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Transitioning to the New US Soccer Guidelines Regarding Purposeful Heading in Youth Players ---- Introducing the NSCAA's Get aHEAD Safely in Soccer Program

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- Isokinetic International website support. 

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Today's Headline!

The Conversation - Neuroscience Should Kids Be Allowed to Play Soccer?

One heading session may result in temporary memory impairment

By Magdalena Jetswaart, Angus Hunter, Thomas Di Virgilio, The Conversation on October 24, 2016





SCIENTIFIC AMERICAN

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“Soccer May Be Hazardous to Your Brain -- Heading for an Injury” (ABCnews.com 1996)

“Young kids should stop heading the ball” – Dr. Robert Cantu 2014


This ball is too big!

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Parents, Stop Obsessing Over Concussions

Op Ed – NY Times STEVEN M. ROTHMAN DEC. 22, 2015




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Head Impact Kinematics

Comparison with everyday activities (1) head strike 11 g's, (2) chair plop 4 g's (3) head shake 4 g's, (4) "aggressive" pillow fight 19 g's



Funk et al. 2010 Ann of Biomed Eng.
A force acting on a body as a result of acceleration or gravity, informally described in units of acceleration equal to one-g. For example, a 12 pound object undergoing a g-force of 2g experiences 24 pounds of force.

Newton's Cradle = 39 g's

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A West Point Tradition Gone Awry!




CNN

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Subconcussive Impacts

- Subconcussive Blow/Repeated Head Impacts.
 - Blows to the head which do not cause concussion signs and symptoms are hypothesized to cause clinical and pathological findings ("slosh" phenomenon)
 - Meehan et al, 2015.
 - Greatest effect through repetitive occurrences whereby cumulative exposure is deleterious
 - Bailes et al, 2013
 - "Probably....genetic factors (APO E and IL-6) that play an important role in susceptibility to injury"
 - Bailes et al, 2013




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Heading as a Skill in Soccer

- Definition**
 - "To play the ball with the forehead, whether the intention is a clearance, a pass, or a shot at goal" (Gardner, 1996)
- Use of frontal bone**
 - Accepted technique is to have players contract neck muscles as ball approaches and remain contracted until after impact






FIFA TV

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Types of Purposeful Headers

- Jumping vs. Standing vs. Diving Headers**
 - pass
 - shot
 - clearance






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Biomechanics of Heading

- A complex skill that requires a great deal of PRACTICE!!
- The ball is struck by the forehead @ the hairline in an ACTIVE manner!
- Three Phases:**
 - Preparation** – crucial to ensure accurate timing for proper technique (trapezius and SCM muscles are active)
 - Impact** – initial contact with a subsequent ball deformation and resultant recoil of the head (10 – 23 milliseconds)
 - Recovery** – muscle activity to aid in decelerating the head




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Factors to Consider

	Size 3	Size 4	Size 5
Mass, g (oz)	215-240 (7.6-8.5)	215-230 (7.6-8.1)	280-425 (9.8-15.0)
Circumference, cm (in)	64-69 (25-27)	67-71 (26-28)	68-75 (27-29)
Coef. of restitution	0.5-0.6	0.5-0.6	0.5-0.6

Kirkendall & Garrett, JAT 36(3), 2001




- Ball Characteristics**
 - 312 – 453 g mass
 - Sizes 3, 4, and 5
- Player Mass Differences**
- Mental Readiness**
 - Strike an unprepared player with linear and/or rotational forces → equals injury!
- Contact Time/Impact Forces**
- Acceleration of the Head**
 - Linear
 - Rotational

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Incidence of Head Injuries in Soccer

- In Europe, head injuries account for between 1% and 20% of all soccer injuries
- 54% of active and 70% of former players suffered some form of head trauma from playing soccer (Tysvaer, 1992)
- NCAA injury surveillance data: concussions result in 4.5% of injuries in soccer compared to 5% in football (1991-1996)
- 79% suffered a head-to-head collision during their career (Matser et al., 1998)
- Some evidence to suggest that females are more susceptible to concussions in soccer than males



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Concussion rates in US High School and Collegiate athletes in practice and competition, 2005-06

Sport	Division	Participating Athletes	Concussions	Rate	95% CI	P Value
Football	High School	1,037	103	1.0	0.8-1.3	<.001
	Collegiate	1,100	103	0.9	0.7-1.1	<.001
Other soccer	High School	4,346	210	0.5	0.4-0.6	<.001
	Collegiate	1,120	120	0.1	0.0-0.2	<.001
Women's soccer	High School	4,346	210	0.5	0.4-0.6	<.001
	Collegiate	1,120	120	0.1	0.0-0.2	<.001
Volleyball	High School	1,100	103	0.9	0.7-1.1	<.001
	Collegiate	1,100	103	0.9	0.7-1.1	<.001
Other volleyball	High School	1,100	103	0.9	0.7-1.1	<.001
	Collegiate	1,100	103	0.9	0.7-1.1	<.001
Baseball	High School	1,100	103	0.9	0.7-1.1	<.001
	Collegiate	1,100	103	0.9	0.7-1.1	<.001
Softball	High School	1,100	103	0.9	0.7-1.1	<.001
	Collegiate	1,100	103	0.9	0.7-1.1	<.001
Wrestling	High School	1,100	103	0.9	0.7-1.1	<.001
	Collegiate	1,100	103	0.9	0.7-1.1	<.001
Judo	High School	1,100	103	0.9	0.7-1.1	<.001
	Collegiate	1,100	103	0.9	0.7-1.1	<.001
Mixed Martial Arts	High School	1,100	103	0.9	0.7-1.1	<.001
	Collegiate	1,100	103	0.9	0.7-1.1	<.001
Other sports	High School	1,100	103	0.9	0.7-1.1	<.001
	Collegiate	1,100	103	0.9	0.7-1.1	<.001
Grand Total	High School	11,000	1,030	0.9	0.7-1.1	<.001
	Collegiate	11,000	1,030	0.9	0.7-1.1	<.001

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Daneshvar et al., 2011

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Incidence of Concussion due to Heading a Soccer Ball

- 1993 US Olympic Festival report indicated that 18% of the concussions resulted from heading – Barnes et al., 1998
- Two factors that have created the concern:
 - Heading-Related Symptoms
 - Headache
 - Neck pain
 - Dizziness
 - Risk of Multiple (Successive) Concussions
 - Each event reduces the "neuron reserve", creating a deficiency that may become evident with future injury
- Others have raised the concern over damage to the cervical spine and TMJ regions



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High School RIO™ Injury Statistics 2005-2006

Table 4.6 Mechanism of Girls' Soccer Injury by Type of Injury

	Sprains/Strains, n=108,556	Concussions, n=15,826	Fractures, n=14,068	Concussions, n=29,425	Other, n=25,766
Defending	13.2%	18.7%	27.0%	18.2%	14.8%
General play	16.6%	7.0%	10.9%	7.8%	17.9%
Ball handling/shooting	18.2%	16.8%	26.0%	6.1%	6.1%
Chasing loose ball	16.5%	8.6%	4.4%	11.9%	7.0%
Shooting/passing	15.2%	7.4%	6.4%	0.7%	8.8%
Slide tackle	7.3%	0%	18.2%	5.1%	6.1%
Goalkeeping	3.3%	28.2%	8.3%	6.5%	0%
Heading ball	0.2%	2.2%	0%	0.2%	3.0%
Other	10.6%	0%	3.4%	7.5%	36.0%
Total	100%	100%	100%	100%	100%

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Heading the Ball in Soccer Not a Significant Cause of Concussion

Although whether repeated, intentional headers can potentially cause brain injury later in life is unknown, existing data are encouraging in that there does not appear to be a correlation. A few early studies suggested that former professional soccer players may have cognitive impairment secondary to headers; however, in subsequent studies that controlled for complicating factors, such as alcoholism, drug use, and repeated more severe head injuries, this effect disappeared. Biomechanical studies suggest that the force of a standard header is far below the theoretical force necessary to cause a concussion. In one study, most non-related concussions were caused by impact between players; concussions caused by head-to-ball contact occurred when an unopposed player was accidentally struck in the head with the ball. It appears that the routine use of the head for controlling and advancing the ball—when performed properly—is not likely to be a significant factor in concussion and reported cognitive deficits.



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What Does the Research Tell Us About Heading a Soccer Ball?

- How often do players head a ball?
 - Professional soccer players head the ball more than 2,000 times during their career
 - 5,250 headers over a course of a 15-year career --- this equates to approximately 6.67 headers/game
 - 16 headers per game by professional players; 8.5 per game by amateur players
 - On average soccer players head the ball 6 times/game
 - US National team (men) – 5 headers/game
 - US Olympic Sports Festival – interviews with elite soccer players – 7.85 headers/game

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Einstein Soccer Study

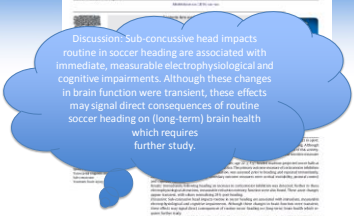


Help the game. Help yourself. Give soccer injuries a Red Card.

Heading is Associated with Abnormal White Matter Microstructure and with Poorer Neurocognitive Performance – Lipton et al, 2014 Radiology

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Alarming New Evidence About Soccer Heading



Discussion: Sub-concussive head impacts routine in soccer heading are associated with immediate, measurable electrophysiological and cognitive impairments. Although these changes in brain function were transient, these effects may signal direct consequences of routine soccer heading on (long-term) brain health which requires further study.

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Historical Perspective – Our First Study

Journal of Sports Sciences, 2001, 19, 171-179

Impact forces and neck muscle activity in heading by collegiate female soccer players

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Accepted 17 October 2000

Three soccer header types (floating, clearing and passing) and two heading approaches (standing and jumping) were manipulated to quantify impact forces and neck muscle activity in nine female soccer players. The 15 participants were Division I intercollegiate soccer players. Impact forces were measured by a 10-sec pressure sensor secured on the forehead. The electromyography (EMG) activity of the left and right sternocleidomastoid and trapezius muscles was recorded using surface electrodes. Maximum impact forces and impulses as well as the EMG data were analysed with separate repeated measures analyses of variance. Impact forces and impulses did not differ among the header types or approaches. Higher values were found for jumping versus standing headers in the mean normalized EMG for the right sternocleidomastoid. In addition, the normalized EMG was greater for the right sternocleidomastoid and right and left trapezius ($P < 0.05$). The sternocleidomastoid became active earlier than the trapezius and showed greater activity before ball contact. The trapezius became active late before ball contact and showed greater activity after ball contact. The increased muscle activity observed in the neck during the jumping approach appears to stabilize the connection between the head and body, thereby increasing the stability of the head-neck complex.

External biomechanics, heading, kinetics, soccer

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International Research in Science and Soccer II

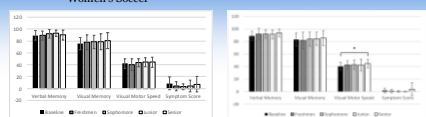
14 Neurocognitive changes in men's and women's soccer players across a collegiate career

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Department of Kinesiology and Applied Physiology, University of Delaware, Newark, Delaware, United States

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Women's Soccer **Men's Soccer**

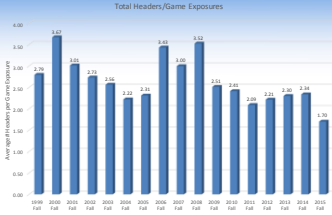


- No evidence of diminished cognitive function at baseline compared to controls
- No statistically significant deficits in cognitive function throughout the collegiate career
- Changes in neurocognitive performance were not associated with number of headers
- Two WS showed cognitive deficits in two or more composite scores across all four seasons. These individuals also had two of the highest cumulative heading totals, 1509 and 1413.

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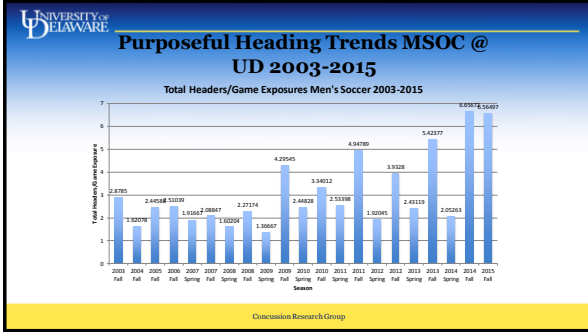
16 Years of Soccer Heading in WSOC

Total Headers/Game Exposures



Season	Total Headers/Game Exposures
1998	0.76
1999	1.07
2000	1.05
2001	0.92
2002	0.92
2003	0.82
2004	0.81
2005	0.81
2006	1.45
2007	1.06
2008	1.12
2009	0.84
2010	0.84
2011	0.82
2012	0.82
2013	0.82
2014	0.81
2015	0.81

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Measuring Head Acceleration in Soccer: A Review of the Literature

James A. Cantu, Thomas W. Kline

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Technological Advances to QUANTITATIVELY Track and Monitor Head Impacts in Soccer

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Wipe That Smile Off Your Face!

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Triaxial accelerometers worn during all practices and games.

10 g Threshold Recommended by King et al. 2016

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Triax Sensors in Play

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What are Head Accelerometers Good For?

- Sensors CANNOT be used to diagnose concussion (only trained medical professionals are able to do this -- especially important in the role of CERTIFIED ATHLETIC TRAINERS [ATC])
- Sensors can be used to monitor the # and magnitude of impacts to the head
- Trends in sensor data can be used to make practice/games safer?
 - Position
 - Type of impact
 - Games vs. practice
 - Type of drill
- Visual observation is also important because of the # of "false" positives being recorded!



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Influences on Head Acceleration in Soccer

- Low head-neck segment mass, ↑ head acceleration
- Head-neck-torso alignment, ↓ head acceleration
- Neck strength and stiffness, ↓ head acceleration
- Head-to-head impacts and unanticipated ball contacts, ↑ head acceleration
- Ball contacts at high velocity, ↑ head acceleration
- Headgear, ↓ head acceleration, but may also cause athletes to play more recklessly because they feel a sense of increased security

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JAT JOURNAL OF ATHLETIC TRAINING

Do Head Accelerations Differ Across Impact Type in NCAA Division-I Women's Soccer Players at Risk for Concussion?

Lamond LC, Caccese JB, Kaminski TW: University of Delaware, Newark, DE



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Greater Number of Impacts Exceeding Threshold in Games than in Practices

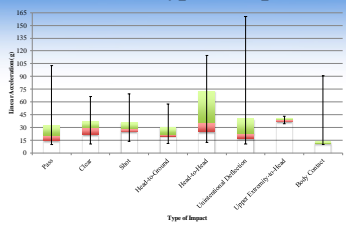
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    graph TD
      A[3,177 Total Impacts] --> B[1596 Game Impacts]
      A --> C[1581 Practice Impacts]
      B --> D[5.85 impacts per A/E]
      C --> E[3.1 impacts per A/E]
    
```

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Results-Type of Impact



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What was our Concussion "Threshold"?

- Linear acceleration = 50.2g; Head to Head (2014)
- Linear acceleration = 89.1g; Head to Head (2014)
- Linear acceleration = 66.3g; Unintentional Deflection (2015)




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Current Research: Head Acceleration Across Youth, High School, and Collegiate Soccer Players



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Soccer Heading Demonstration



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Importance to the Healthcare Professionals?

- Purposeful heading is an important and vital skill in soccer!
- Sensors are a good tool to help us study and monitor head impacts in soccer.
- Using sensors allow us to make comparisons.
- Heading in soccer, when done properly, may not be bad.



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Can We Decrease Acceleration Through Appropriate Technique?

- Ensure that a RIGID head and neck segment be maintained so that an AGGRESSIVE force is imparted on the ball, instead of the ball imparting force on the head!
 - "Strike through the ball"
 - "Absorb the energy" (timing is important)
 - Rigid head/neck segment allows the mass of the head to approximate the mass of the body resulting in less acceleration (less force on the head)





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Decreasing the Risk of Concussion in Soccer

- Teach proper heading techniques
 - *the effective mass of the player via proper technique alters by the trunk/neck/head become !!*
- Develop strong neck musculature
- Teach EYES OPEN concept (visual training implications?)
- Avoid dangerous play situations
 - Coaches should take time to talk to young soccer athletes about this
- Referees who enforce the rules and guidelines
- Use softer/under-inflated soccer balls (especially in the youth players)
- Kids ≤ 10 y.o. DO NOT need to be heading the ball!


<http://thetrainingtriangle.com/>

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Teaching Heading as a Skill

- "Age 9, 10, and 11 might be the Golden Age of Learning, but it is not the Golden Age of Heading" - Howe & Walters
- Coaches must be careful when and how to correctly teach proper heading methods



Watch the overzealous dad getting his 3 y.o. daughter to head a ballouch!!

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Out with the Old and In With the ...

Age	Frequency	Methodology	Emphasis
U8	None	None	None
U9	No formal training	Touch ball and soft goal ball Relaxed ball control Use of own hands/feet and catch Use of own strength soccer ball	Fun and ball possession No heading. Emphasize safety for players. Do not attempt to try heading a ball on their own
U10	1 activity, 15 minutes per session	Use 4 or 6 soft balls, e.g. Soft Soccer Touch ball and soft goal ball Self-pass - own strength soccer ball	Control of ball possession ✓ Kick ✓ Pass ✓ Heading control ✓ Heading of goal
U11	1 activity, 15 minutes per week	Use 4 or 6 soft balls, e.g. Soft Soccer Touch ball and soft goal ball Relaxed ball control (soft goal) Use of own strength soccer ball Use of own strength soccer ball Use of own strength soccer ball	Control of ball possession ✓ Kick ✓ Pass ✓ Heading control ✓ Heading of goal ✓ Control of ball possession ✓ Control of ball possession ✓ Control of ball possession
U12	1.2 activities, 15 minutes per week	Use 4 or 6 soft balls, e.g. Soft Soccer Touch ball and soft goal ball Relaxed ball control (soft goal) Use of own strength soccer ball Use of own strength soccer ball Use of own strength soccer ball	Control of ball possession ✓ Kick ✓ Pass ✓ Heading control ✓ Heading of goal ✓ Control of ball possession ✓ Control of ball possession ✓ Control of ball possession
U13	1.2 activities, 15 minutes per week	Use 4 or 6 soft balls, e.g. Soft Soccer Touch ball and soft goal ball Relaxed ball control (soft goal) Use of own strength soccer ball Use of own strength soccer ball Use of own strength soccer ball	Control of ball possession ✓ Kick ✓ Pass ✓ Heading control ✓ Heading of goal ✓ Control of ball possession ✓ Control of ball possession ✓ Control of ball possession

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New US Youth Soccer Heading Guidelines

No heading ages 10 and under!
Limited heading in practice for those aged 11-13

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Introducing "Get aHEAD Safely in Soccer"™

<http://www.nscaa.com/heading>

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Objectives of the On-line Course

- Discover 5 practical ways to decrease the risk of concussions in soccer
- Learn key coaching points for proper heading technique and training drills
- Understand the techniques for the correct practice of "attacking" and "defensive" headers
- Explore a series of interactive videos for neck and core strengthening exercises
- Increase player safety by understanding head impact sensor technology and how it can be used to validate and enforce proper heading technique
- Receive an NSCAA Diploma awarded upon completion

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Keys to Decreasing Concussion Risk in Youth Soccer

- TEACH PROPER HEADING TECHNIQUE
- DEVELOP STRONG NECK AND CORE MUSCULATURE
- AVOID DANGEROUS PLAY SITUATIONS
- EDUCATE REFEREES WHO ENFORCE THE RULES AND GUIDELINES
- USE LIGHTWEIGHT SOCCER BALLS TO DECREASE THE MASS IMPARTED ON THE HEAD



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The Solution Based on The Facts

(the basis of the new NSCAA Educational Program)

- Improve Technique**
 - Eliminate the "bobble-head" doll effect
 - Make the head-neck-torso "one" unit
- Use Lightweight Balls**
 - Reduce fear
 - Reduce mass impacting the head
 - A terrific teaching tool for the 11-14 y.o. age group
- Improve Strength**
 - Focus on neck
 - Focus on core





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Guiding Principles for Teaching Safe and Effective Purposeful Soccer Heading Techniques

- LIMIT purposeful heading practice in both number of repetitions and duration
- All techniques will be introduced in a logical progression:
 - Basic technique (seated – on knees – standing)
 - Standing jump technique
 - Running jump technique
- Intensity progression to include "self-loss" to "partner/server loss"
- Once mastered – progress to coaches "chipping" balls to players to head
- The use of kicked or machine (jugs™-style) launched balls is discouraged!!!**
- Let each child learn the skill as their confidence in performing heading strengthens
- Both "attacking" and "defensive" purposeful heading techniques will be taught
- Twice weekly sessions of 15' devoted to the skill



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8 HEADING ACTIVITIES

Click on each activity to learn more.




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Logical Ball Progression


- Ball progressions will include the use of:
 - Balloons/beach balls
 - Foam (Nerf™-style) ball
 - Soft kickball or play ball
 - Volleyball
 - Partially inflated size 3 or 4 soccer ball
 - Size 4 Ball (between 8.5 psi and 15.6 psi)
 - Soccer Heading Trainer (lightweight size 5 ball)



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Neck and Core Strengthening



7 NECK/CORE EXERCISES

Click to learn more on each exercise.

- The "overlooked" yet "vital" component to the education program
- Easy, fun, and safe to implement in this aged-group population
- Evidence in adults has demonstrated the positive aspects of strength in reducing head accelerations
- Program involves:
 - Neck isometrics
 - Shoulder shrugs
 - Core strengthening (lunges, bridging, "Bird-Dogs")

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Rule Enforcement



- PLAYERS AGED 10 AND UNDER SHOULD NOT ENGAGE IN HEADING, NEITHER IN PRACTICE NOR IN GAMES
- PLAYERS BETWEEN 11-14 SHOULD HAVE LIMITED HEADING TRAINING
- THERE IS AN ALLOWANCE FOR A TEMPORARY SUBSTITUTION FOR A PLAYER SUSPECTED OF A HEAD INJURY
- ALL COACHES SHOULD BE INSTRUCTED TO TEACH AND EMPHASIZE THE PROPER TECHNIQUE FOR HEADING THE SOCCER BALL

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Future Research

- Impact of a ball on the head
- Verify the exposure to heading across all ages
- Longitudinal studies on soccer players focusing on exposure and injury
- Determine the minimum safe age to begin heading the ball.
- Importance of body awareness in heading.

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US Soccer

US Youth Soccer Heading Survey Fall 2016

In an attempt to gain greater understanding of adoption and compliance with these new soccer heading recommendation, the Medical Advisory Committee of US Soccer lead by Chief Medical Officer Dr. George Chiampas agreed to an on-line survey created by researchers Dr. Thomas W. Kaminski (University of Delaware) and Dr. Anthony Kontos (University of Pittsburgh). The survey went on-line in September 2017 and closed after 3 months on November 18, 2016. A total of 8,104 respondents participated.

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Thank You



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Questions



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