth Spurt starts age 12 |
| ▪ Gain 13" @ 3" / year | ▪ Gain 14.5" @ 4" / year |
| ▪ Spurt in weight continues for 2 years after height @ up to 20 lbs / year | ▪ Spurt in weight continues for 2 years after height @ up to 25 lbs / year |
| ▪ Hips wider | ▪ Shoulders broaden |
| ▪ Body shape more rounded gaining more fat | ▪ Body shape more defined gaining more muscle mass. |

## Impact of AGS

- For boys and girls running performance impacted by the AGS through the well-known factors of -
  - Loss of coordination and biomechanical efficiency
  - Low energy levels - diversion of ATP
  - Increased weight - ↓ power to weight ratio
  - Decreased functional VO2 max
  - For girls - biomechanical changes as hips broaden
- Rapid growth impacts body's ability to control stiffness as the athlete 'loses' the skill of running
- This includes the ability to adapt to the running speed or surface to create and utilise elastic energy.

Presented by

HOKA ONE ONE

# Growing Pains - the Effects of the Adolescent Growth Spurt on Biokinetic Energy Production and Running Performance

## Running and Stiffness

- Running - propelling the body forward while body tries to keep center of gravity level
- During impact with ground the leg acts much like a spring absorbing energy - releasing it later in the running cycle
- The closer the 'stiffness' of the spring is to optimal the ↑ elastic return and the ↓ metabolic energy you will need to run at a certain speed or the faster you can run for the same metabolic contribution.



## Stiffness in Action

- Run gently across a concrete parking lot at the beach and continue straight onto the sand
- Legs would adapt and be stiffer on the sand
- The stiffness of legs is a function of the lower kinetic chain involving the
  - hip, knee, ankle and foot joints
  - connective tissues, tendons and fascia
- Now - sprint across the concrete on to the sand
- Insufficient time to adapt stiffness.



## Consequences of Incorrect Stiffness

- Leg stiffness will relatively ↑ softer surfaces and will ↓ on harder surfaces
- Incorrect stiffness produces negative results in either direction
- If the lower kinetic chain is too stiff then ground impact and reaction forces are increased and elastic energy is dissipated - lost - in the impact
- If the stiffness not sufficient then the energy dissipated - lost - into the squidgy spring
- Another consequence is that the muscles will have to activate more and use more metabolic energy.



## The Stretch-Shortening Cycle SSC and Biokinetics

Old View

- Imagine muscle-tendon system as a 'rubber band'
- While stretching the system energy will be stored (muscle - eccentric phase)
- This energy will be regained at shortening (muscle - concentric phase)



## Source of Biokinetic Energy – Current View

- Muscle eccentric contraction not so important as elastic properties of tendon and muscle fascia
- Muscle needs to be in isometric mode in movement
- Essentially same 'rubber band' analogy except -
  - Recognition that muscle response and contribution not as great as was thought for creating force but vital as stabilizer & resistance
  - 'Rubber band' now the tendon & muscle fascia - most energy will be regained if stiffness optimal
  - Level of isometric stabilization by muscles and positioning of the joints determines 'stiffness'



## The Hardware

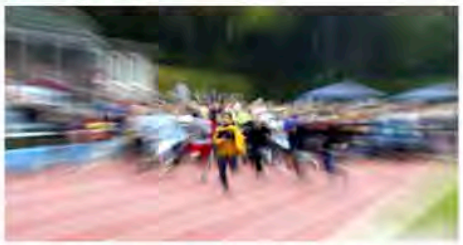
- For adolescents - boys and girls alike - negative impact on stiffness during AGS from changes to hardware - the kinetic chains
  - the skeleton
  - muscles and
  - connective tissues
- Girls added factor of changes to non-contributing body weight
- For girls the adaptations required during and after the AGS before recapture of full biokinetic elastic energy capacities generally takes much longer.

# Growing Pains - the Effects of the Adolescent Growth Spurt on Biokinetic Energy Production and Running Performance

## What can be done?



## Athlete Development



*"You can't make the grass grow faster by pulling on the blades."*

African proverb



## See the Individual

- To be effective the coach of adolescents must
  - Have some sense of biological development of each of their athletes
  - Use individualized approach rather than 'group' approach
- Within any group you may occasionally develop sub-groups based on varying criteria dependent on the activity - Socio-mental maturation, Physical maturation, Competitive level or, simply - Height.



## Nutritional Strategies

- Encourage and model healthy eating habits for all
- Many girls and some boys experience negative body image in adolescence -
  - They try to halt healthy weight gains of the AGS or even reverse it
  - Eating disorders - helps an athlete maintain or improve performance as a runner for about six months
  - Then consequences are inevitable and disastrous.



## Consequences of Disordered Eating

- An eating disorder often leads to amenorrhea - the absence of menstruation
- Amenorrhea decreases bone density
- Low bone density leads to stress fractures and osteoporosis and a destructive downward spiral that leads to a fragile skeleton for life
- The emphasis for both boys a girls through the AGS is to maintain a healthy lean body mass.



## Postural Strategies

- Introduce at early age to be continued through AGS - sessions that develop awareness of
  - Correct - Natural - Neutral posture
  - Without correct posture kinetic chains unlikely to ever be in position to function optimally
- Introduce novel and new coordination movements along with the continued practice and re-learning of previous skills and coordination
- Since all of these activities require learning and re-learning fatigue should not be allowed to be a factor in the session.

# Growing Pains - the Effects of the Adolescent Growth Spurt on Biokinetic Energy Production and Running Performance

## Quality vs. Quantity

- Frequency and variety is better than quantity
- 'More' training rarely equals 'better' training
- Stiffness in running is function of non-fatigue and
  - Speed of running
  - Shoe softness
  - Surface softness and terrain
- In all there should be variety and more variety
- Change paces and never jog - either walk or run from easy to faster
- Use a variety of shoe models and brands and run on differing surfaces and terrain.



## Complimentary Activities

- Use multi-lateral movements
- Use different and particularly glute-dominant movement patterns in cross-training
- Take part in other sports - do not lose the athletes to these other sports!
- Strength needs to be developed to handle the new and increased body weight - should be developed within functional body movements.



## Other Strategies

- What else can you do through the AGS?
- Encourage getting sufficient uninterrupted sleep
- Use an empathetic process-oriented non-comparison model of coaching
- Motivate to persevere when what was easy becomes tough
- Be honest - particularly the possible time to recover performance levels
- Encourage patience and have patience
- Respect the athlete's socio-mental development as well as their physical development
- Be aware of the athlete's susceptibility to training injuries especially during and immediately after AGS.



## Timelines

- Can take many years to recover prior-AGS performance levels - for some - barely a change in progression
- We see athletes who continue and at age 25 finally surpasses their best from age 15
- While AGS appears to rob athletes of their ability a good young athlete will usually develop into a good adult athlete - particularly the late developers - provided they regain and further develop the natural 'spring' of their pre-adolescent youth.



## Summary

- Understand the patience required to change and adapt some movement patterns and behaviors
- Be committed to a long-term movement improvement strategy working through mobility evaluation, posture, stability, strengthening and neuromuscular conditioning
- Identify what you can do today - now - to quickly improve your running mechanics with:
  - Posture
  - Running faster in all runs - the faster we run the shorter the ground contacts and the greater the stiffness
  - Running on soft surfaces – increases stiffness
- Enjoy your running ..... and regain your 'inner kangaroo'



## Essential Reading

*Anatomy for Runners*
Jay Dicharry, 2012

*New Interval Training*
Peter Thompson, 1995
www.newintervaltraining.com



Presented by