

Exploring tennis environment
(racket size, court and net height)
to improve serve biomechanics
in young players

Caroline Martin


Associate professor, expert in tennis biomechanics
Rennes 2 University
Tennis Coach

Vierumaki, Finland, April 2026







Tennis training programs for kids




**Play & Stay
Tennis 10s**







**Project
36/60**

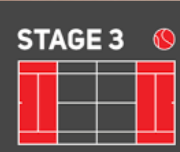


**ANZ Tennis
Hot Shots**

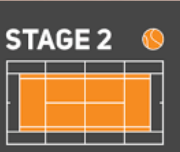


**Galaxie
Tennis**

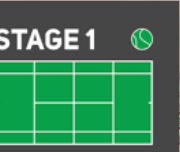




STAGE 3



STAGE 2




STAGE 1

2007

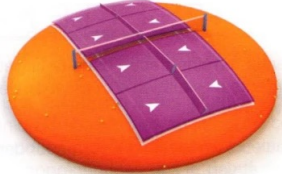
2007

2008


202014




Terrain blanc : 5 ans et plus
8m
Dans le sens de la largeur
Sans filet, mais avec une ligne le matérialisant au sol
Ballon paille 26cm
Raquette 43 à 48 cm (17 à 19")




Terrain violet : 5 ans et plus
11m
Dans le sens de la largeur
Avec un filet à 0,50m maximum
Balle petit tennis 15cm non gonflée à bloc
Raquette 43 à 53 cm (17 à 21")






Terrain rouge : 6 ans et plus
12,80m
Dans le sens de la longueur
Avec un filet à 0,80m maximum
Balle rouge
Raquette 48 à 58 cm (19 à 23")

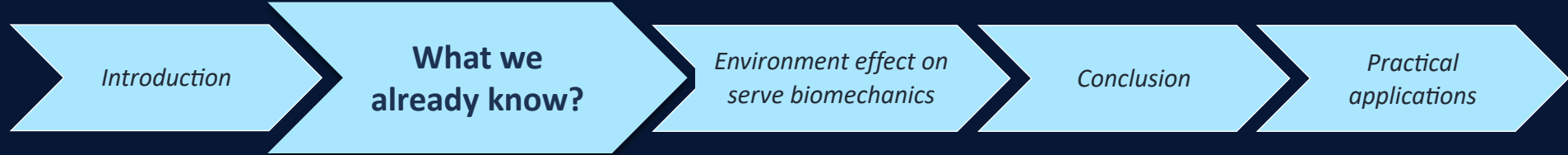


Terrain orange : pas avant 7 ans
18m x 8,23m
Avec un filet à 0,80m
Balle orange
Raquette 56 à 63 cm (22 à 25")



Terrain vert : pas avant 9 ans
24m
Filet traditionnel
Balle verte
Raquette 63 à 68 cm (25 à 27")

- Dynamic theory of motor learning (Farrow et Reid, 2010; Buszard et al., 2014)
- Scaling environment (courts) and equipment (racket and balls)
- Successive tennis courts according to players' age and level



Specific effects of these training programs on kids' groundstrokes

Adapting the environment
(balls, rackets,
court size, net height)



ANZ Tennis Hot Shots Pathway

AGE 3-5 LAUNCH PAD STAGE
Fundamental and Perceptual Motor Skills (PPMS)
Court size: variable
Tennis ball: red ball (25 per cent compression)
Recommended racket size: 19-21 inches

AGE 5-8 RED STAGE
Court size: 3 m x 8.23 m or 6 m x 10.97 m
Tennis ball: red ball (25 per cent compression)
Recommended racket size: 21-23 inches

AGE 8-10 ORANGE STAGE
Court size: 6.5 m x 18 m
Tennis ball: orange ball (40 per cent compression)
Recommended racket size: 23-25 inches

AGE 9+ GREEN STAGE
Court size: 10.97 m x 23.76 m (full court)
Tennis ball: green ball (75 per cent compression)
Recommended racket size: 25-27 inches

STAGE	AGE	BALL	COURT	RACKET <small>*(Dependent on the size of the player)</small>	SCORING OPTIONS	STAGE DESCRIPTION
tennis 10&U	5-8 years	75% slower than a yellow ball	11-12m (36-39ft) x 5-6m (16-19ft)	Up to 23" (43.68cm)*	1 x tiebreak to 7 or 10 Best of 3 tiebreaks to 7 Timed Matches	At Red, slower balls, smaller courts and shorter rackets, enable players to play the game from the first lesson. Players start to play fun, team-based matches, and develop good technique and use realistic tactics.
tennis 10&U	6-10 years	50% slower than a yellow ball	18m (60ft) x 6.5-8.23m (21-27ft)	23-25" (58-63cm)*	Best of 3 tiebreaks to 7 1 x short set to 4	Players move to a larger court, relevant to their size. The ball is slightly faster, but continues to provide an optimal striking zone and the ability to implement advanced tactics. Matches are longer than at Red, and children play both team and individual events.
tennis 10&U	9-10 years	25% slower than a yellow ball	Full Size Court	25-26" (63.66cm)*	1 x short set to 4 Best of 3 short sets to 4 (3rd set as match tiebreak)	The ball is faster than at Orange, but still slower and lower bouncing than the yellow ball helping players to continue to develop good technique and to implement advanced tactics. Matches are slightly longer than at Orange, and both team and individual events are played.
tennis	11 years and over	Yellow Ball	Full Size Court	26-26" (66-73.7cm)*	Any scoring system within the Rules of Tennis	Once players have progressed through the Red, Orange and Green stages, they will usually be ready to train and compete with a yellow ball on the full court.

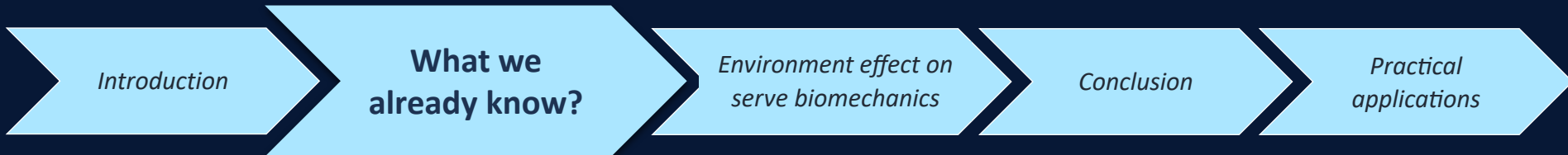
The International Tennis Federation recommend that all 10 and under competition and training, should be organised using slower Red, Orange or Green balls on the appropriate sized courts, with the appropriate sized rackets. Players who begin tennis later (e.g. 5 years or above) are still recommended to begin training and competing at Red, before progressing to Orange and then Green.

Positive effects

- Motor performance (⬆️ speed, accuracy, number of consecutive groundstrokes)
- Tactical patterns (⬆️ winners, ⬆️ unforced errors, ⬆️ net strokes)
- Fun & motivation





Gimenez-Erido et al., (2020); Kachel et al., (2015); Larson et Guggenheimer (2013); Timmerman et al., (2015); Buszard et al. (2014; 2020)





Specific effects of these adaptations on kids' serve

Table 4. Serve characteristics across MT Stages (M ± SD)

Age & Stage	Successful first serves (%)	Aces (%)	Double faults (%)	Points won on first serve (%)	Points won on second serve (%)
U8 	77.08 ± 13.75	0.79 ± 2.19	9.29 ± 14.32	55.85 ± 16.39	43.50 ± 34.16
U9 	60.84 ± 14.47	0.33 ± 1.05	26.07 ± 17.81	59.10 ± 16.39	35.56 ± 11.58
U10 	47.70 ± 4.94	3.48 ± 2.87	23.55 ± 11.32	61.97 ± 6.94	47.48 ± 8.49
U14 	61.73 ± 8.09	3.34 ± 2.62	11.60 ± 6.92	61.32 ± 5.48	43.23 ± 5.80

Fitzpatrick et al. (2017)

Table 3. Service parameters (mean ± SD)

	ATP	U12	U10	U9
Aces (n)	5.17±3.87* ^{#,Δ}	0.04±0.20	0.21±0.51	0.29±0.46
1st Serve(%)	63.89±6.43 ^Δ	62.86±12.57 ^Δ	55.65±12.63	50.75±14.08
Double Faults (n)	2.33±2.16	3.71±2.91	3.33±2.28	2.17±1.69
1st Serve Points Won %	68.49±7.78* ^{#,Δ}	53.19±11.86	52.72±16.22	60.32±11.63
2nd Serve Points Won %	46.41±13.09	40.73±11.18	36.39±14.91	46.76±18.69
Total Serve Points Won %	60.15±5.89* ^{#,Δ}	48.25±9.58	45.13±13.27	52.35±11.87

One-way ANOVA ($p < 0.05$). * = significant difference to U12; # = significant difference to U10; Δ = significant difference to U9

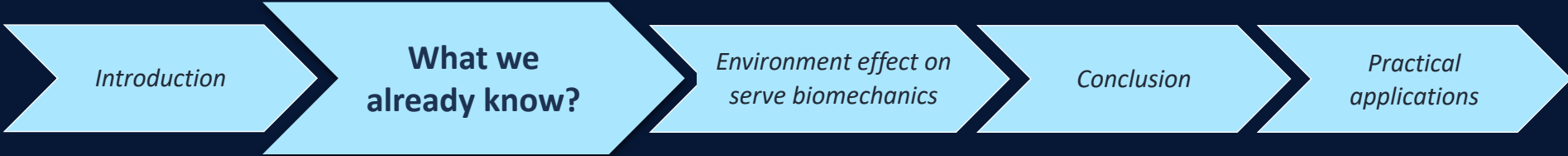
Schmidhofer et al. (2014)



The green stage for U10 is the least efficient one:

- Less aces & more double faults, lowest success rate for the 1st serve
- Performance far removed from junior / « adult » / « professional » serves





Perception of serve self-efficacy

How was your serve during last match?

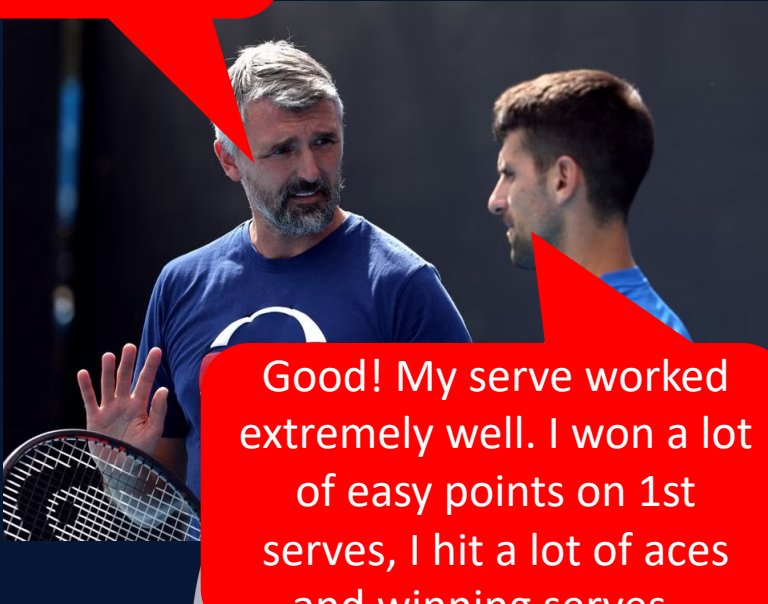


Good! I only hit 4 double faults.

Serve = start of point

≠

How was your serve during last match?



Good! My serve worked extremely well. I won a lot of easy points on 1st serves, I hit a lot of aces and winning serves...

Serve = weapon

Introduction

What we already know?

Environment effect on serve biomechanics

Conclusion

Practical applications

U12 serve



ATP serve



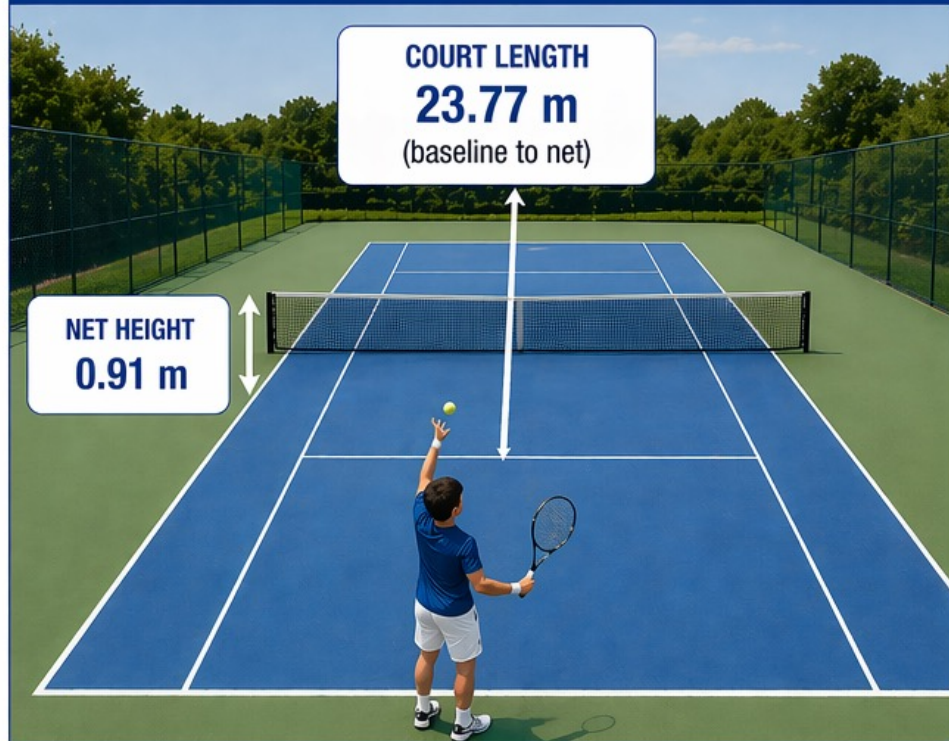
Serve = start of point

Serve = weapon

WHAT IF AN ADULT PLAYED IN THE CONDITIONS OF A 12-YEAR-OLD CHILD?

Dimensions based on height (geometric constraints) and **body weight** (racket mass – dynamic constraints)

REAL 12-YEAR-OLD CHILD CONDITIONS (REAL COURT)

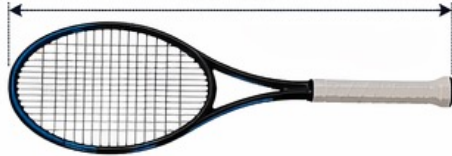


COURT LENGTH
23.77 m
(baseline to net)

NET HEIGHT
0.91 m

RACKET

68.5 cm



300 g

EQUIVALENT CONDITIONS FOR AN ADULT (BASED ON 12-YEAR-OLD CHILD)



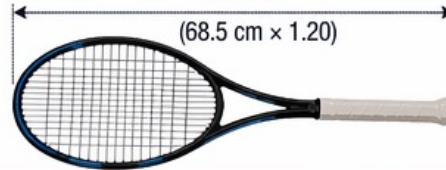
COURT LENGTH
~29.0 m
(baseline to net)
(23.77 m × 1.20)

NET HEIGHT
~1.10 m
(0.91 m × 1.20)

RACKET

~82 cm

(68.5 cm × 1.20)

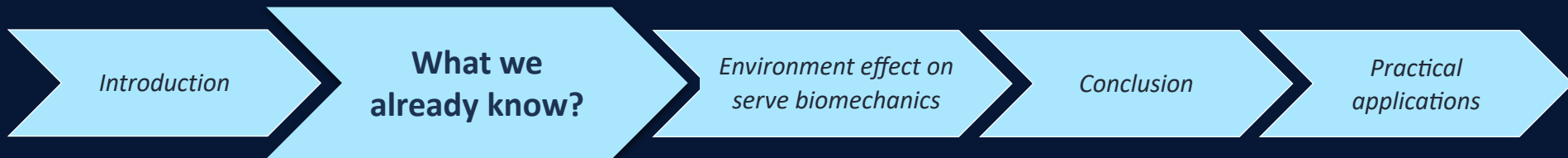


~500 g
(300 g × 1.75)

(based on body weight)

LET'S EXPERIMENT!





Perception of serve self-efficacy

Perceived self-efficacy by Under-10 tennis players when scaling the equipment and play area

Jose Maria Gimenez-Egido^{a,d,*}, João Carvalho^{b,c}, Duarte Araújo^c, Enrique Ortega-Toro^a

^a Department of Physical Activity and Sport, University of Murcia, Regional Campus of International Excellence "Campus Mare Nostrum", Faculty of Sport Science, Murcia, Spain

^b CIPER, Escola Superior de Educação e Comunicação da Universidade do Algarve, Faro, Portugal

^c CIPER, Faculdade de Motricidade Humana, Universidade de Lisboa, Cruz Quebrada, Portugal

^d Department of General and Specific Didactics, Faculty of Education, University of Alicante, Alicante, Spain

20 young tennis players:

- competing at regional level
- 9.5 ± 0.7 years
- 3.7 ± 1.5 years of practice

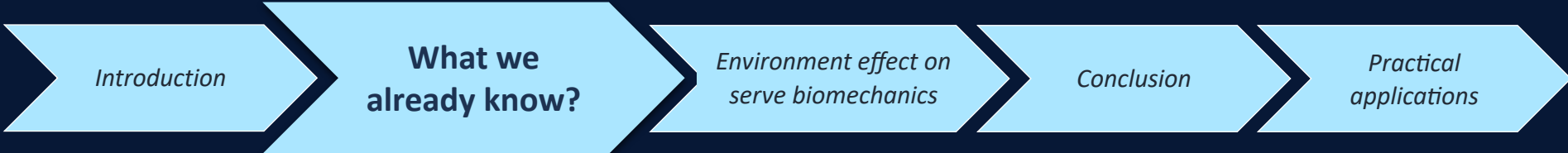
- 4 matches in each tournament
- 15 – 20 min after the match : Tennis specific self-efficacy questionnaire



Table 1
Playing conditions for each tournament.

Characteristics	Green Tournament	Modified Tournament
Competition system	Round-robin	Round-robin
Match format	1 set to 4 games with a tie break of 7 points, if both players reach four games	1 set to 4 games with a tie break of 7 points, if both players reach four games
Net height at center	0.91 m	0.80 m
Net posts height	1.07 m	0.91 m
Ball	Low compression ball "green"	Low compression ball "green"
Racket-size (inch)	26" - 27" (your tennis racket)	26" - 27" (your tennis racket)
Court size (length x wide)	23.77 m × 8.23 m	18.00 m × 8.23 m
Ratio of m ² per court player	97.81 m ²	74.07 m ²
Service box dimensions (length x wide)	6.40 m × 4.11 m	6.40 m × 4.11 m
Surface	Asphalt	Asphalt

Note: GT = tournament with standard playing conditions; MT = tournament with scaled playing conditions



Results of serve efficacy

Perceived self-efficacy by Under-10 tennis players when scaling the equipment and play area

Jose Maria Gimenez-Egido^{a,d,*}, João Carvalho^{b,c}, Duarte Araújo^c, Enrique Ortega-Toro^a

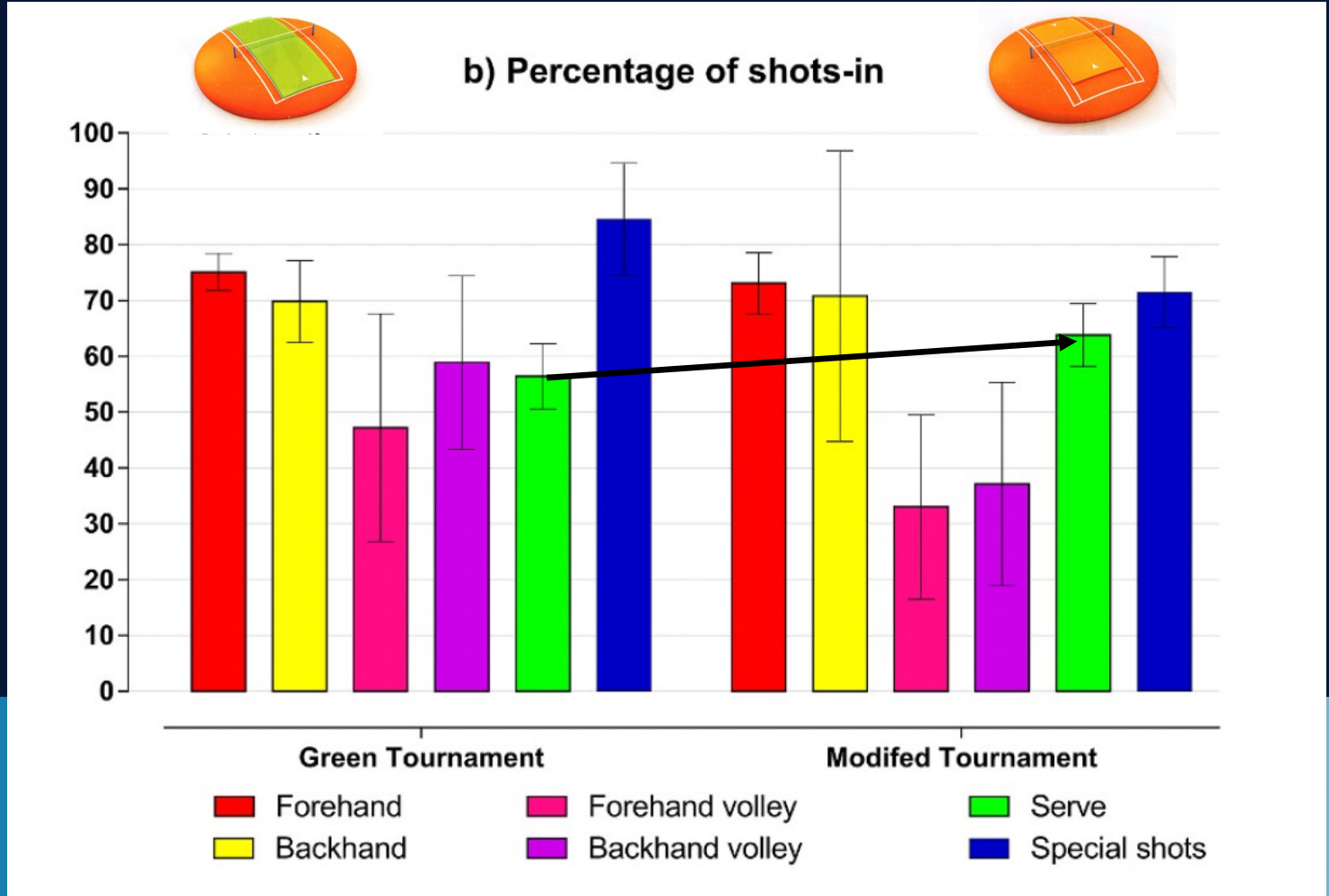
^a Department of Physical Activity and Sport, University of Murcia, Regional Campus of International Excellence "Campus Mare Nostrum", Faculty of Sport Science, Murcia, Spain

^b CIPER, Escola Superior de Educação e Comunicação da Universidade do Algarve, Faro, Portugal

^c CIPER, Faculdade de Matricidade Humana, Universidade de Lisboa, Cruz Quebrada, Portugal

^d Department of General and Specific Didactics, Faculty of Education, University of Alicante, Alicante, Spain

By scaling net height and court size, the serve-in percentage improved, so playing in scaled conditions provided a more satisfactory serving experience in U10.



Perception of self-efficacy

Perceived self-efficacy by Under-10 tennis players when scaling the equipment and play area

Jose Maria Gimenez-Egido ^{a,d,*}, João Carvalho ^{b,c}, Duarte Araújo ^c, Enrique Ortega-Toro ^a

^a Department of Physical Activity and Sport, University of Murcia, Regional Campus of International Excellence "Campus Mare Nostrum", Faculty of Sport Science, Murcia, Spain

^b CIPER, Escola Superior de Educação e Comunicação da Universidade do Algarve, Faro, Portugal

^c CIPER, Faculdade de Motricidade Humana, Universidade de Leão, Cruz Quebrada, Portugal

^d Department of General and Specific Didactics, Faculty of Education, University of Alicante, Alicante, Spain



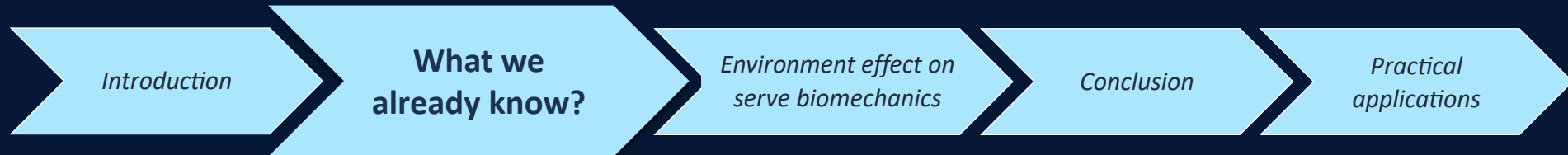
Table 3

Descriptive analysis (mean and 95% CI), *t*-test for paired sample (Bayesian analysis and NHST) and effect size of the sub-scales of "Perceived self-efficacy of basic tennis shots".

Self-efficacy	GTmean (95% CI)	MT mean (95% CI)	BF10	Error %	ES δ	NHST <i>p</i>
Forehand	77.25 (70.28–84.20)	74.33 (66.16–82.48)	0.435	0.014	0.233	.246
Backhand	70.33 (61.05–79.60)	69.33 (59.91–78.75)	0.252	0.022	0.081	.679
Forehand volley	72.00 (58.85–85.10)	62.25 (47.00–77.45)	0.424	0.014	0.228	.256
Backhand volley	56.25 (39.95–72.50)	57.75 (44.25–71.20)	0.241	0.022	–0.054	.782
<i>L</i> (Smash)	62.75 (45.35–80.10)	65.00 (50.95–79.00)	1.379	0.022	–0.082	.677
Serve	62.70 (52.22–73.17)	70.70 (61.45–79.94)	4.796	0.002	–0.562	.011

Note: *L* = logarithmic transformation

U10 tennis players perceive a greater serving efficacy when net height and court size are reduced probably because they achieved higher serve performance



Evolution of serve biomechanics

1) Leg drive

(Fadier et al., 2021; Whiteside et al., 2013; Fleisig et al., 2003; Fett et al., 2021)



Immature flexion of the back leg
=> limit ground reaction forces, propulsion and impact height



➡ in maximal knee flexion angles (especially back knee)

Evolution of serve biomechanics

1) Leg drive

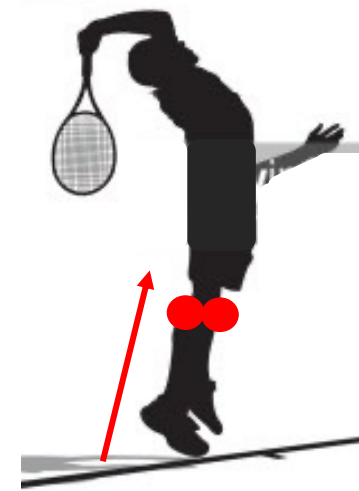
(Fadier et al., 2021; Whiteside et al., 2013; Fleisig et al., 2003; Fett et al., 2021)

Kids (U8 – U12)

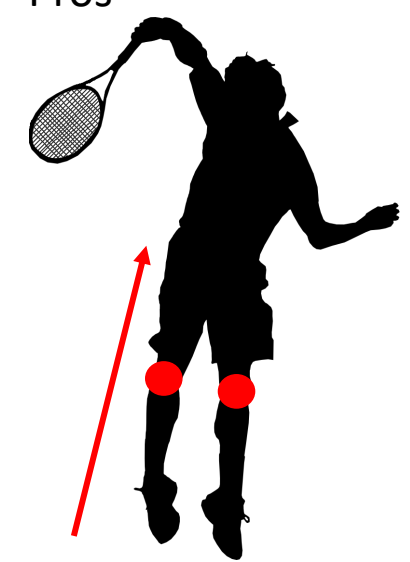


Deficit in knee and ankle extension velocities

Juniors (U14 - U18)



Pros



➡ in maximal knee and ankle extension velocities (especially back ones) = ➡ in impact height

Evolution of serve biomechanics

2) Trunk rotations

(Fadier et al., 2021; Whiteside et al., 2013; Fleisig et al., 2003; Fett et al., 2021)

Kids (U8 – U12)



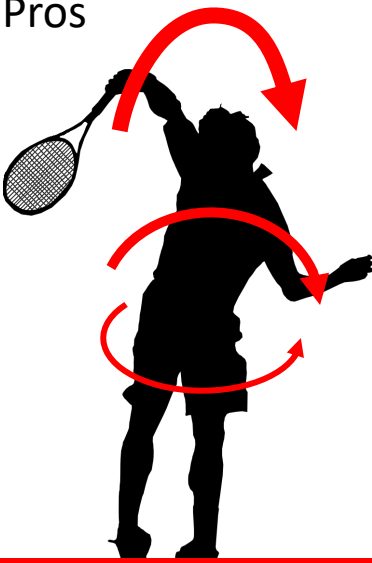
Kids favor longitudinal trunk rotation to create speed

Juniors (U14 - U18)



Juniors favor trunk longitudinal rotation and flexion to create speed

Pros




Pros favor shoulder over shoulder rotation to create speed

➡ in trunk flexion & shoulder over shoulder velocities = ➡ ball speed

Evolution of serve biomechanics


3) Upper limb rotations

Kids (U8 – U12)



Limited upper limb joints velocities

Juniors (U14 - U18)



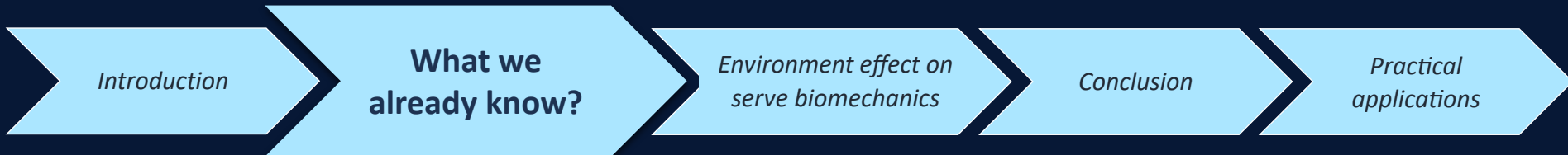
Wrist flexion and shoulder velocities < pros

Pros



Shoulder internal rotation velocity is the best contributor to racket speed


↗ in shoulder internal rotation, wrist flexion & forearm pronation velocities = ↗ ball speed



Synthesis

How we can help them to improve serve biomechanics and to explore better coordinations?

Kids (U8 – U12)



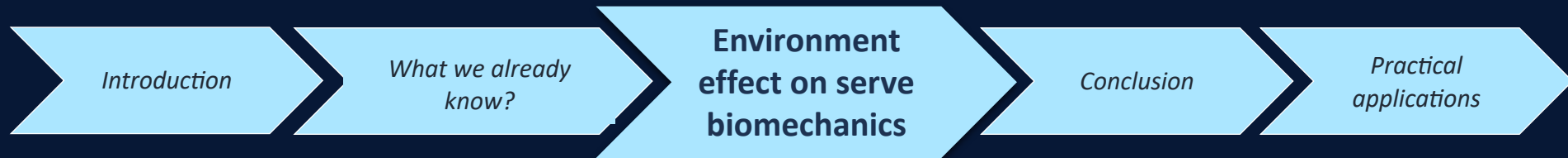
Limited upper limb joints velocities

Deficit in knee and ankle extension velocities

Immature flexion of the back leg = limited GRF

Kids favor longitudinal trunk rotation to create speed





Can the environment (racket & court sizes, net height) improve serve biomechanics in young players?

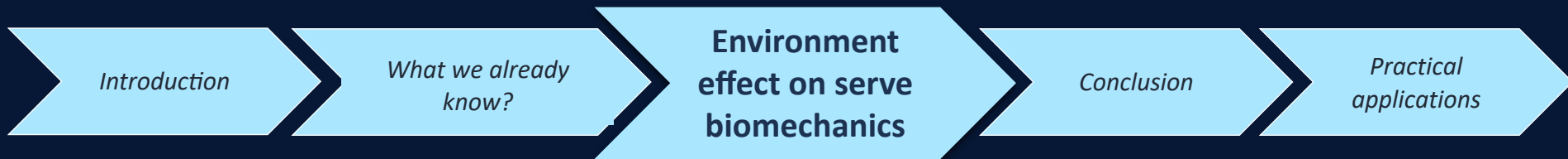


Joint loadings (injury risks) / Performance ?

Are there biomechanical advantages to having kids
1) serve in a forward position?
2) serve with small rackets?

Aims: evaluate the effect of tennis environment (racket and court sizes, net height) on serve biomechanics in U12 players

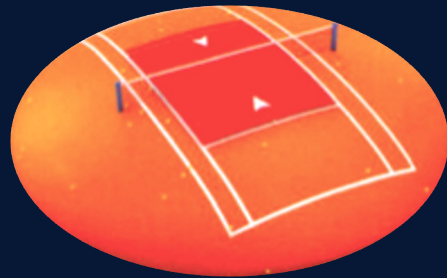




Study 1

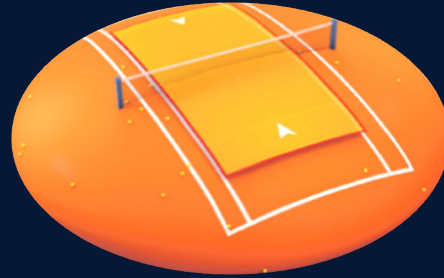
Population : 5 girls and 5 boys (*at least 3 years of practice, 10.2 ± 1.4 years; 1.41 ± 0.09 m; 31.8 ± 6.7 kg, ITN 6-9*)

Task : 3 powerful serves in the serve box – green balls



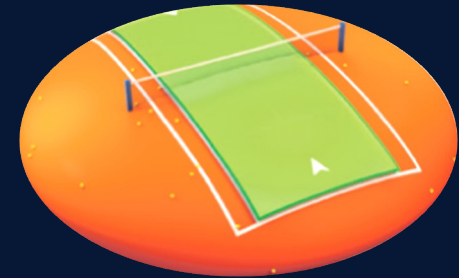
Red stage (12.80 x 8.23 m)

- Serve distance: 6.40 m
- Net height : 0.80 m



Orange stage (18 x 8.23 m)

- Serve distance: 9.00 m
- Net height : 0.80 m



Green stage (24 x 8.23 m)

- Serve distance: 11.89 m
- Net height: 0.91 m

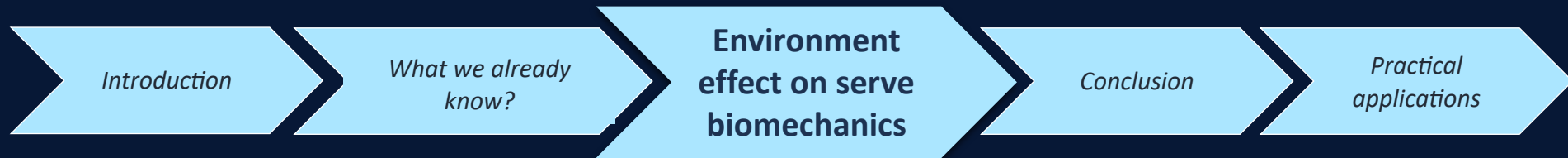
Material : radar and 3D motion capture system (Qualisys)

Measures : Ball speed and racket head velocity

Biomechanical data

Shoulder and elbow loadings (joint forces and torques)





Performance

Table 2. Serve performance and kinematics for the different serve conditions (mean \pm SD).

	Green	Orange	Red	Main effect P value	Effect size η_p^2 or W
Ball speed and racquet velocity					
Ball speed (m.s⁻¹) *	26.5 \pm 3.7 ^{\$}	27.6 \pm 3.3	27.8 \pm 3.2	0.014	0.418
Maximal racquet head velocity (m.s⁻¹) *	26.6 \pm 2.9	27.1 \pm 2.8	28.1 \pm 3.0	0.018	0.358

Shoulder and elbow loadings

Table 1. Maximum shoulder and elbow kinetic values for different serve conditions (mean \pm SD).

	Green	Orange	Red	F (2,18)	P value	Effect size η_p^2
Shoulder kinetics						
Proximal force (N.kg ⁻¹)	3.5 \pm 1.0	3.6 \pm 0.9	3.8 \pm 1.1	1.430	0.275	0.137
Anterior force (N.kg ⁻¹)	2.3 \pm 0.6	2.5 \pm 0.5	2.4 \pm 0.5	0.929	0.150	0.094
Posterior force (N.kg ⁻¹)	2.3 \pm 0.5	2.5 \pm 0.6	2.5 \pm 0.5	0.315	0.734	0.034
Superior force (N.kg ⁻¹)	2.6 \pm 1.0	2.9 \pm 0.9	2.7 \pm 0.7	1.85	0.186	0.171
Internal rotation torque (N.m.kg ⁻¹ .m ⁻¹)	45.2 \pm 7.6	47.0 \pm 8.1	48.2 \pm 8.0	0.464	0.636	0.049
Elbow kinetics						
Proximal force (N.kg ⁻¹)	4.2 \pm 0.8	4.2 \pm 0.6	4.2 \pm 0.8	0.062	0.940	0.007
Anterior force (N.kg ⁻¹)	1.2 \pm 0.3	1.3 \pm 0.5	1.3 \pm 0.5	2.34	0.125	0.206
Medial force (N.kg ⁻¹)	1.9 \pm 0.7	2.0 \pm 0.3	2.0 \pm 0.5	0.137	0.873	0.015
Varus torque (N.m.kg ⁻¹ .m ⁻¹)	49.2 \pm 8.0	49.0 \pm 8.2	50.7 \pm 7.8	0.057	0.944	0.006

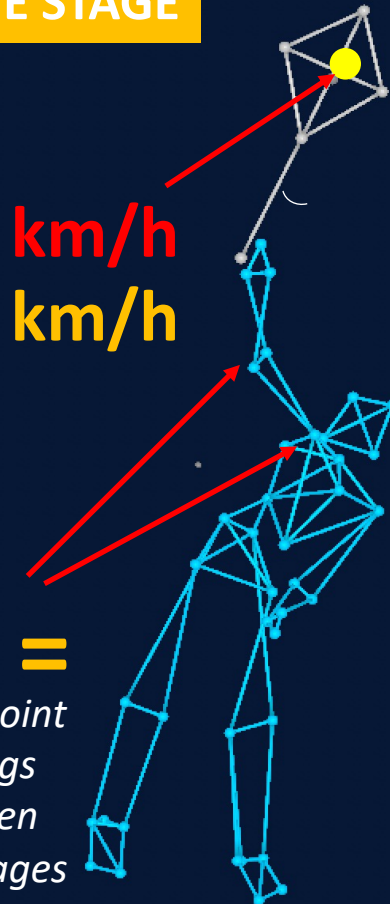
RED STAGE

ORANGE STAGE

+ 5.0 km/h
+ 4.0 km/h

= =
Similar joint loadings between the 3 stages

Better efficiency



Introduction

What we already know?

Environment effect on serve biomechanics

Conclusion

Practical applications

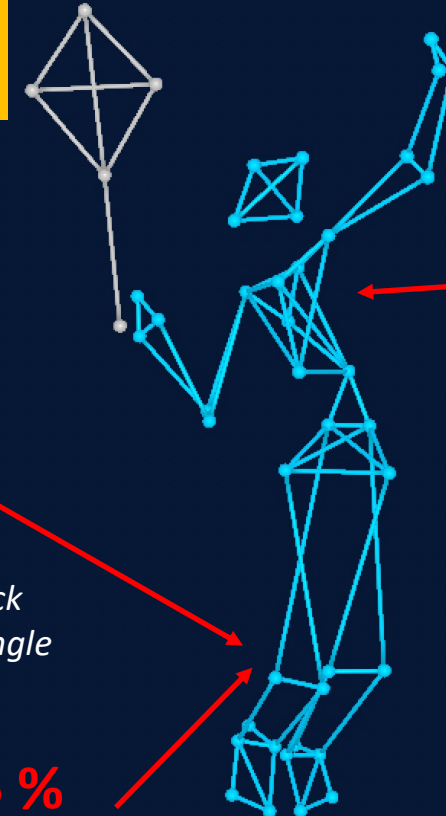
Biomechanical data

Table 2. Serve performance and kinematics for the different serve conditions (mean \pm SD).

	Green	Orange	Red	Main effect P value	Effect size η_p^2 or <i>W</i>
Maximal angles					
Back ankle flexion (°)	80 \pm 6	80 \pm 6	81 \pm 5	0.736	0.033
Front ankle flexion (°)	78 \pm 6	79 \pm 8	79 \pm 7	0.363	0.106
Back knee flexion (°) *	127 \pm 21 ^{\$}	124 \pm 20	123 \pm 19	0.014	0.430
Front knee flexion (°)	119 \pm 10	118 \pm 11	121 \pm 11	0.135	0.199
Maximal velocities					
Back ankle extension (°. <i>s</i> ⁻¹)	531 \pm 174	531 \pm 164	527 \pm 163	0.981	0.002
Front ankle extension (°. <i>s</i> ⁻¹)	460 \pm 121	478 \pm 92	472 \pm 118	0.421	0.045
Back knee extension (°.<i>s</i>⁻¹) *	385 \pm 221 ^{&\$}	442 \pm 235	446 \pm 226	0.037	0.307
Front knee extension (°. <i>s</i> ⁻¹)	458 \pm 174	484 \pm 167	464 \pm 167	0.311	0.122
Trunk flexion (°.<i>s</i>⁻¹) *	247 \pm 63 ^{\$}	263 \pm 54	275 \pm 66	0.002	0.511
Upper trunk longitudinal rotation (°. <i>s</i> ⁻¹)	626 \pm 138	638 \pm 136	661 \pm 154	0.378	0.102
Pelvis longitudinal rotation (°. <i>s</i> ⁻¹)	534 \pm 135	549 \pm 144	576 \pm 154	0.176	0.176
Shoulder internal rotation (°. <i>s</i> ⁻¹)	1603 \pm 569	1644 \pm 613	1771 \pm 546	0.273	0.130
Upper arm pronation (°. <i>s</i> ⁻¹)	1331 \pm 696	1407 \pm 749	1473 \pm 739	0.263	0.174
Shoulder-over-shoulder rotation (°. <i>s</i> ⁻¹)	136 \pm 59	150 \pm 59	141 \pm 63	0.376	0.103
Elbow extension (°. <i>s</i> ⁻¹)	1027 \pm 333	1057 \pm 339	1081 \pm 321	0.194	0.167
Wrist flexion (°. <i>s</i> ⁻¹)	1581 \pm 174	1614 \pm 224	1601 \pm 214	0.546	0.065

RED STAGE

ORANGE STAGE



+ 11 %

+ 6 %

Maximal trunk flexion velocity

+ 4°

+ 3°

Maximal back knee flexion angle

+ 16 %

+ 15 %

Maximal back knee extension velocity

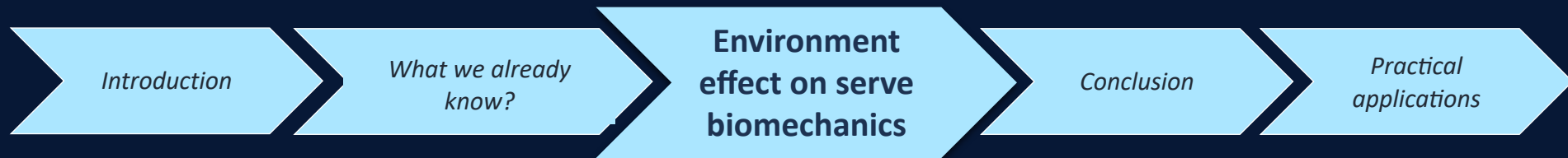
11 years old



Serve from
the serve line



Serve from
the baseline



Performance: ↗ ball speed (red & orange stages)

Intuitive increase in ball speed
based on target perception
(Vaverka et Cernosek, 2013)

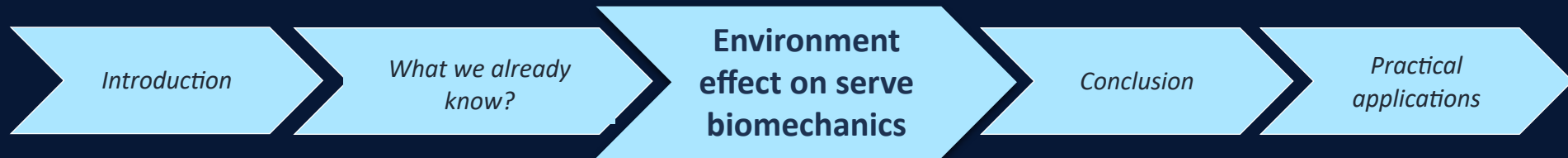
Serve box closer and net lower
↗ margin for error over the net

Accessible target perceived as larger
↗ probability of success

Greater motor engagement and
power when serving

The constraints imposed by the environment (court size, net height) determine the limits of possible tactical and technical actions.





Performance: ↗ ball speed (red & orange stages)



The constraints of the environment (size of court, height of net) can offer opportunities to kids to explore new serve biomechanics.



Introduction

What we already know?

Environment effect on serve biomechanics

Conclusion

Practical applications

Study 2

frontiers | Frontiers in Psychology

TYPE Original Research
PUBLISHED 10 February 2023
DOI 10.3389/fpsyg.2023.1104146

Check for updates

OPEN ACCESS

EDITED BY
Goran MacKovic,
University of Ljubljana,
Slovenia

REVIEWED BY
Selcuk Akpinar,
Nevşehir Hacı Bektaş Veli University,
Türkiye
Ersan Arslan,
Tokat Gaziosmanpaşa University,
Türkiye
Nicolas Robin,
Université des Antilles et de la Guyane, France

*CORRESPONDENCE
Caroline Martin
✉ caromartin@numericable.fr

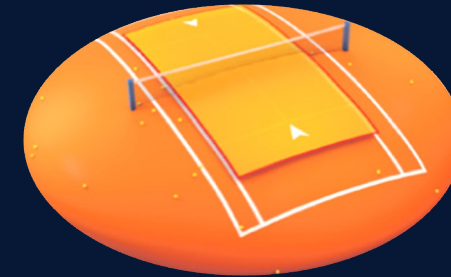
There is no rush to upgrade the tennis racket in young intermediate competitive players: The effects of scaling racket on serve biomechanics and performance

Pierre Touzard^{1†}, Chloé Lecomte^{1†}, Benoit Bideau², Richard Kulpa², Loïc Fourel¹, Maxime Fadier¹, Nicolas Cantin³ and Caroline Martin^{1*†}

¹M2S Laboratory, University Rennes, Rennes, France; ²M2S Laboratory, Inria, University Rennes, Rennes, France; ³Île-et-Vilaine Tennis Departmental Committee, Maison Départementale des Sports, French Tennis Federation, Rennes, France

Population : 4 girls and 5 boys (at least 3 years of practice, 9.9 ± 1.0 years; 1.39 ± 0.07 m; 30.3 ± 5.1 kg, ITN 6-9)

Task : 3 powerful serves in the serve box



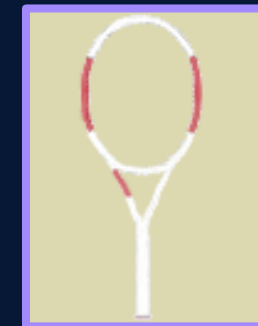
Scaled 23" racket

- Weight: 190g
- Balance: 27.5 cm
- Head size: 613 cm²



Scaled 25" racket

- Weight: 239g
- Balance: 30.5 cm
- Head size: 645 cm²

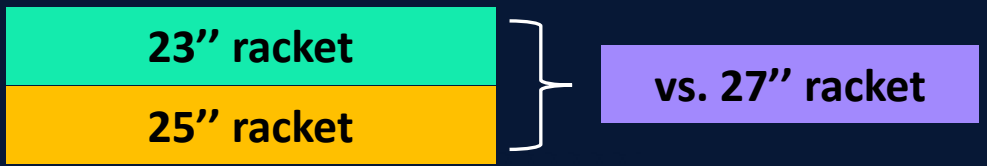
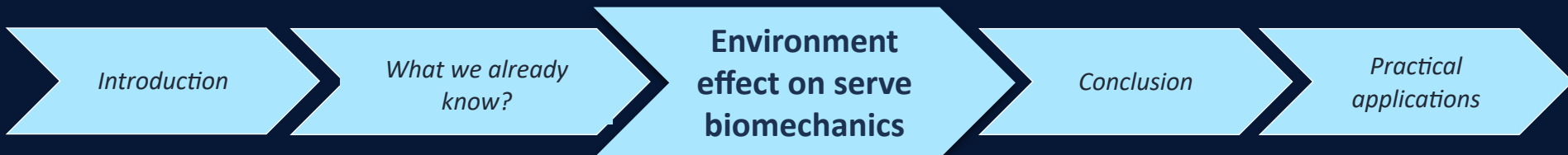


Full size 27" racket

- Weight: 249g
- Balance: 34 cm
- Head size: 658 cm²

Same material and parameters





Better efficiency



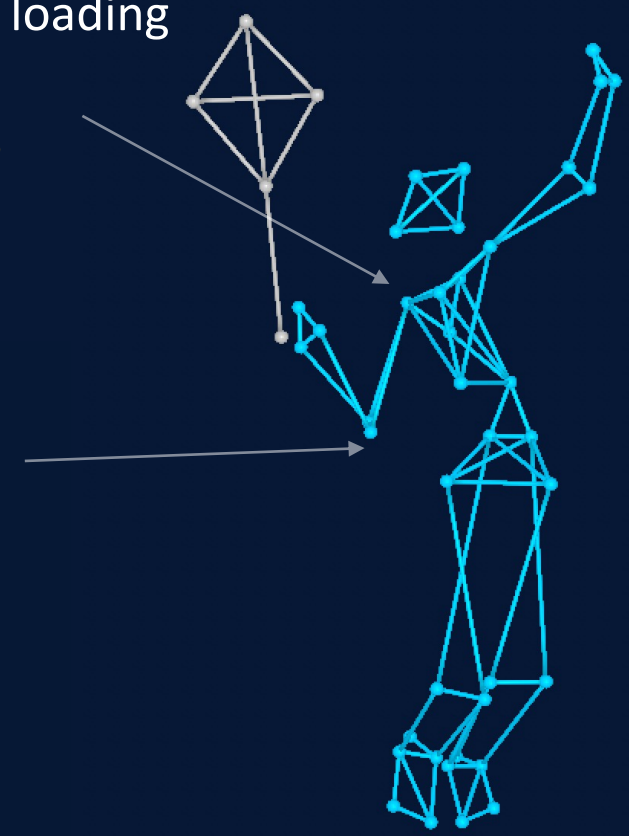
Performance

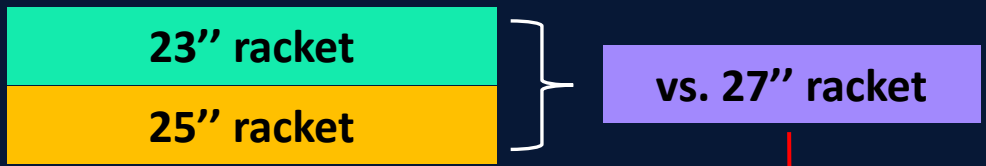
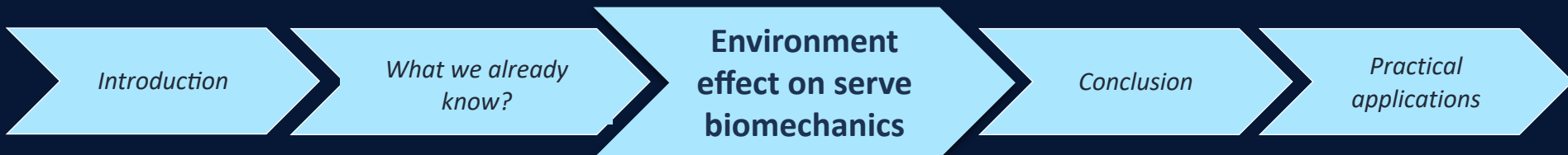
==
Ball speed
% of serve in

Injury risks

Max. shoulder loading
- 22 %
- 13 %

Max. elbow loading
- 31 %
- 14 %

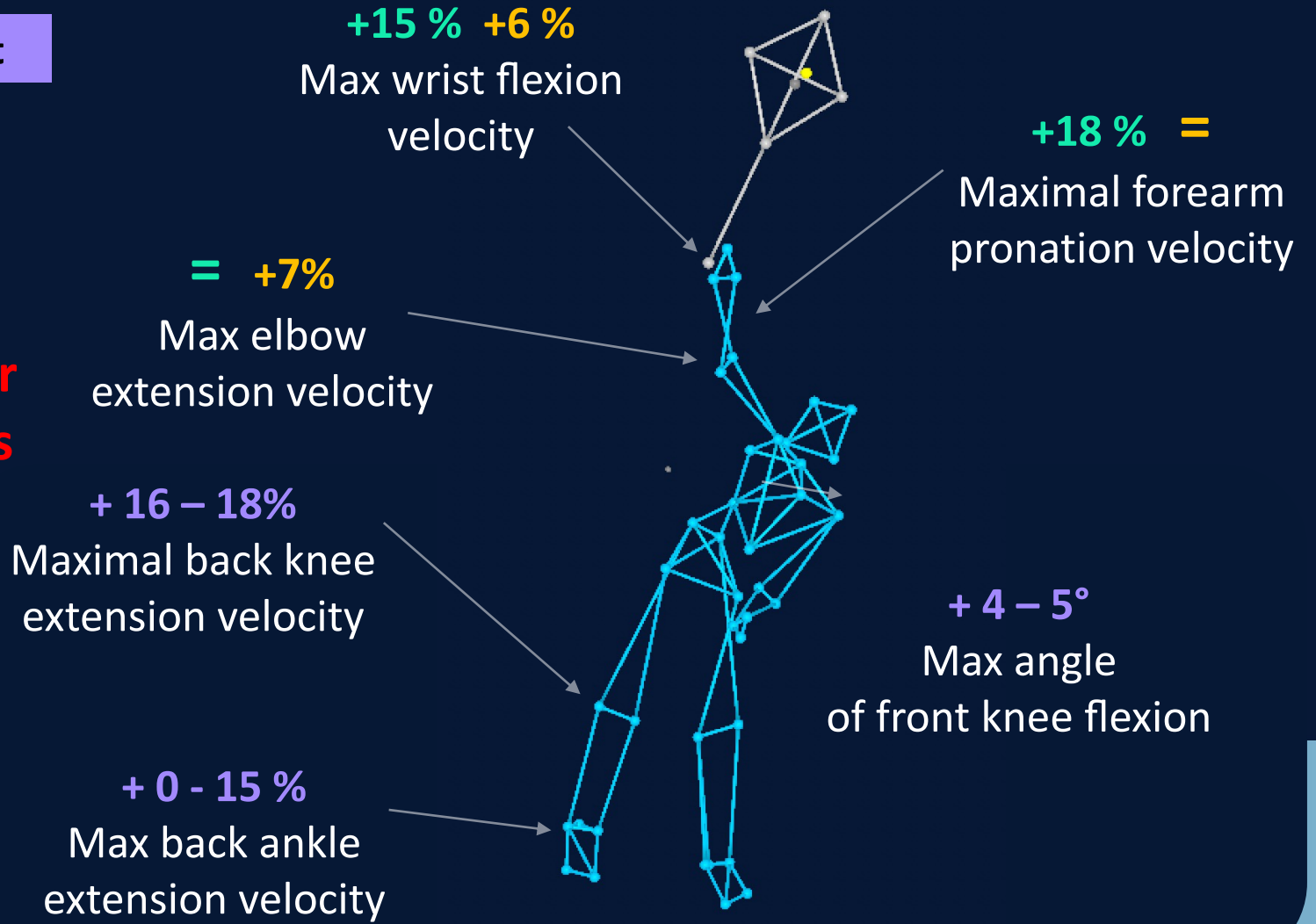




Better upper limb actions

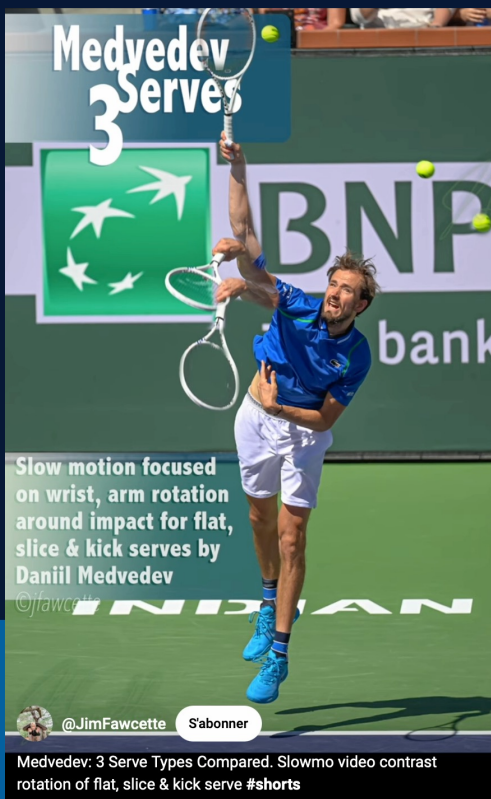
Better lower limb actions

Biomechanical data



Spin production

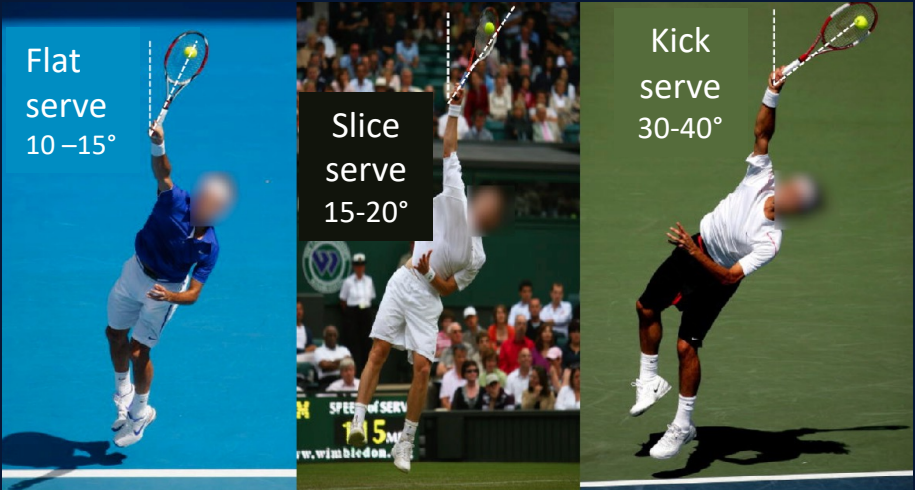
- = 1) lateral flexion of the racket
- + 2) racket trajectory
- + 3) racket face angle at impact



2) Racket trajectory



1) Lateral flexion of the racket



3) Racket face angle



Introduction

What we already know?

Environment
effect of serve
biomechanics

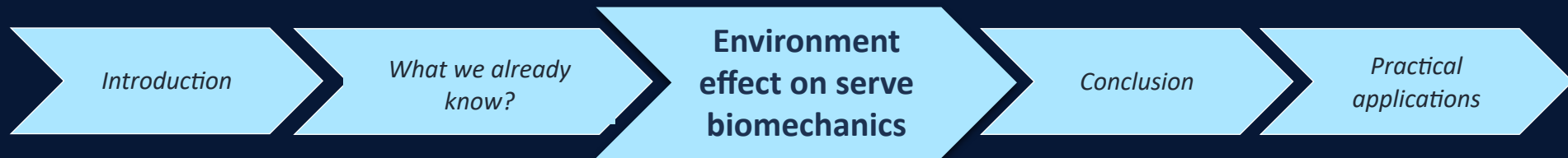
Conclusion

Practical
applications

Serve with small rackets (21") for spin learning

- 1) lateral flexion of the racket
- 2) racket trajectory
- 3) racket face angle at impact





	23" racket	25" racket	27" racket
Shoulder & elbow loadings	↘	↘	↗
Ball speed	=	=	=
% of serve in	=	=	=
Upper body	↗ wrist flexion & forearm pronation velocities	↗ wrist flexion & elbow extension velocities	↘ wrist flexion, forearm pronation & elbow extension velocities
Lower body	↘ knee flexion ↘ knee & ankle extension velocities	↘ knee flexion ↘ knee extension velocity = ankle extension velocity	↗ knee flexion ↗ knee & ankle extension velocities
	A regular intervention to improve serve upper limb actions and spin learning	The best compromise for daily practice	A sparingly intervention to help kids to intuitively and immediately increase their leg drive action

Introduction

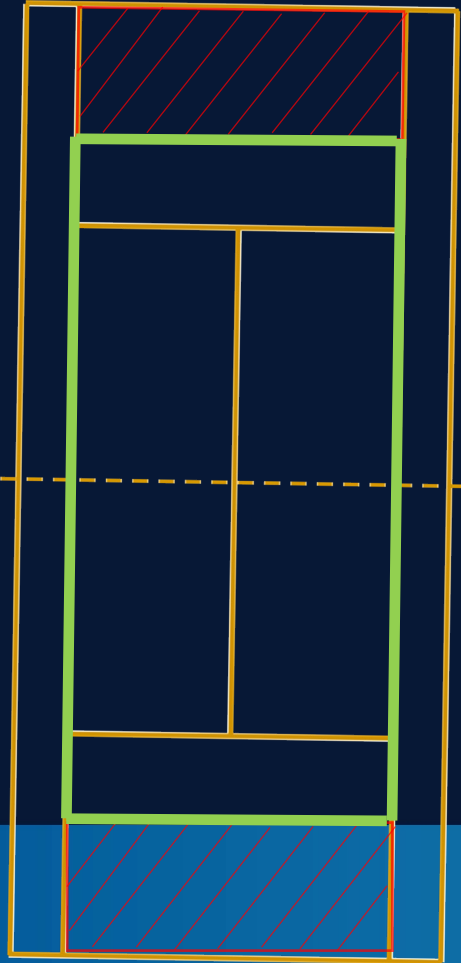
What we already know?

Environment effect on serve biomechanics

Conclusion

Practical applications

When kids serve from a forward position or with a smaller racket



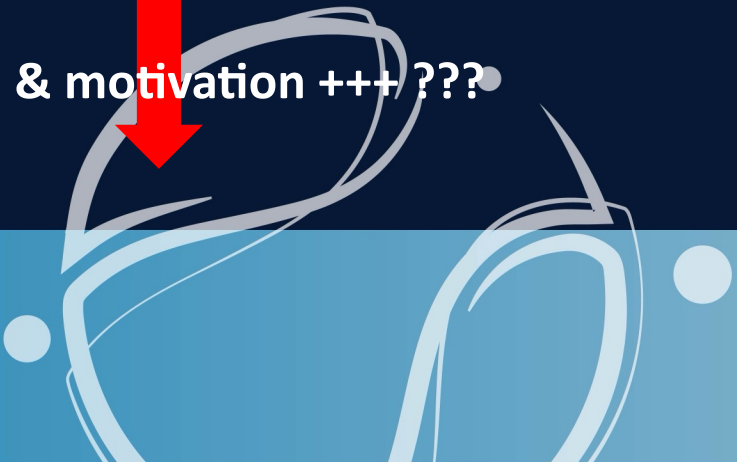
Improve serve biomechanics

Better serve efficiency (perf ↗ / risks ↘)

Fun & motivation +++ ???

What we do not know

- Accuracy – Long term learning?



Introduction

What we already know?

Environment effect on serve biomechanics

Conclusion

Practical applications

U12 serve

ATP serve



~~Serve – start of point~~

Serve = weapon

Serve = weapon

Introduction

What we already know?

Environment effect on serve biomechanics

Conclusion

Practical applications



**Take home message*

Exploring tennis serve environment (court size & net height)

Tactical learning

Serve becomes a weapon

Promoting an offensive rather than a defensive style of play

(the serve is directly linked to winning points)

Technical learning

Kids serve biomechanics closer to juniors / adults ones



Effects on return of serve training?

Introduction

What we already know?

Environment effect on serve biomechanics

Conclusion

Practical applications


*Take home message

There is no rush to upgrade too soon the racket size in young intermediate competitive players to avoid overuse injury risks in the long term



Incorporate deliberate modifications of the serve motion with different racket sizes to induce immediate and better coordination:

- 23" racket → upper limb rotations (spin learning)
- 27" racket → lower limb action


*Take home message

Introduction

What we already know?

Environment effect on serve biomechanics

Conclusion

Practical applications

We have to be creative to find constraints in the tennis environment, that offer kids new possibilities of actions to improve their serve biomechanics.

Examples to improve the leg drive



Soccer throw




*Take home message

Introduction

What we already know?

Environment effect on serve biomechanics

Conclusion

Practical applications

In the tennis environment, we have to be creative to find constraints that offer kids new possibilities of actions to improve their serve biomechanics.

Examples to improve trunk rotations

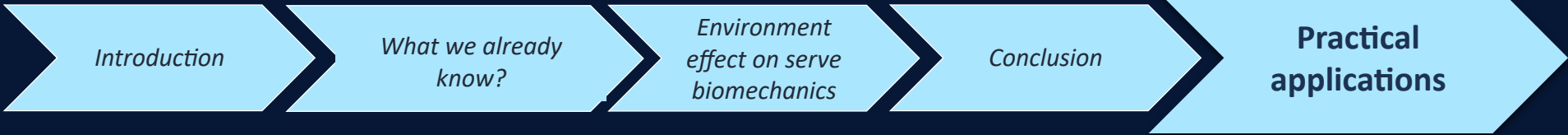


Trunk flexion (arabesque)

Vertical throw over an obstacle
Shoulder over shoulder rotation



 *Take home message



In the tennis environment, we have to be creative to find constraints that offer kids new possibilities of actions to improve their serve biomechanics.

Examples to improve upper limb actions



Thanks for your attention

www.caromartin-tennis.com



caromartin_tennis

