

Soccer

Game intelligence

Junior Barrera

IME-USP

Layout

- Introduction
- Goal keeper
- Soccer game model
- Example
- Game evaluation and design
- Future works

Layout

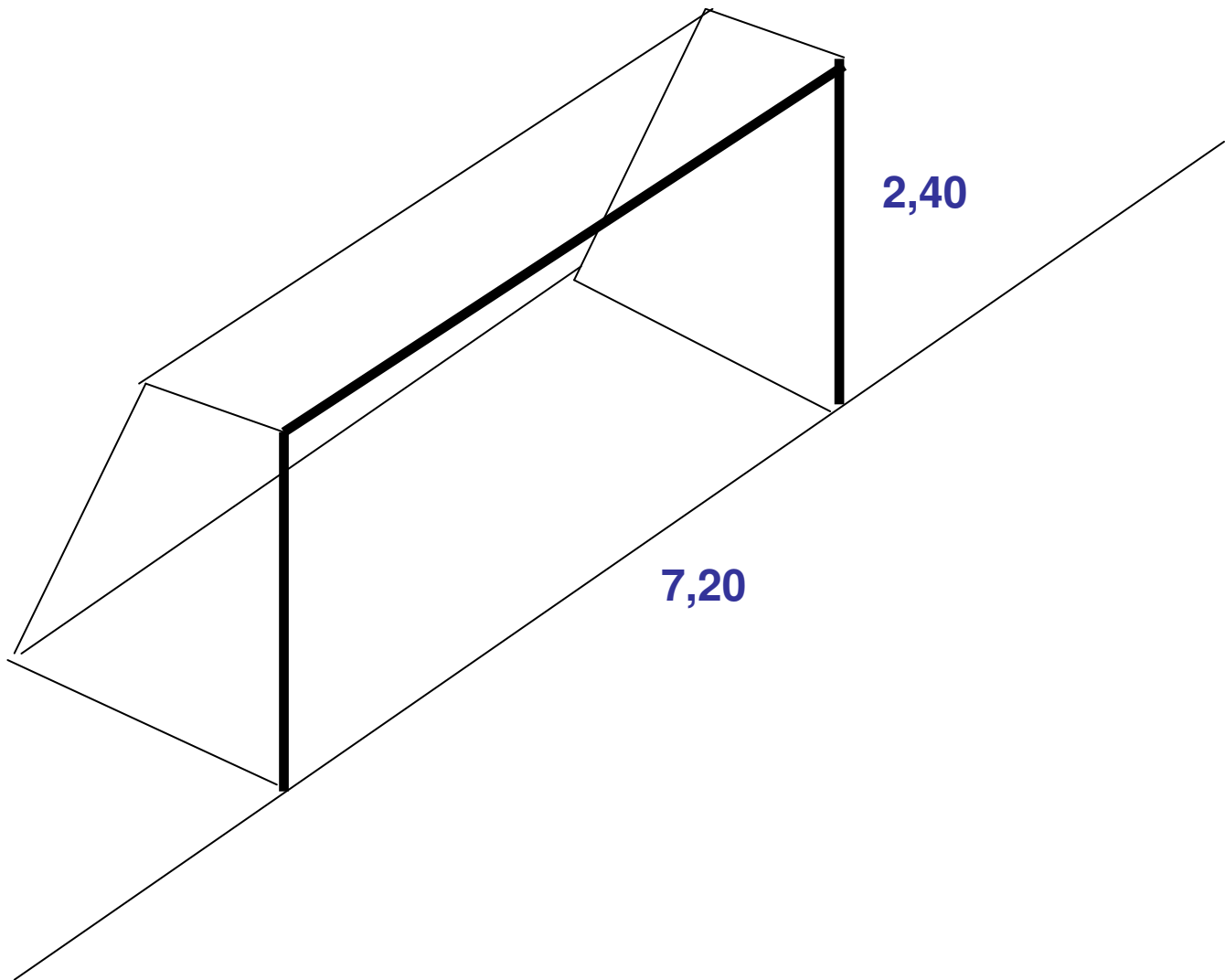
- Introduction
- Goal keeper
- Soccer game model
- Example
- Game evaluation and design
- Future works



Rodrigo







Layout

- Introduction
- Goal keeper
- Soccer game model
- Example
- Game evaluation and design
- Future works

The problem

Avoid that the ball crosses the goal line

Solution

- Defending attacks
- Avoiding attacks
 - defensive actions
 - offensive actions

The proposed technique

- Dictionary of actions
- Taxonomy of keeper action sequences
- Prediction and decision rules

Goal keeper

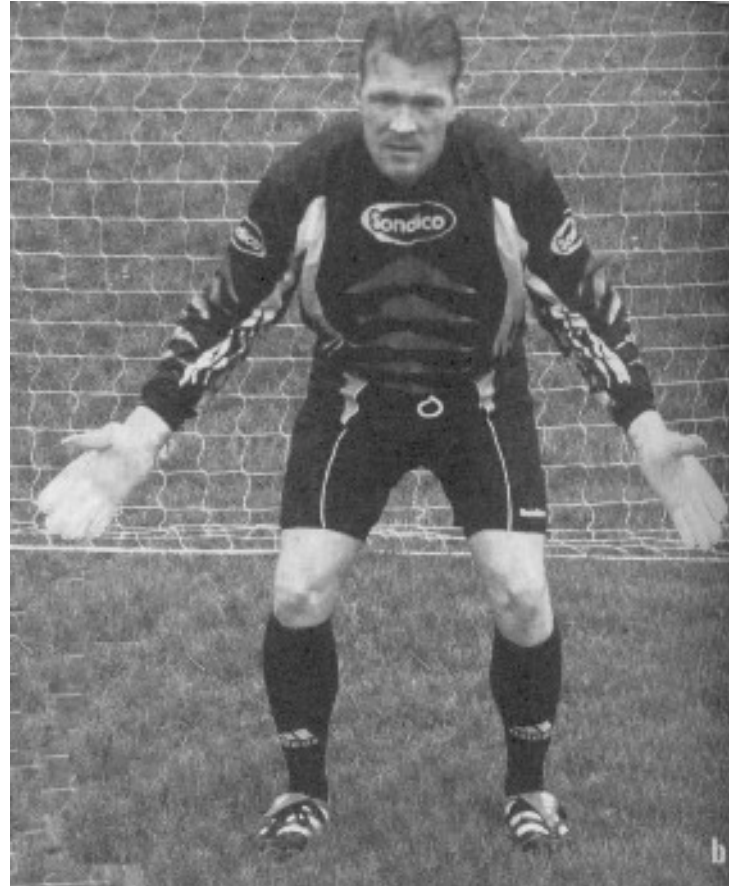
- Dictionary of actions
- Taxonomy of keeper action sequences
- Prediction and decision rules

Dictionary of actions

- Ready
- Motion
- Catch
- Cut
- Close and break
- Ball pass

Dictionary of actions

- Ready
- Motion
- Catch
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- Ball pass



Low ready position

Facilitate lateral jumps



High ready position

Facilitate vertical jumps



High ready: crosses

Dictionary of actions

- Ready
- Motion
- Catch
- Cut
- Close and break
- Ball pass



Lateral walk



Ahead walk

Dictionary of actions

- Ready
- Motion
- Catch
- Cut
- Close and break
- Ball pass

Low slow catch



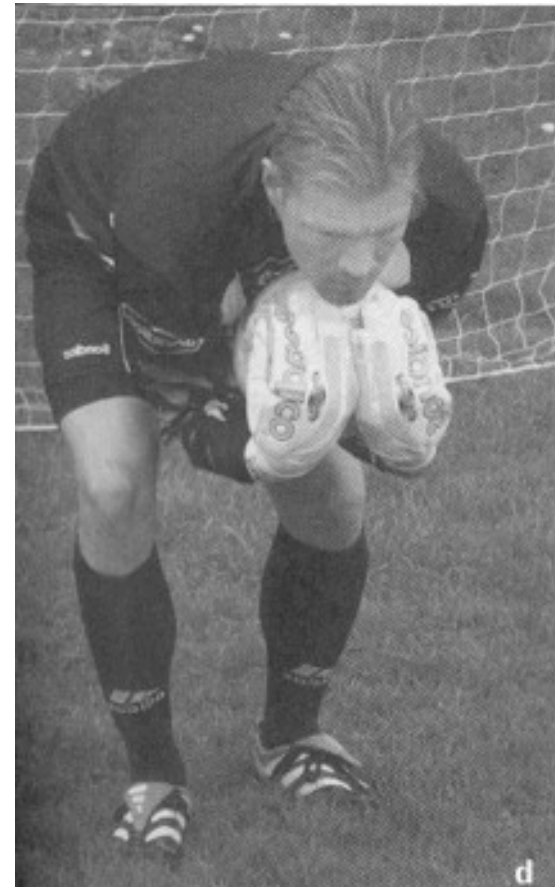
Low fast catch



Low fast catch



Low meddle catch



High meddle catch



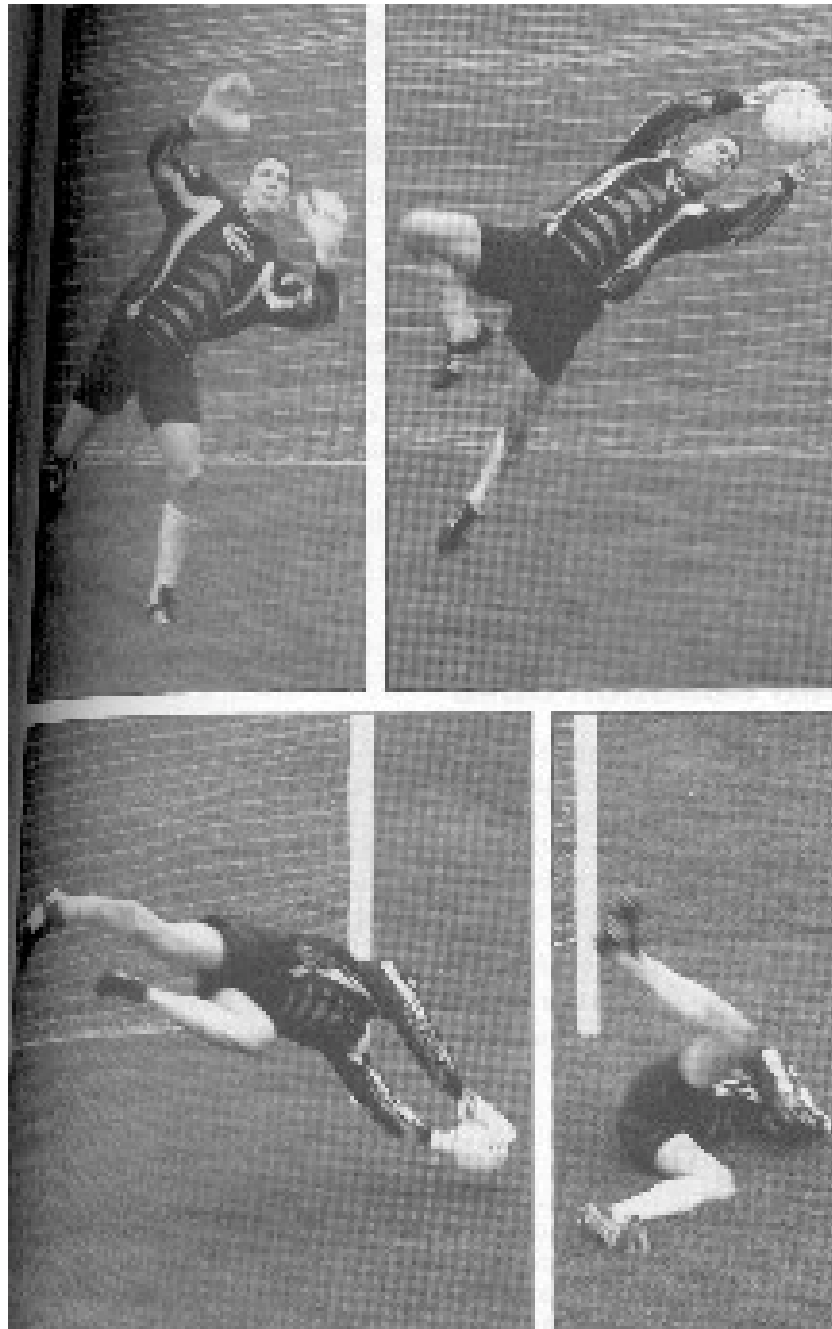
High catch



Low lateral
catch



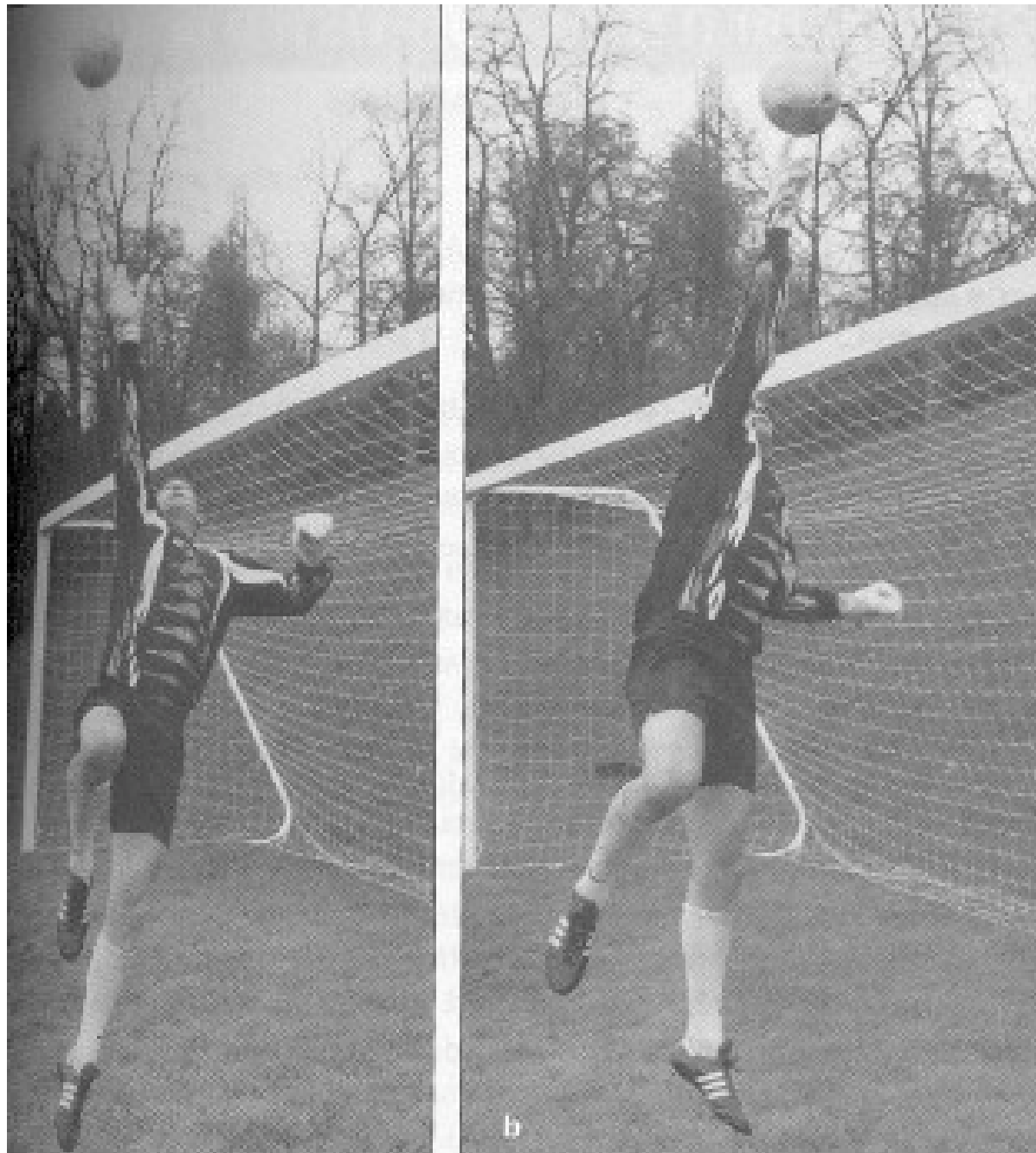
High lateral catch



Dictionary of actions

- Ready
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- Ball pass





Dictionary of actions

- Ready
- Motion
- Catch
- Cut
- Close and break
- Ball pass



Ahead walk



Close: stay in front of the player that has the ball



Lose balls on the grass



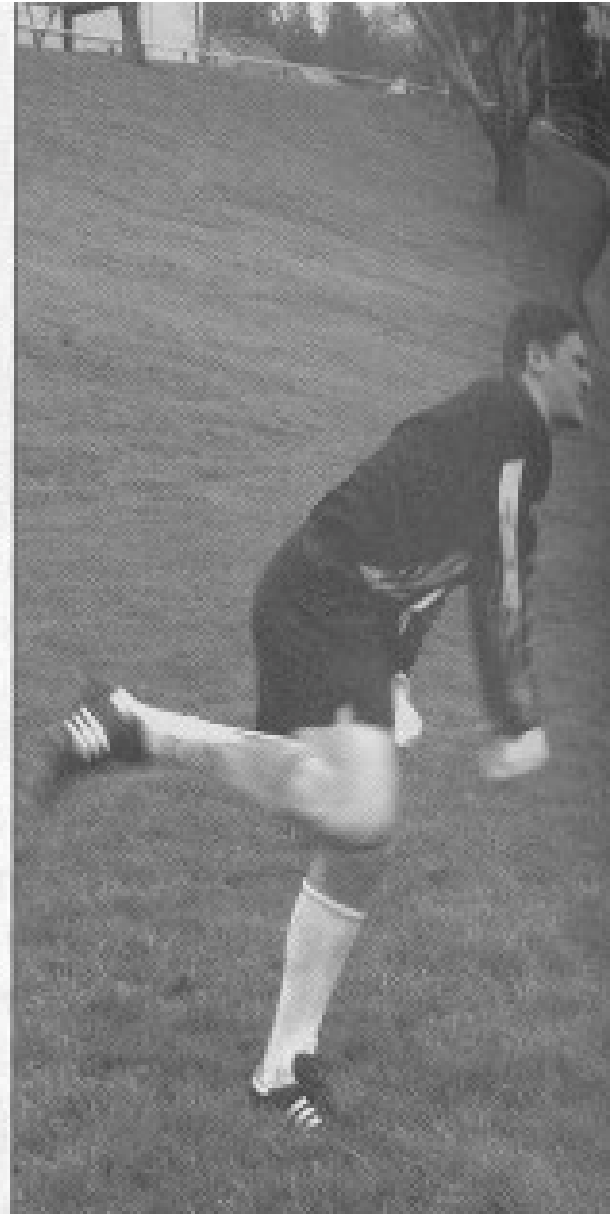
Lose balls on the grass

Dictionary of actions

- Ready
- Motion
- Catch
- Cut
- Close and break
- Ball pass











Goal keeper

- Dictionary of actions
- Taxonomy of keeper action sequences
- Prediction and decision rules

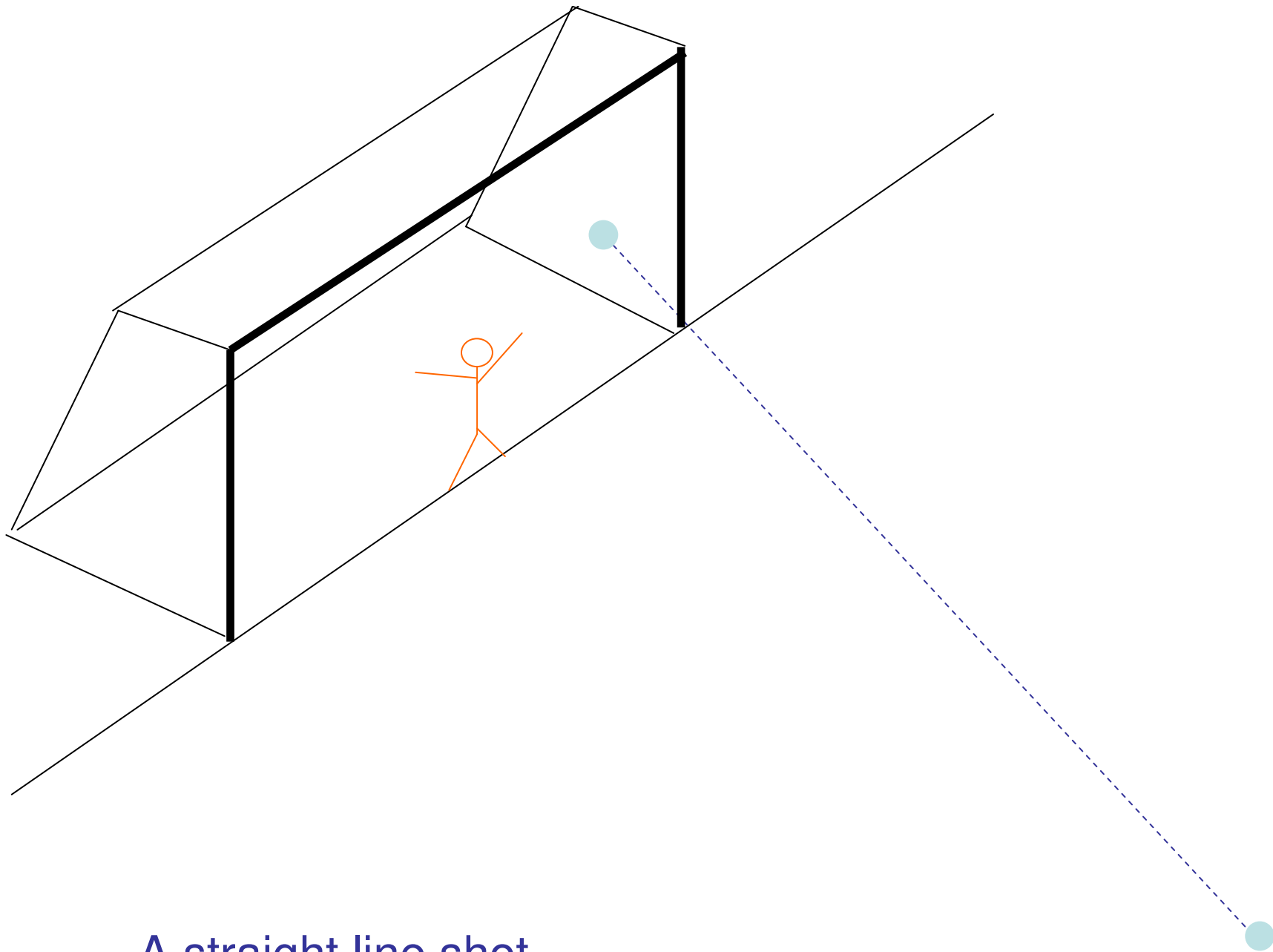
Taxonomy of action sequences

- Goal shots
- Covering
- Close and break
- Defense organization
- Ball repositions

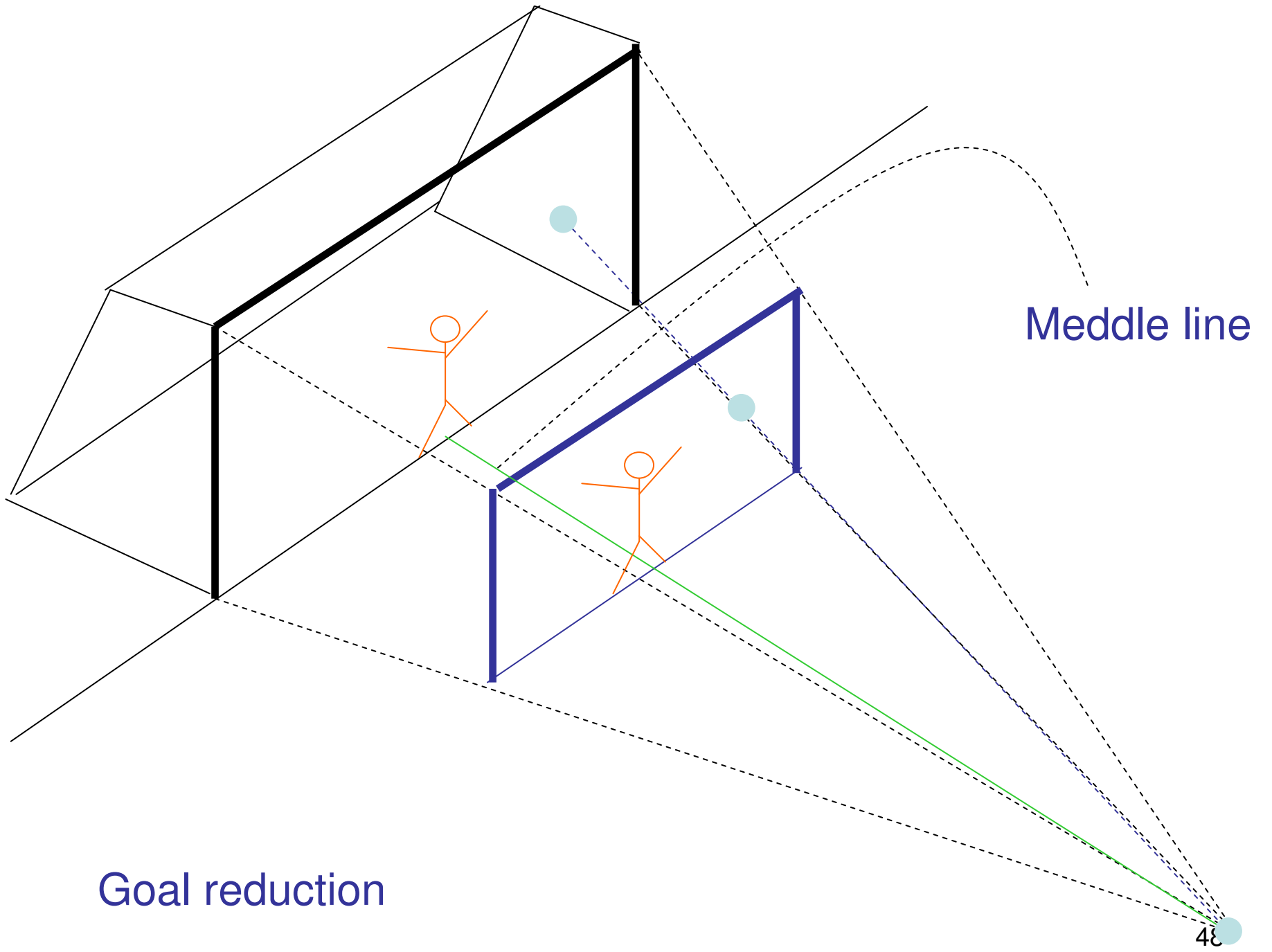
Taxonomy of actions sequence

- Goal shots
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Straight line shots



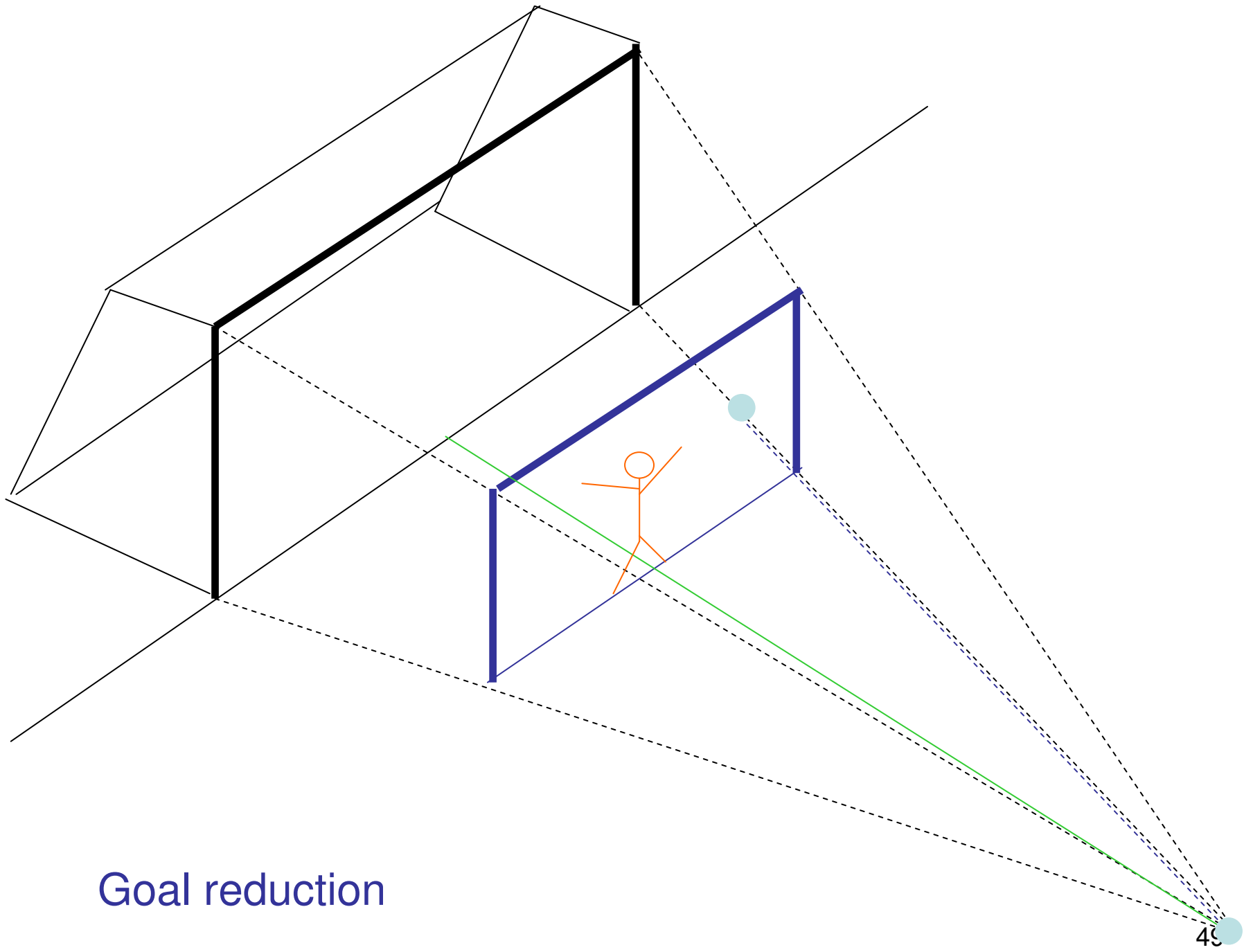
A straight line shot



Goal reduction

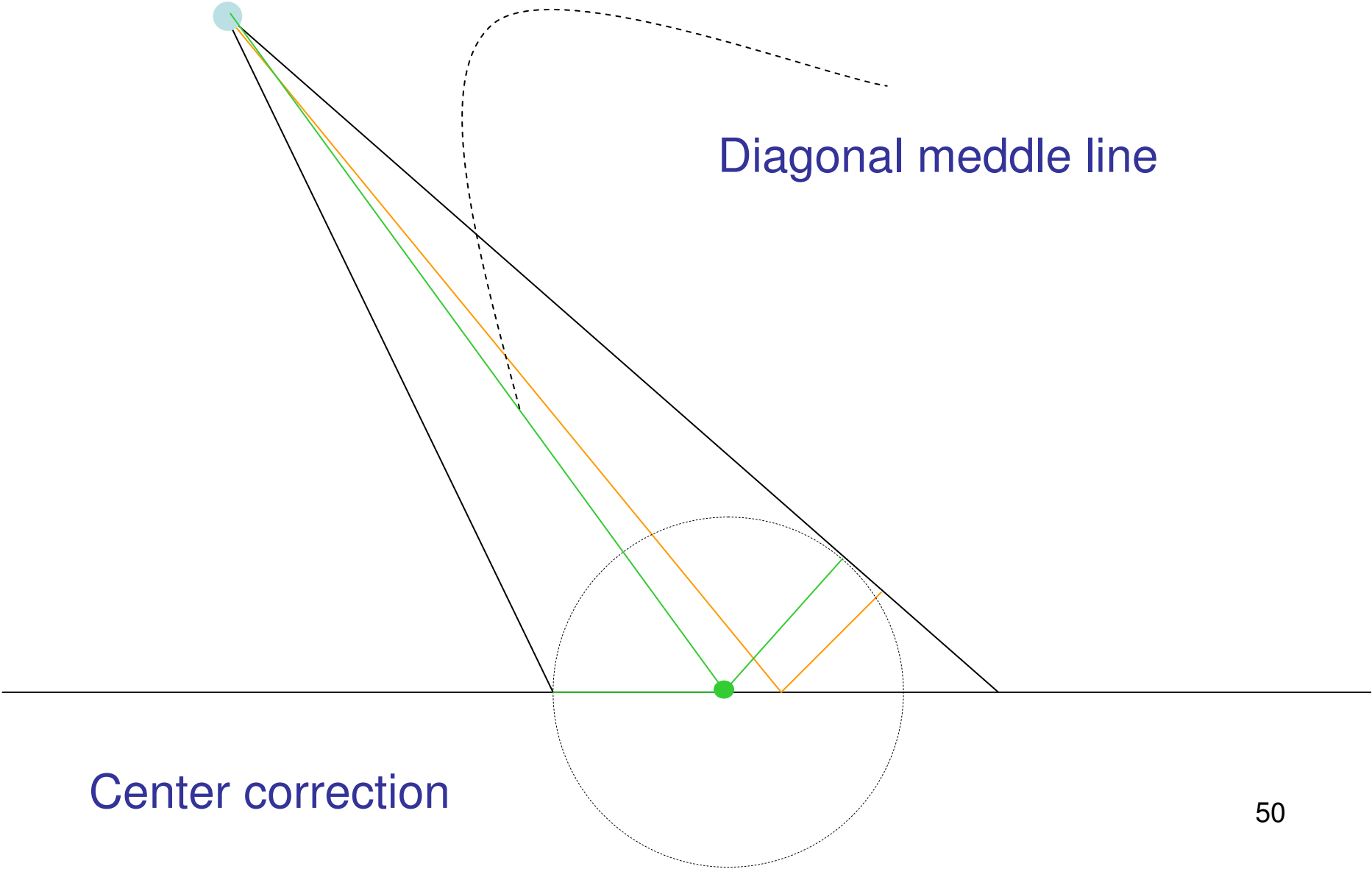
Meddle line

48



Goal reduction

Diagonal shot



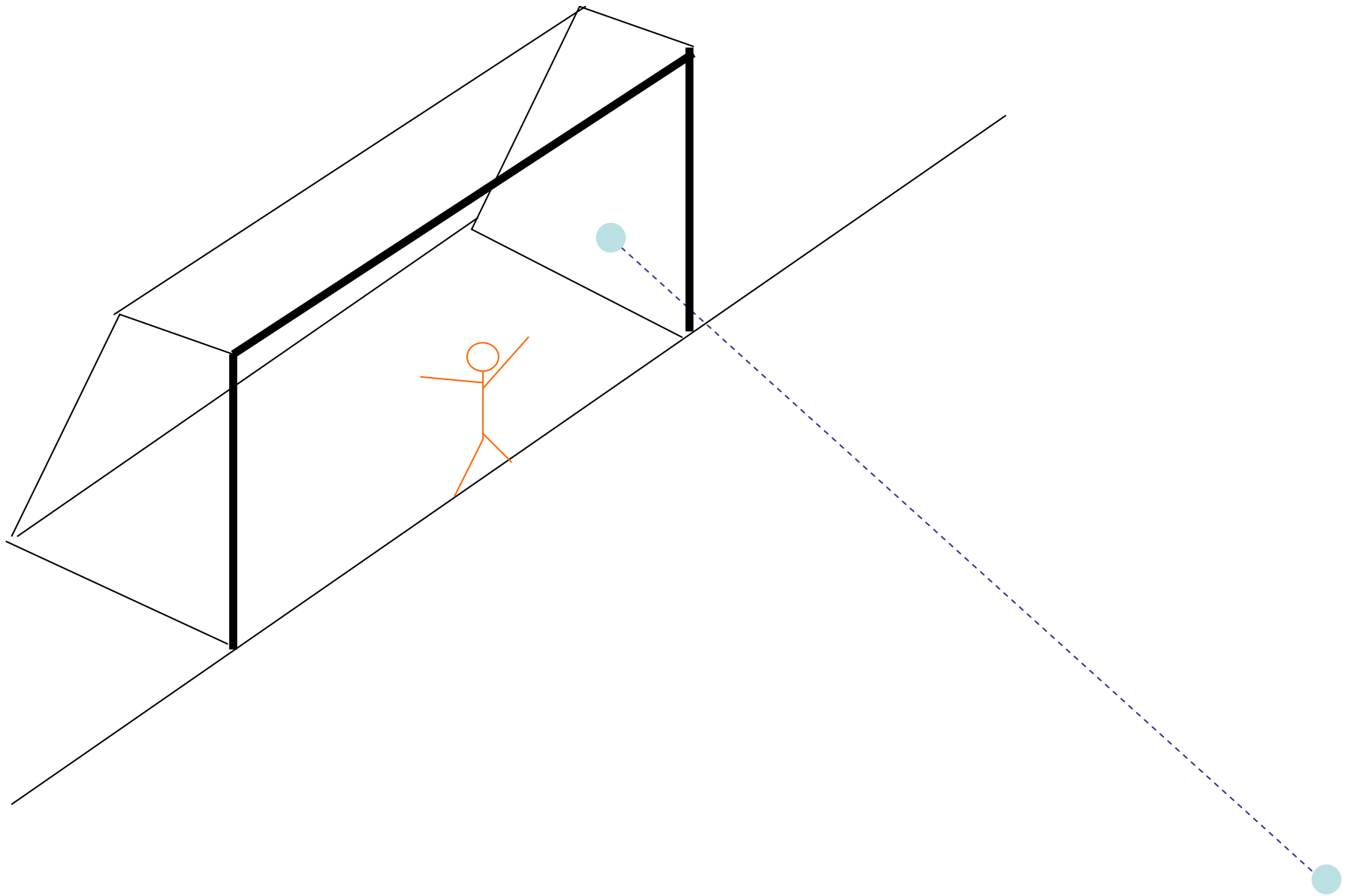
Diagonal meddle line

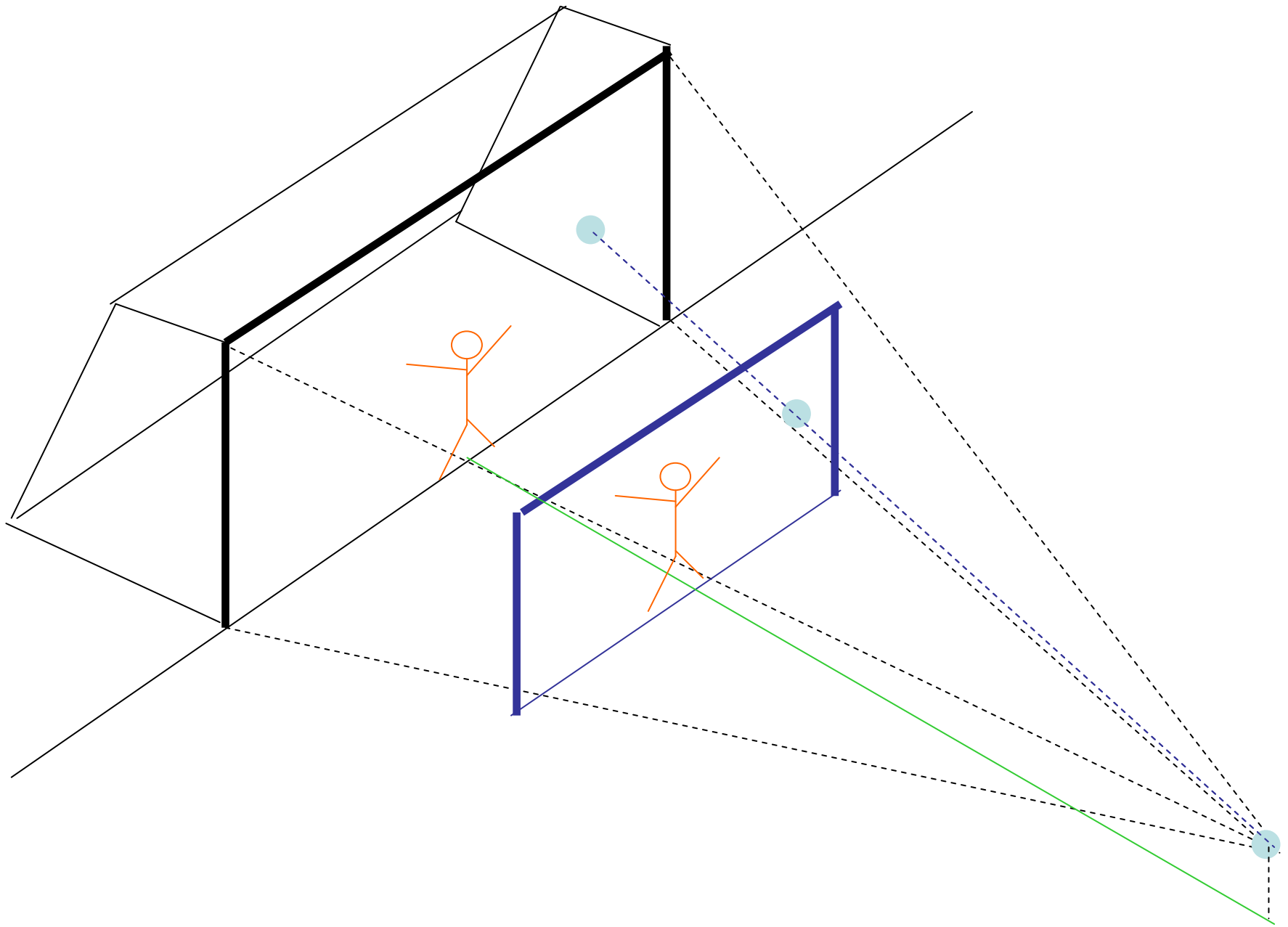
Center correction

Straight line kicking shots



Foot does not make an up movement



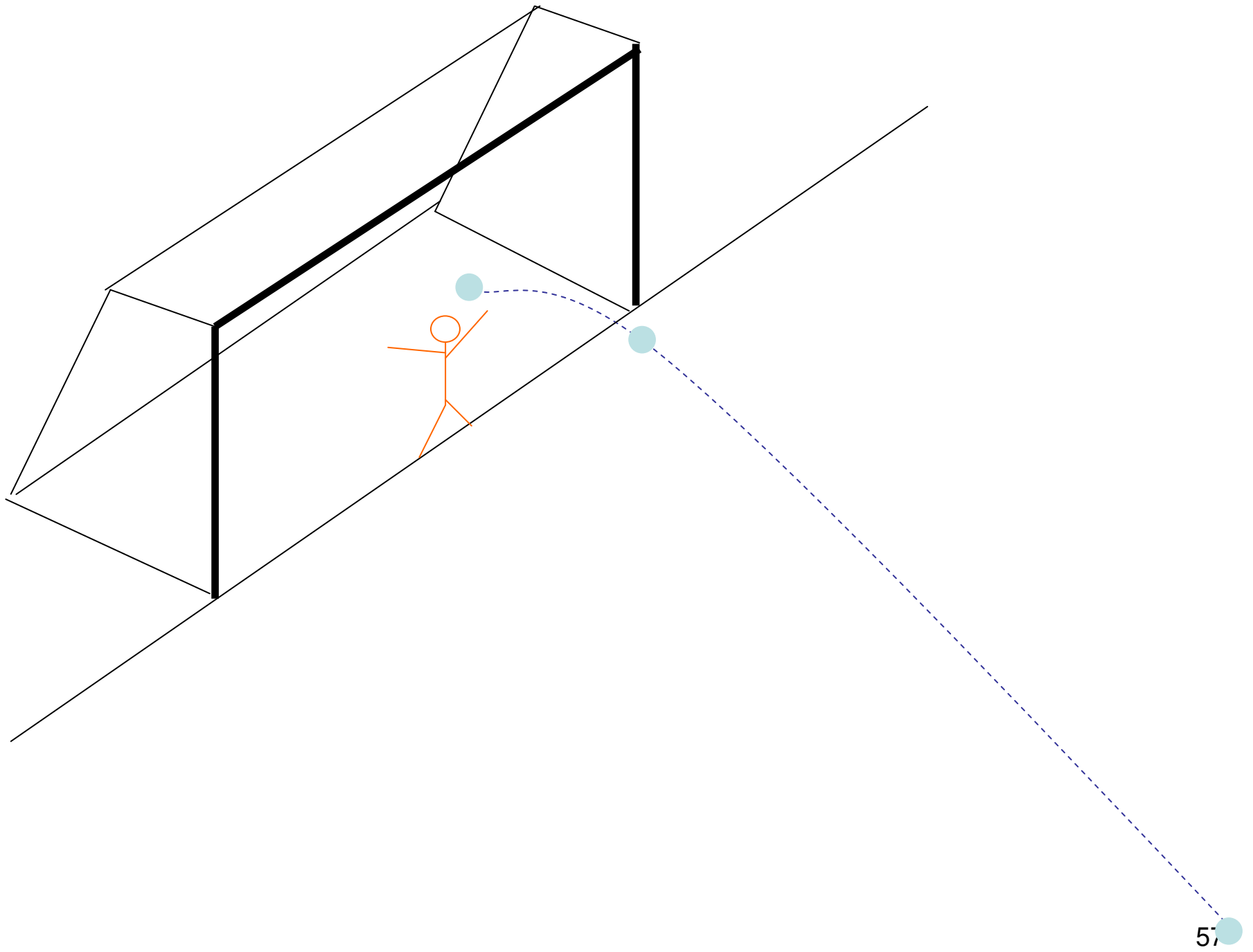


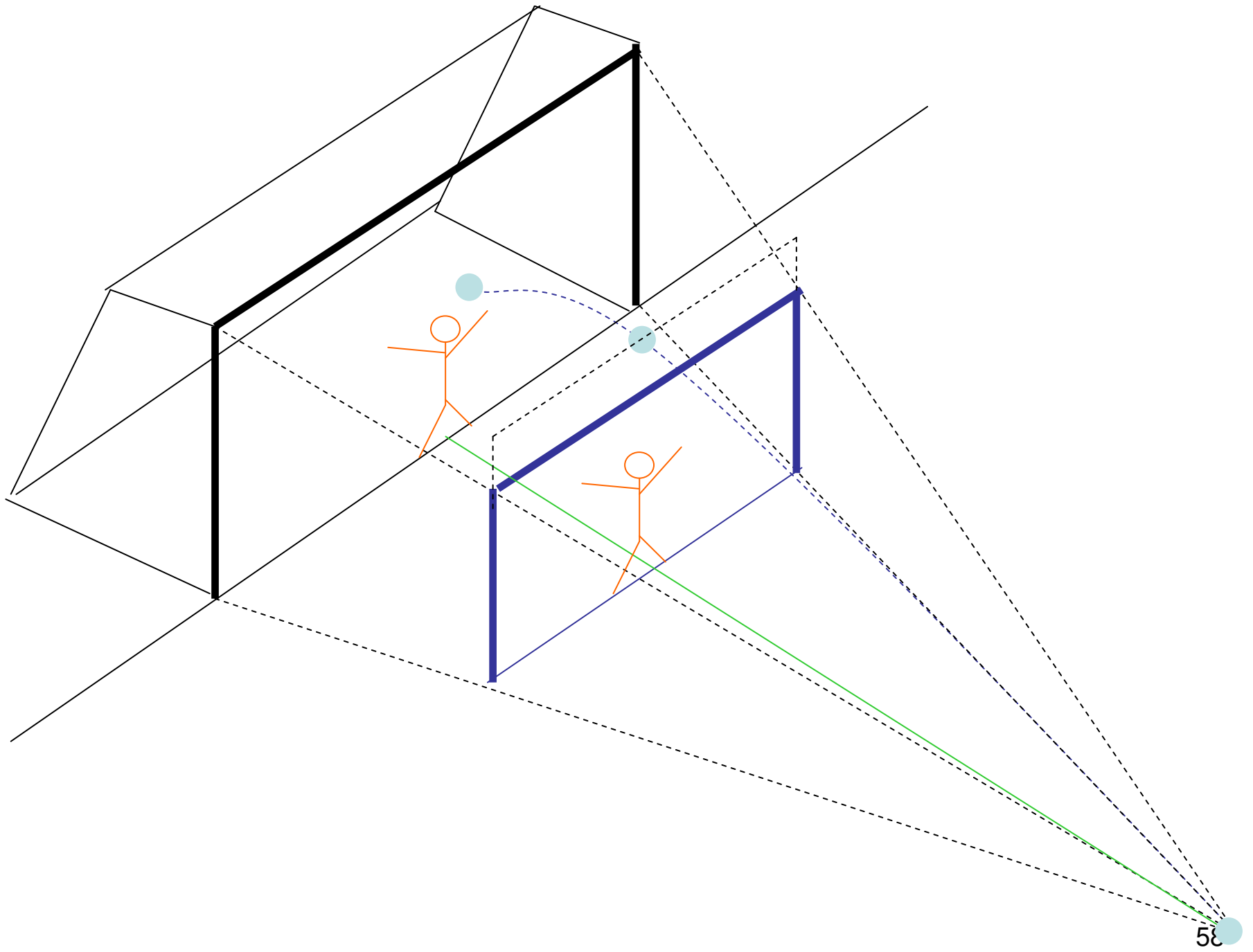
Parabolic shots

Parabolic kicking shot

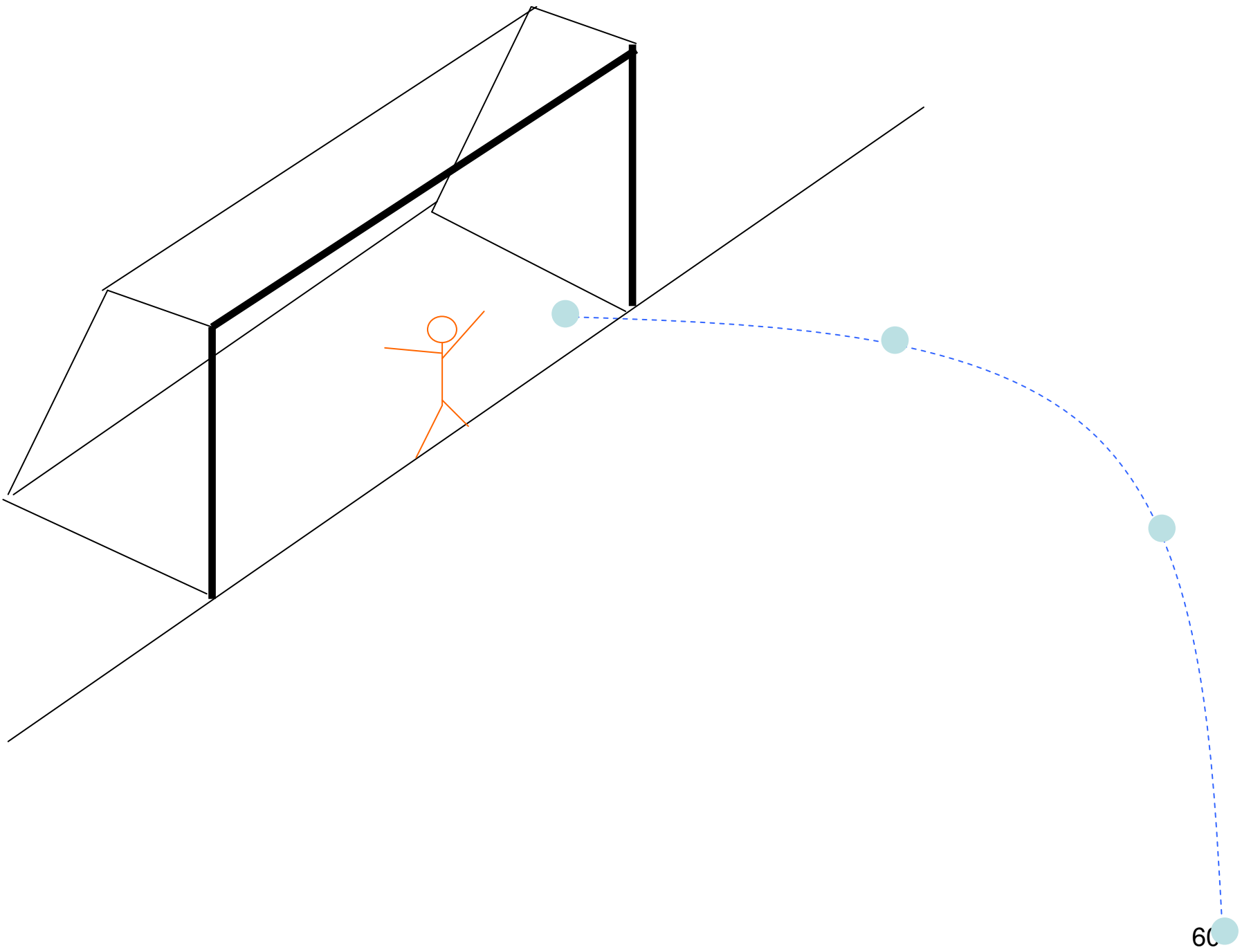


Foot makes an up movement

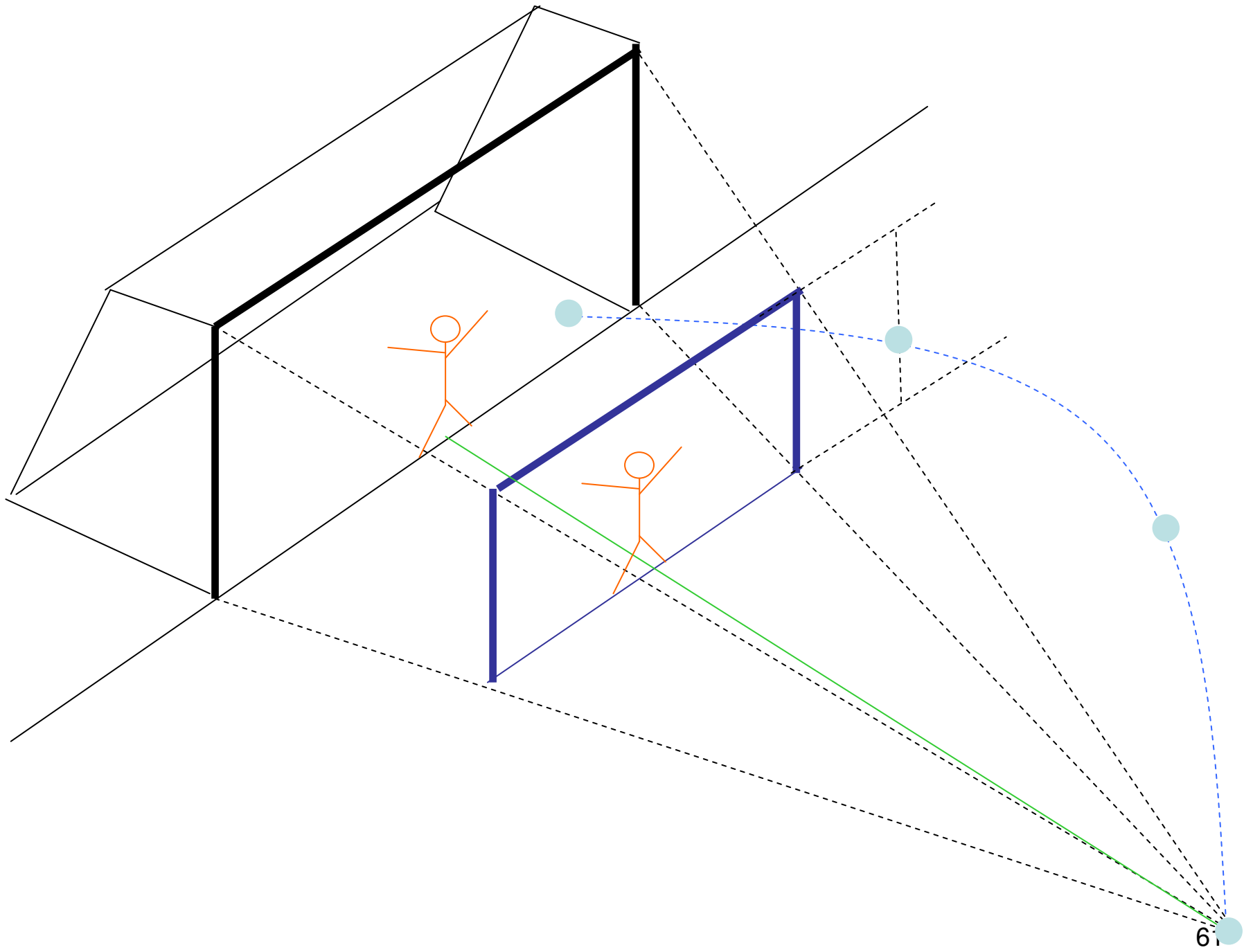




Curve shots



60



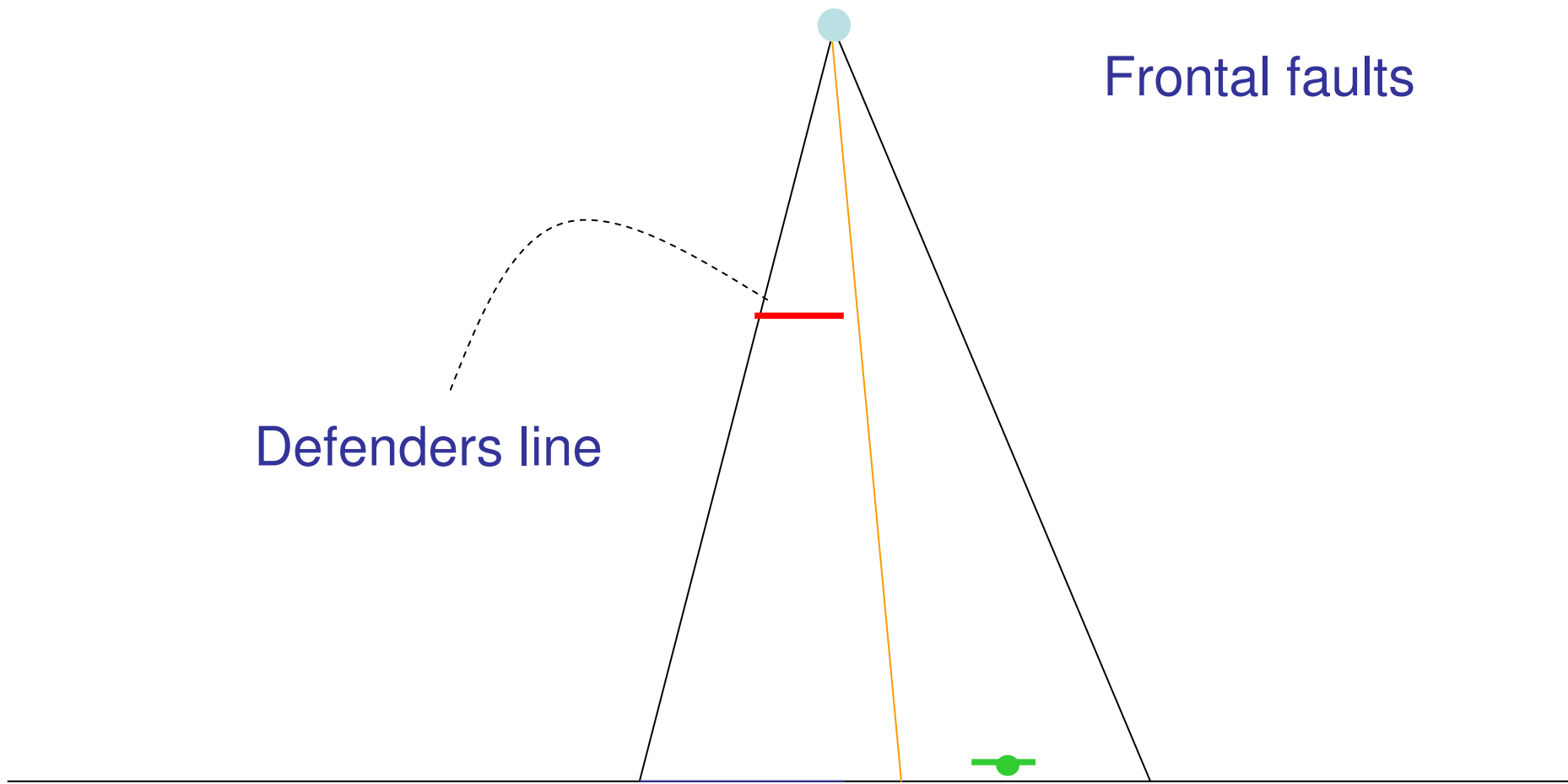
Faults



Defenders line

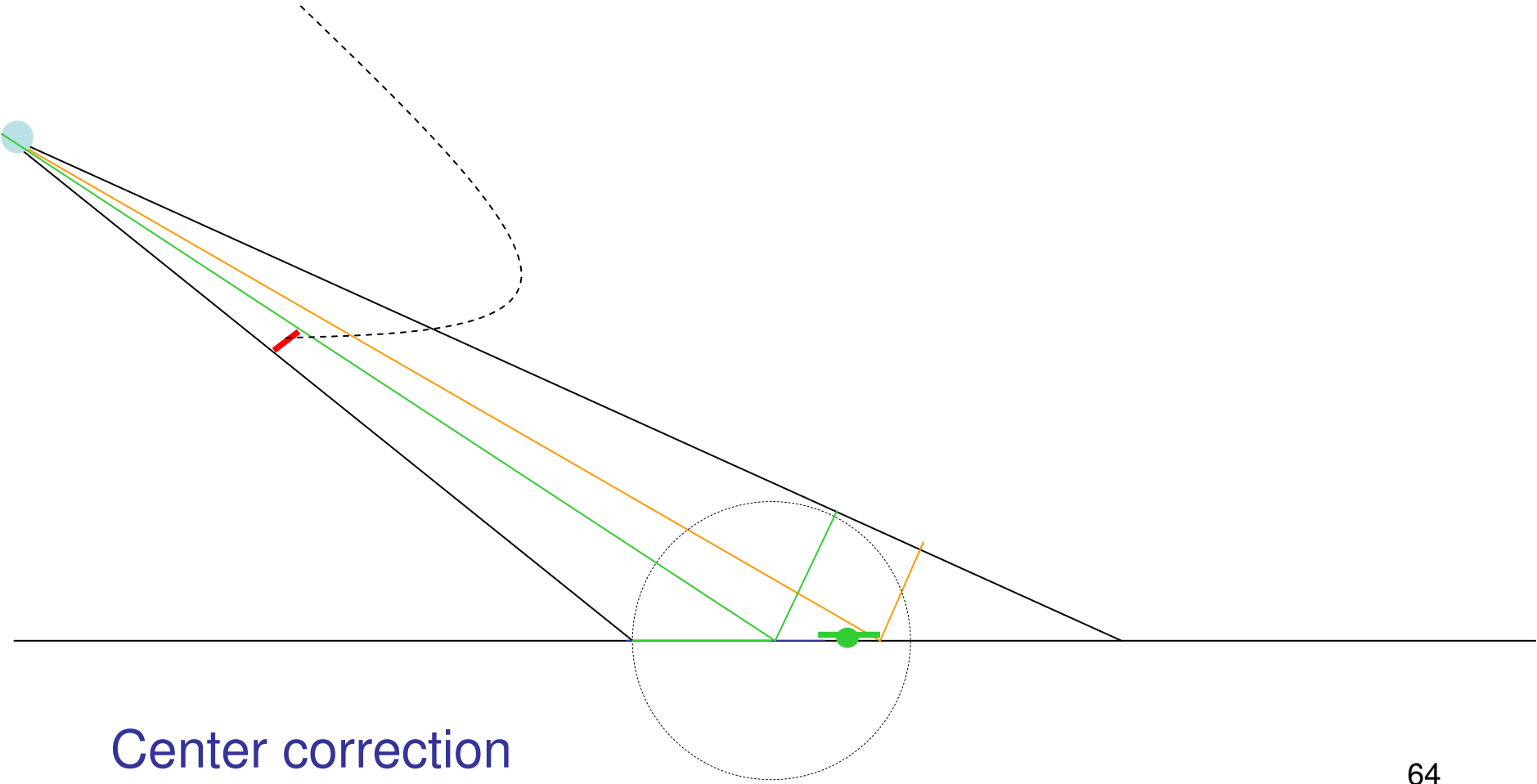
Frontal faults

Defenders line



Defenders line

Diagonal faults



Center correction

Analysis, prediction and decision rules

- Goal shots
- Covering
- Close and break
- Defense organization
- Ball repositions

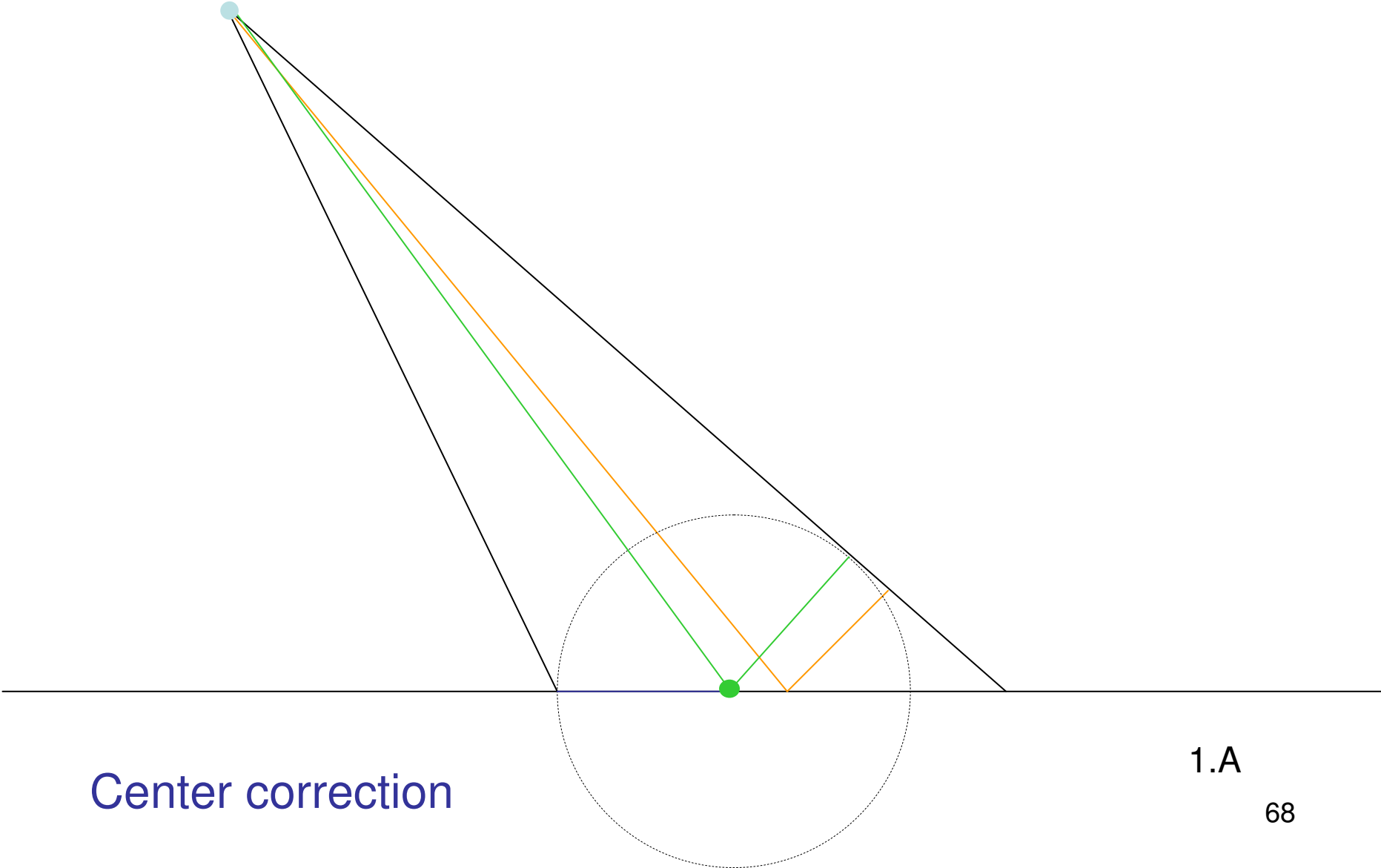
Covering the defense

means

arriving to the ball before any other player

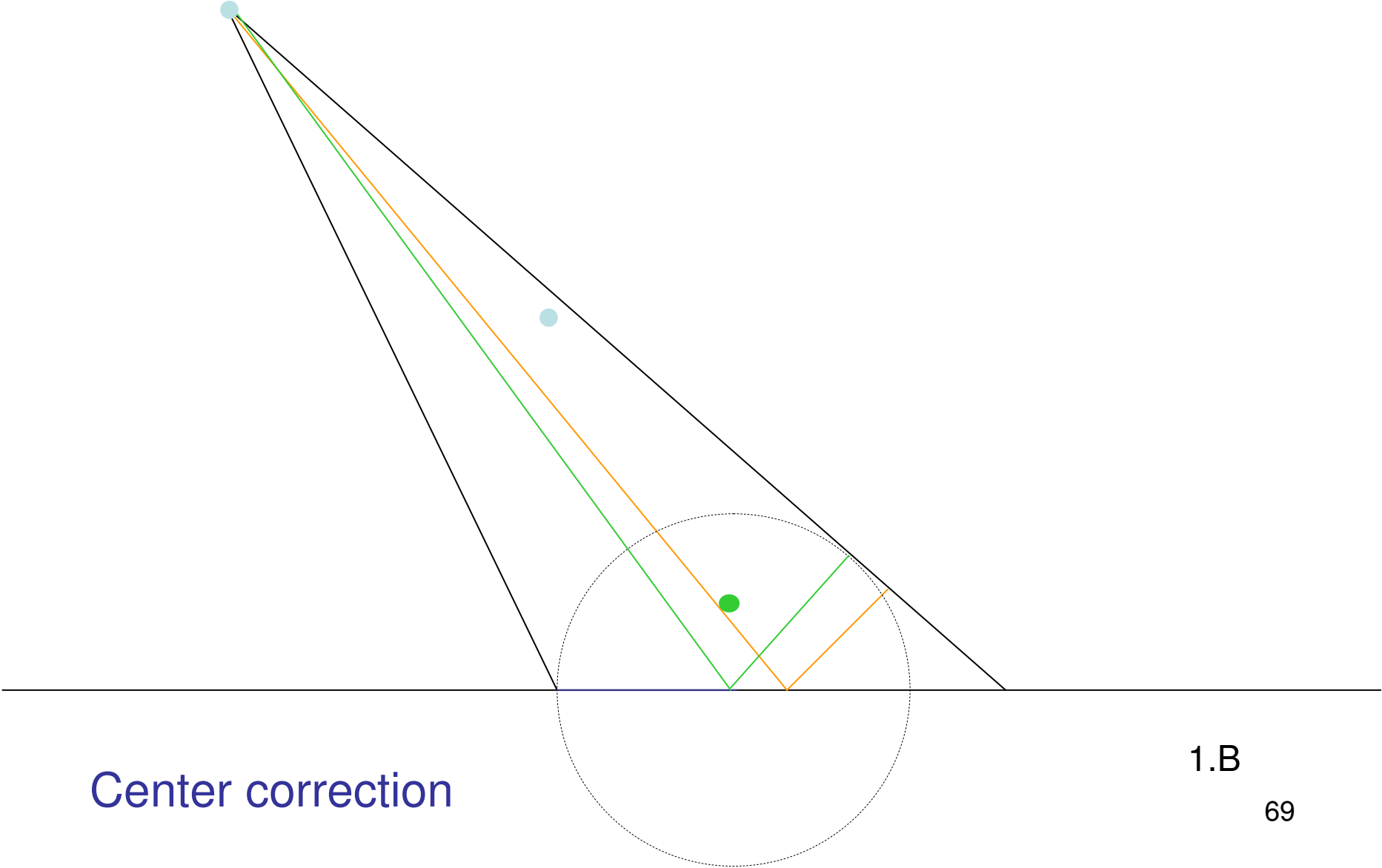
- Protecting balls that will go out
- “breaking” loose balls on the grass
- Catching or socking high balls
- Footing balls (in limit situations)

Slow balls
or
dead zone balls



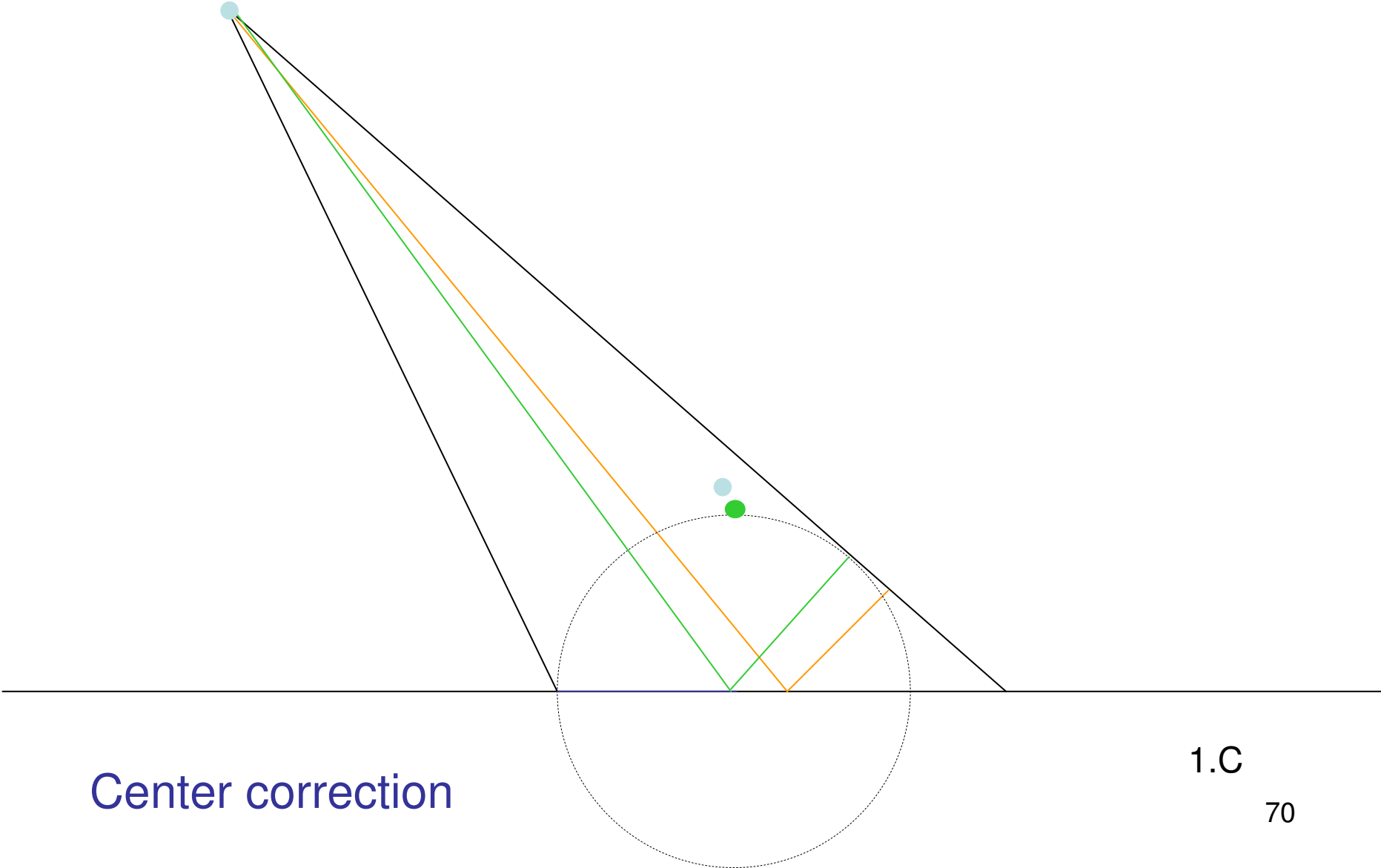
Center correction

1.A



Center correction

1.B

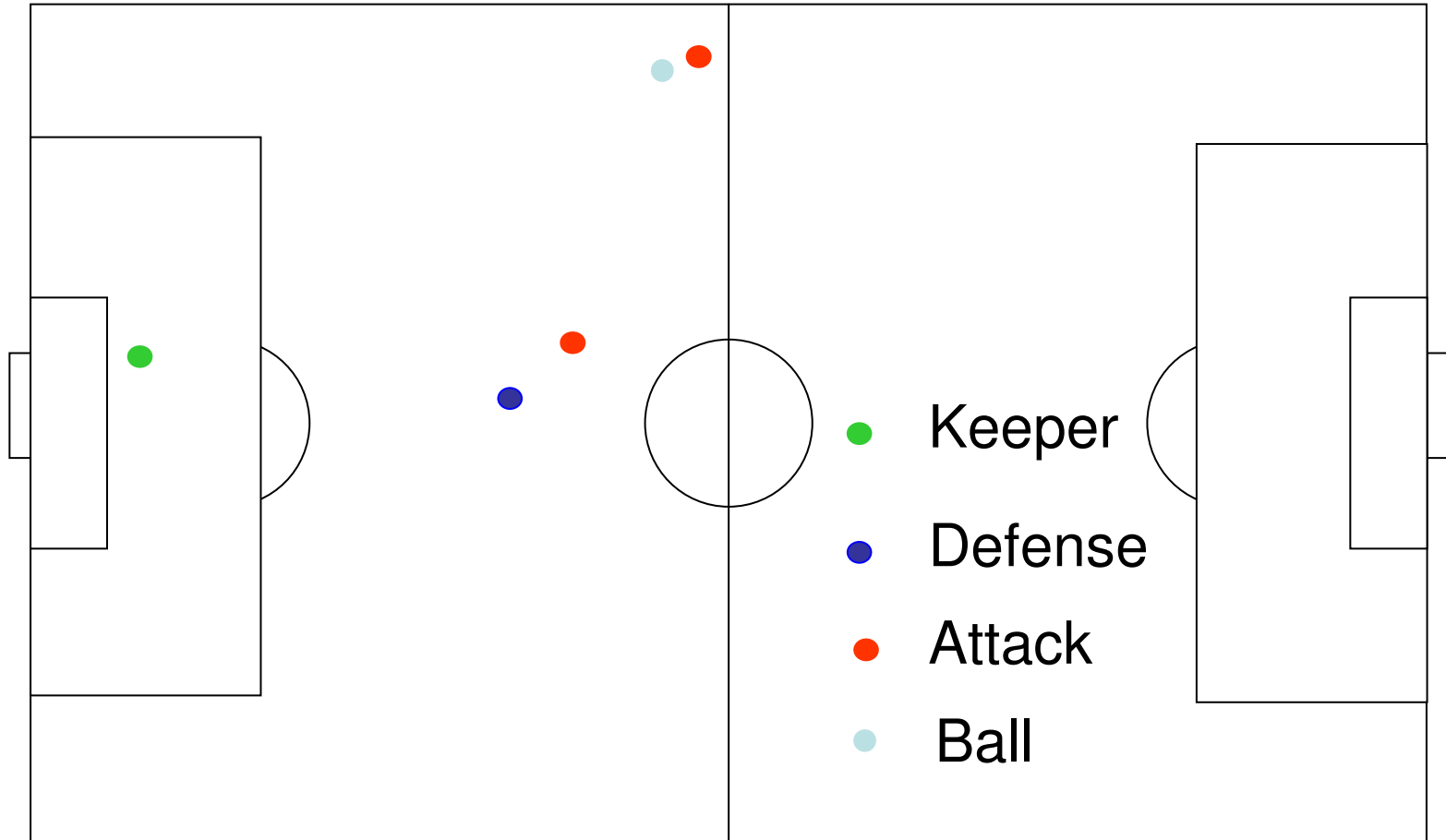


Center correction

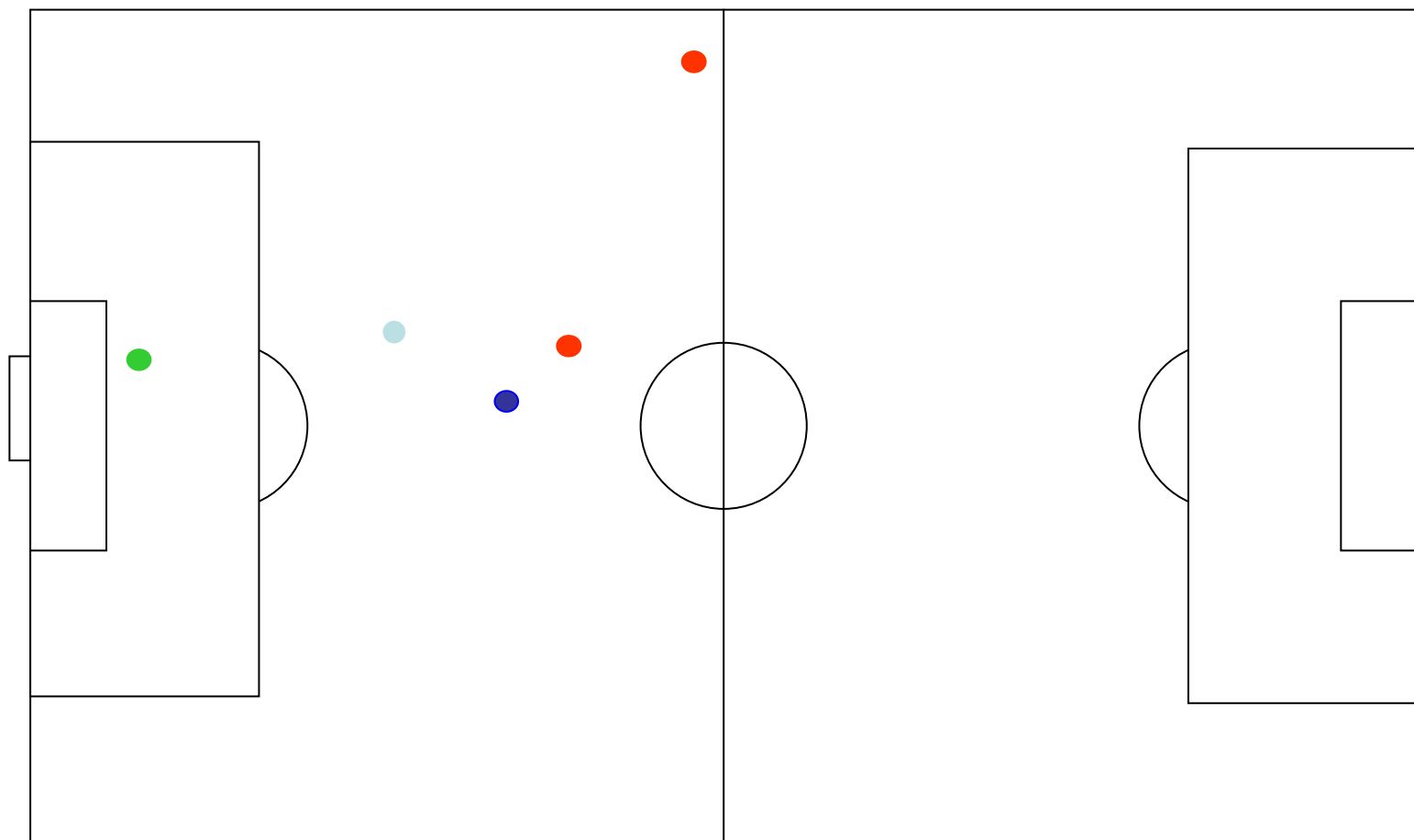
1.C

70

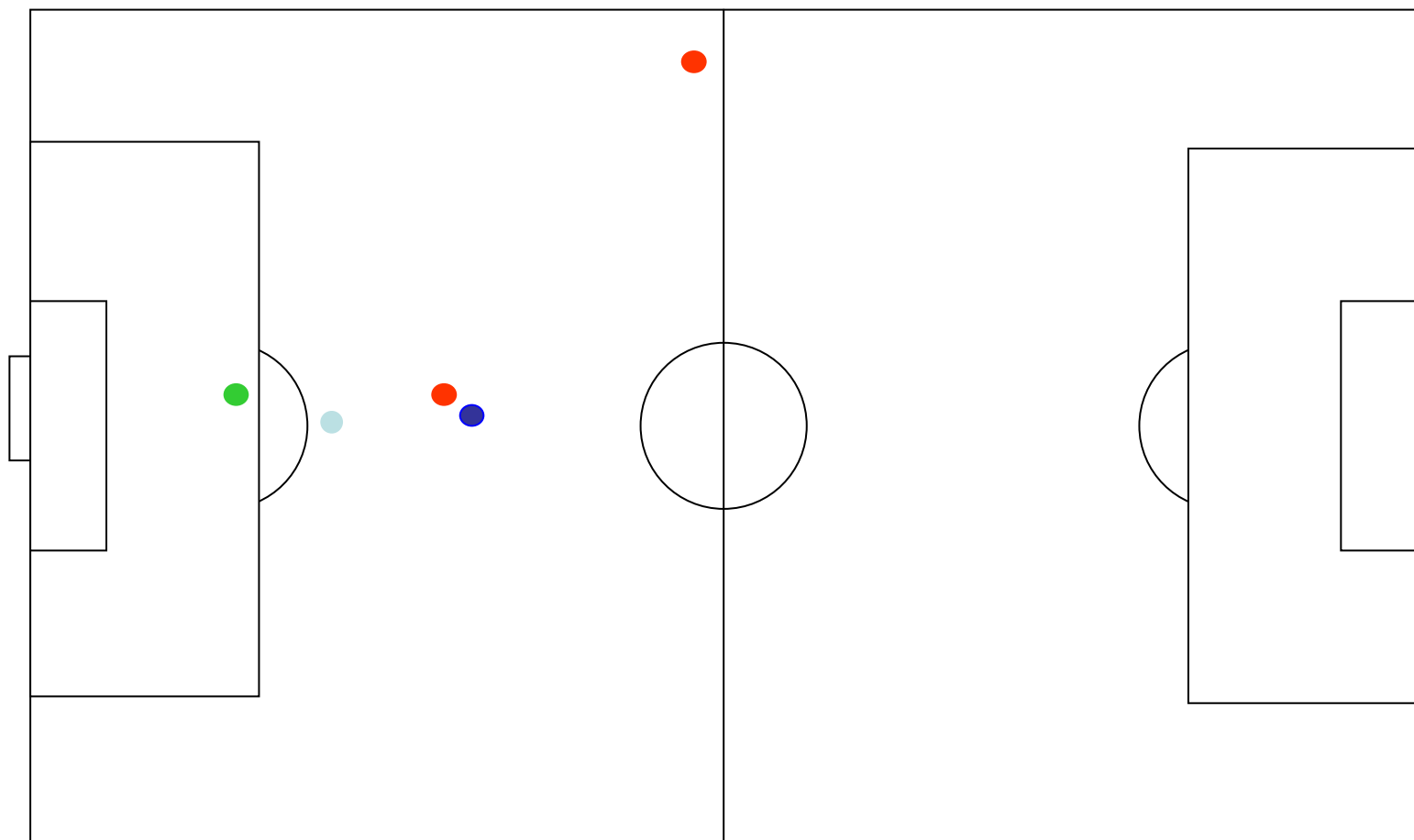
Defending back attacks



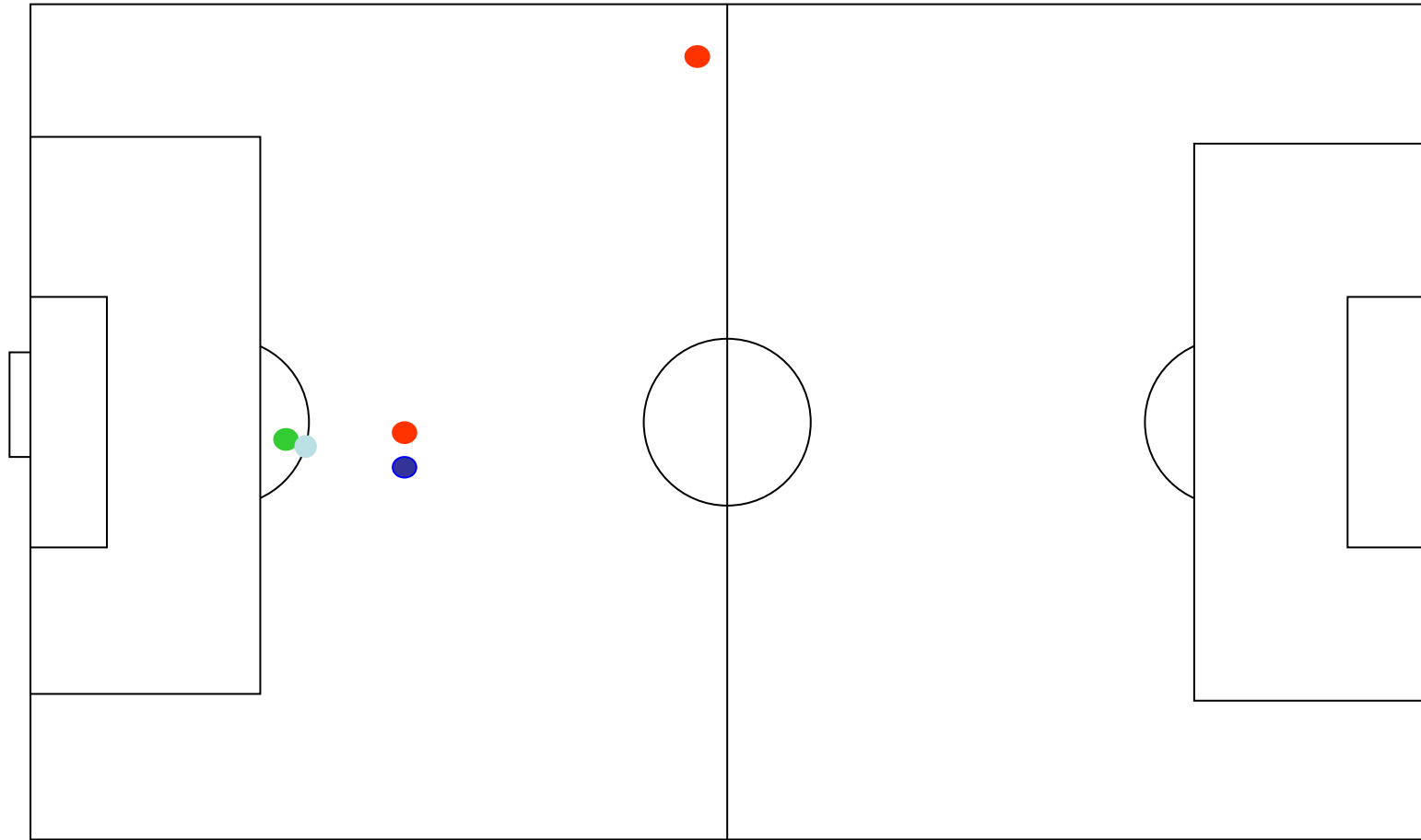
1A



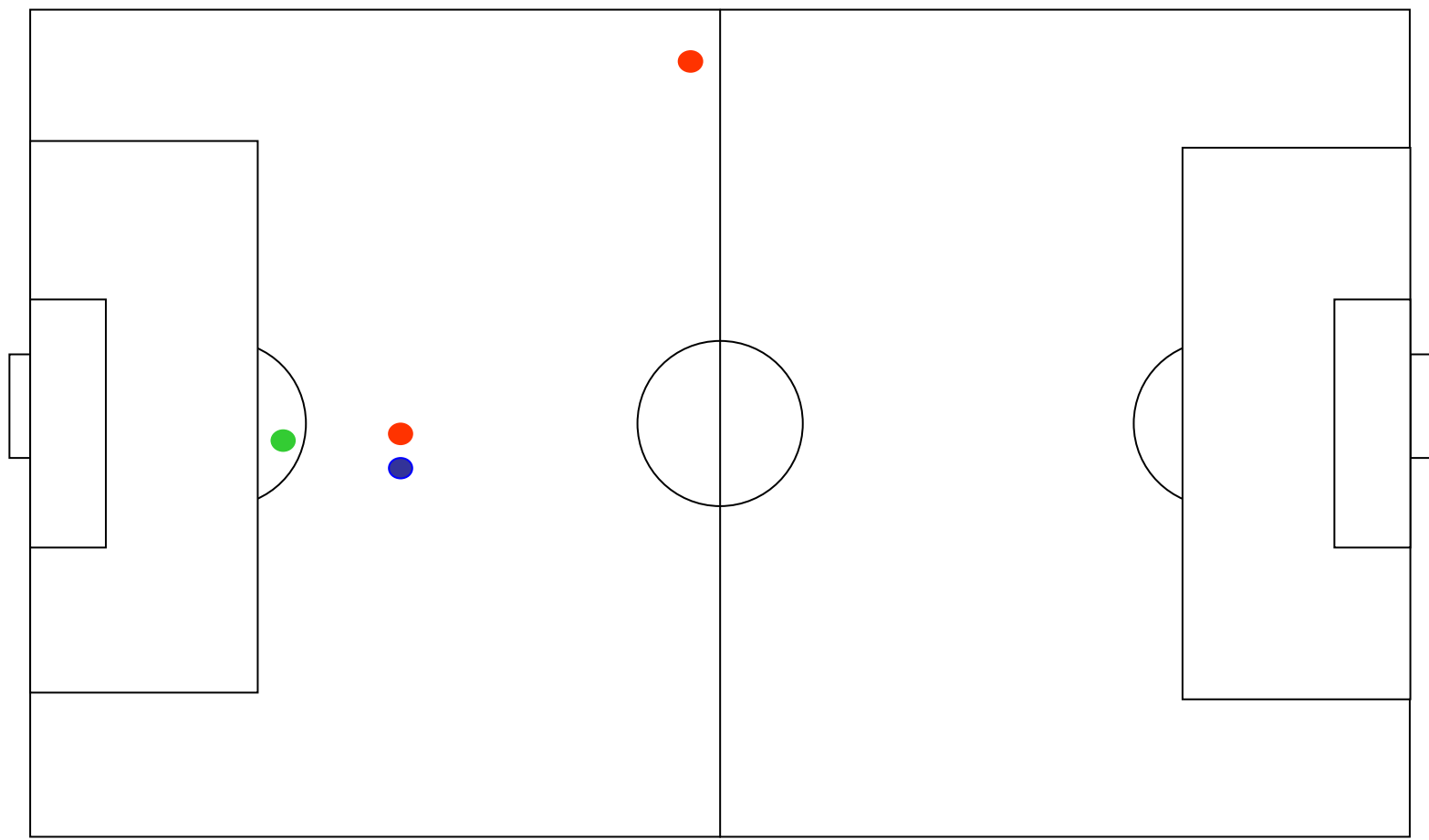
1B



1C

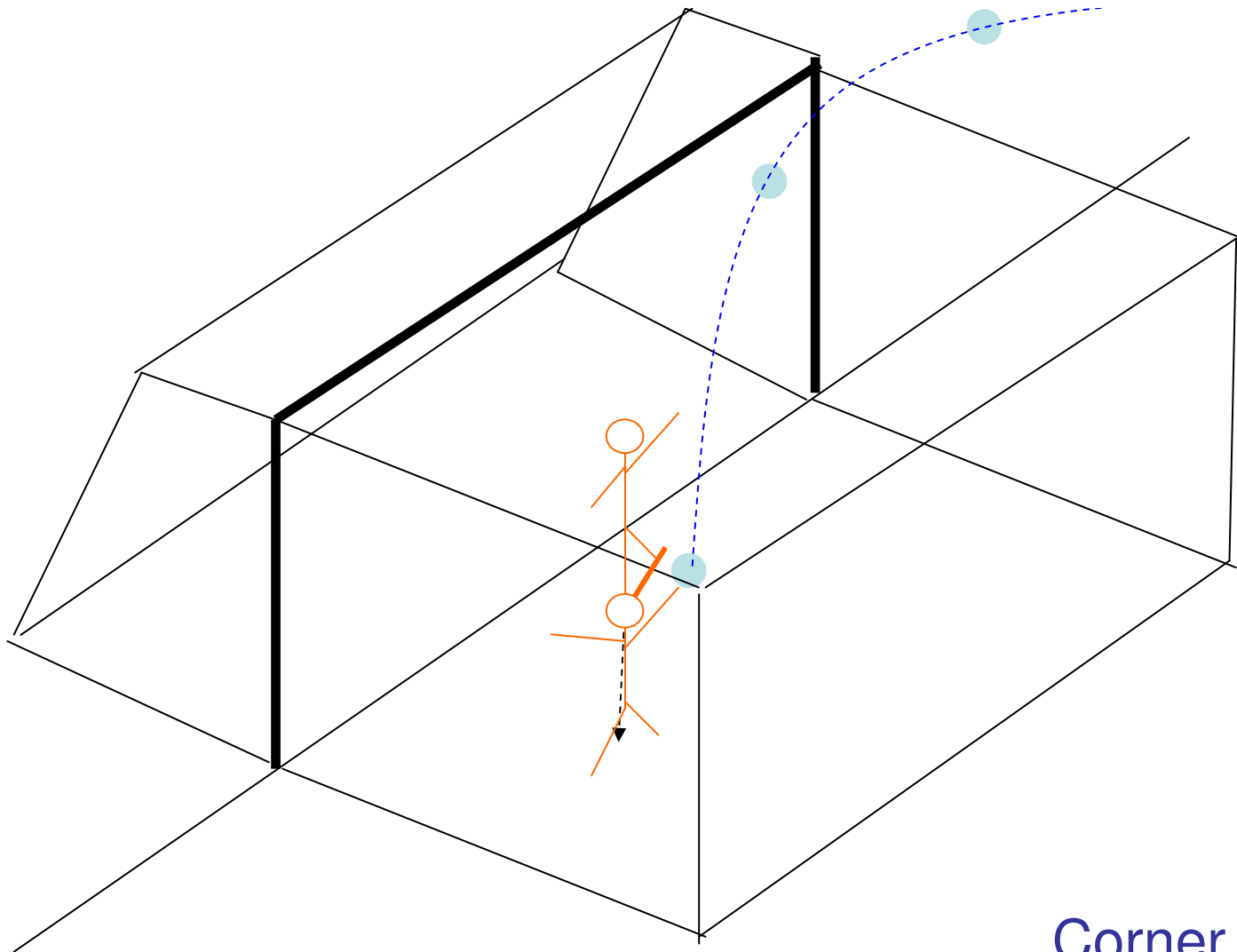


1D

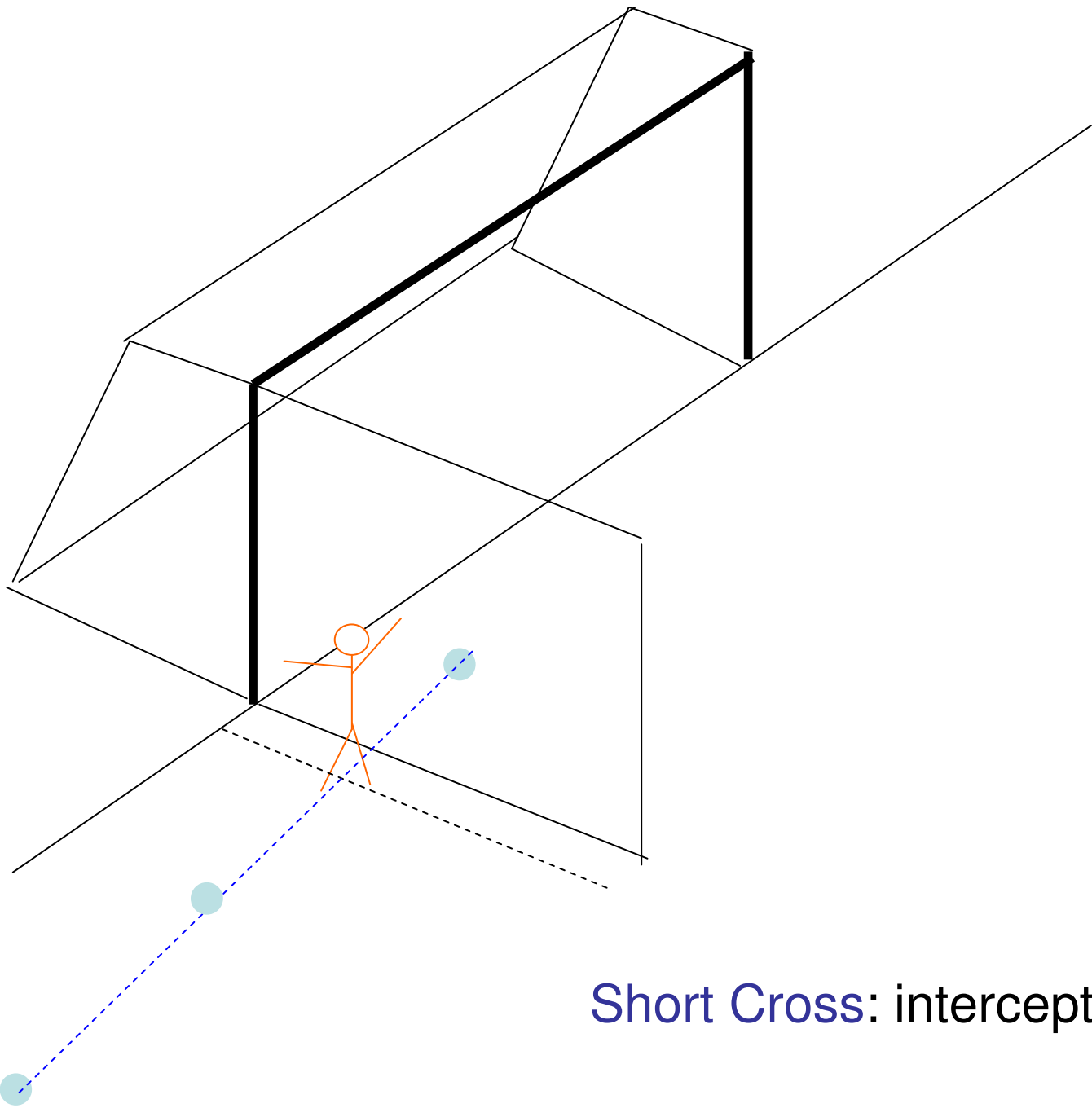


1E

Crosses



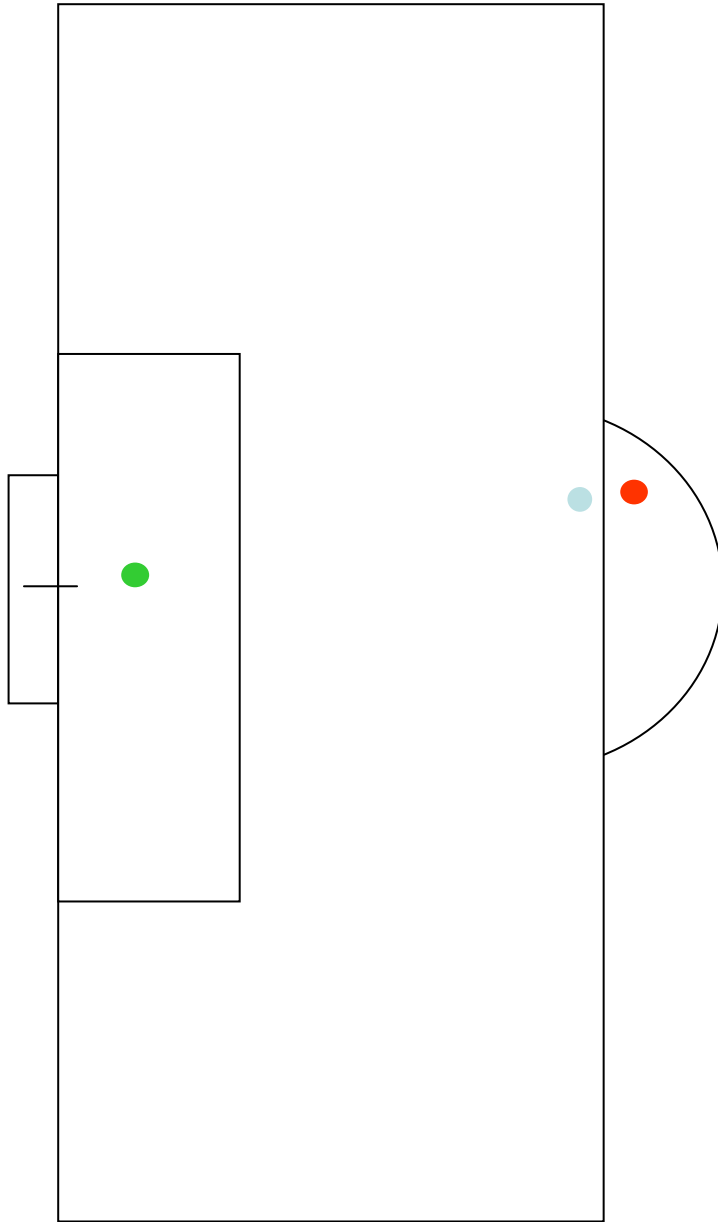
Corner



Short Cross: interception

Analysis, prediction and decision rules

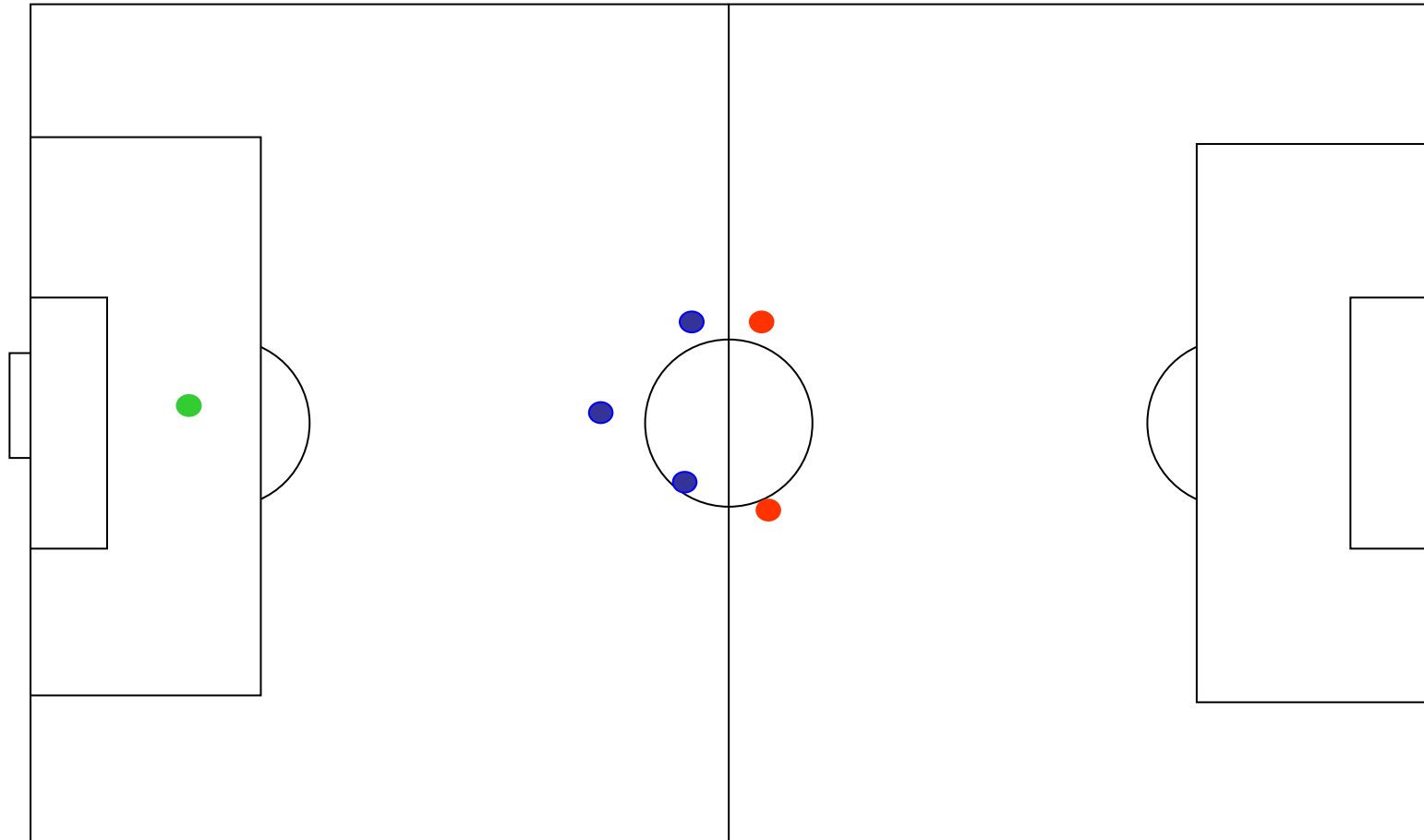
- Goal shots
- Covering
- Close and break
- Defense organization
- Ball repositions



2A

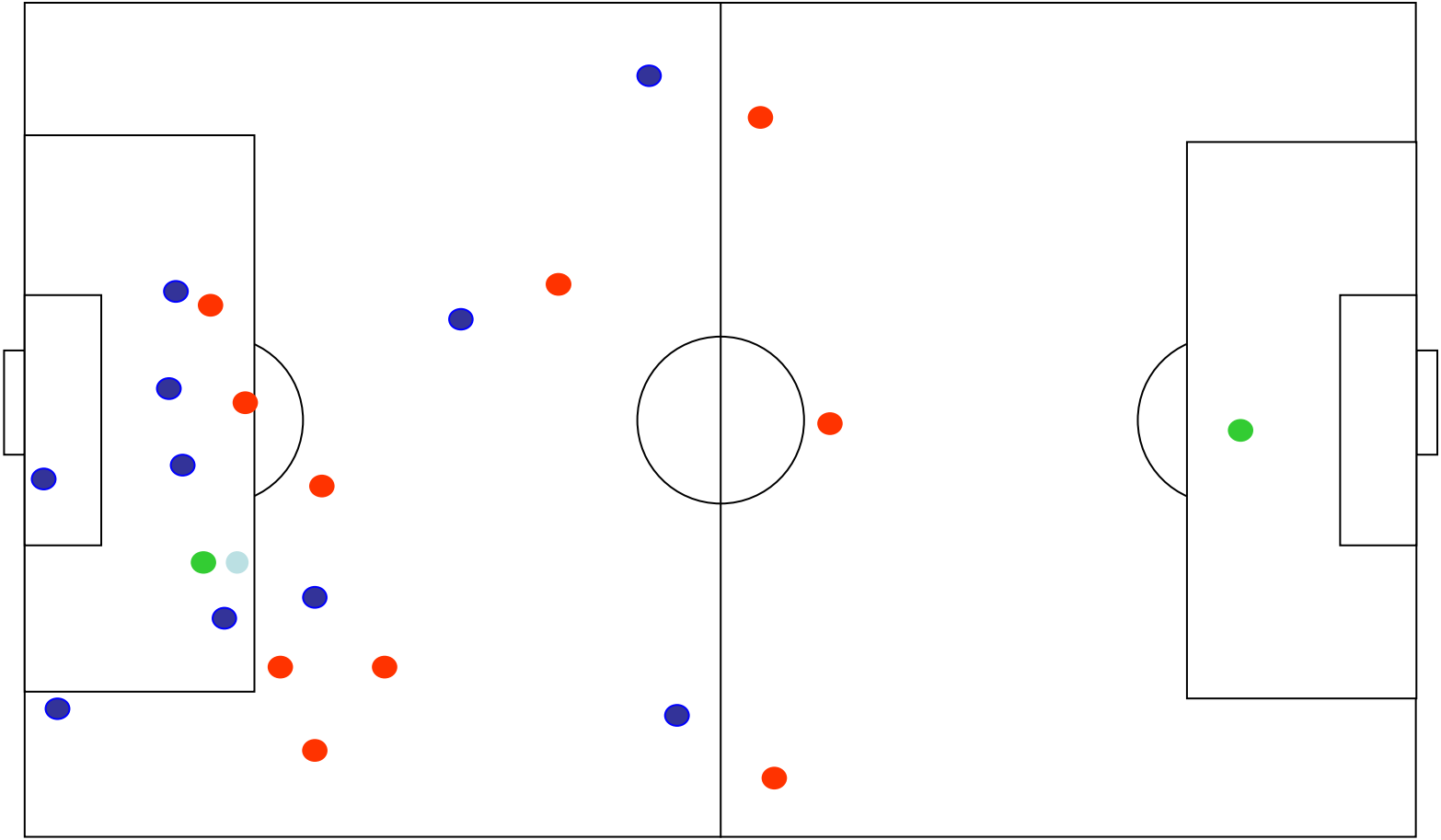
Analysis, prediction and decision rules

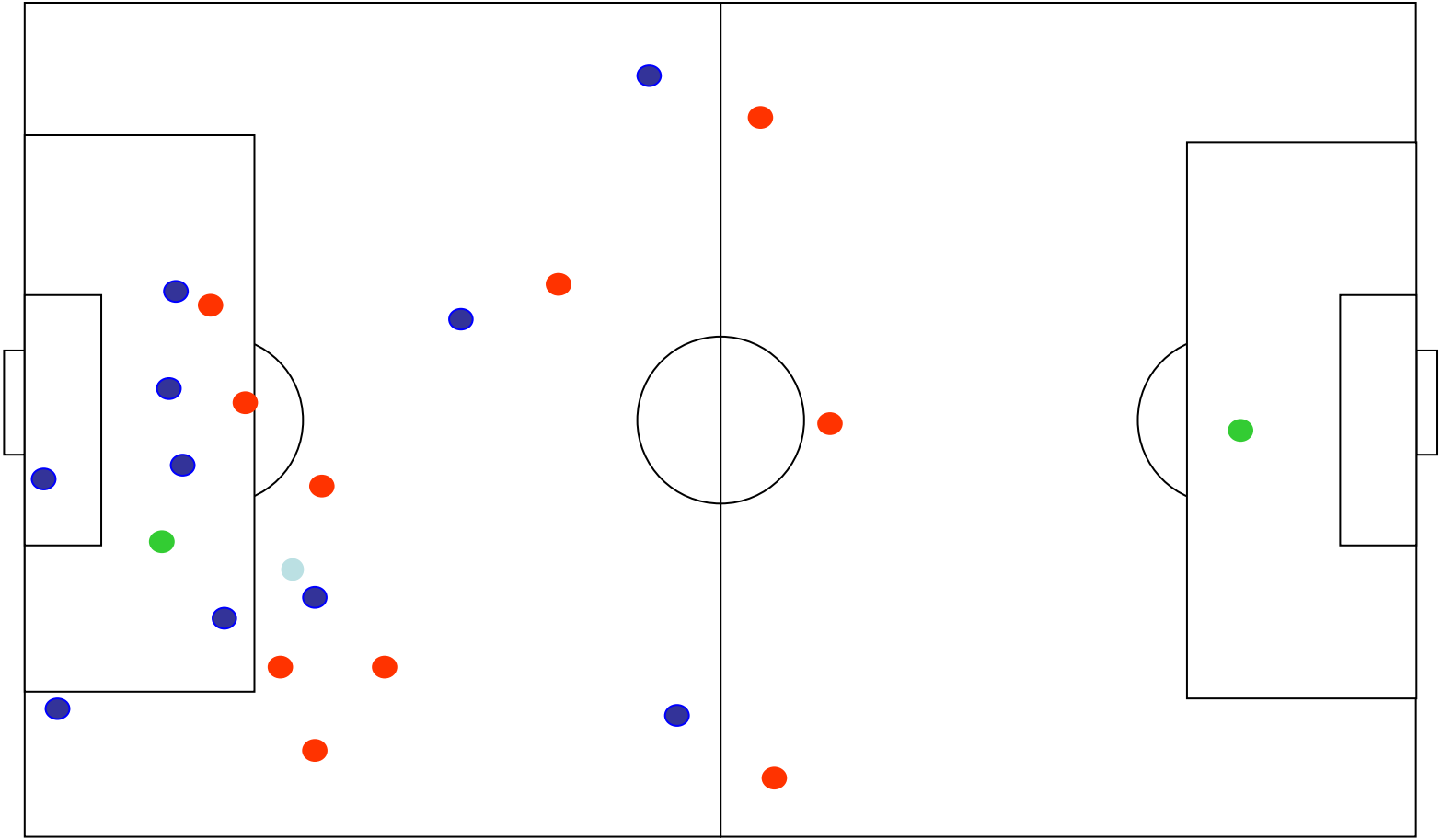
- Goal shots
- Covering
- Close and break
- Defense organization
- Ball repositions

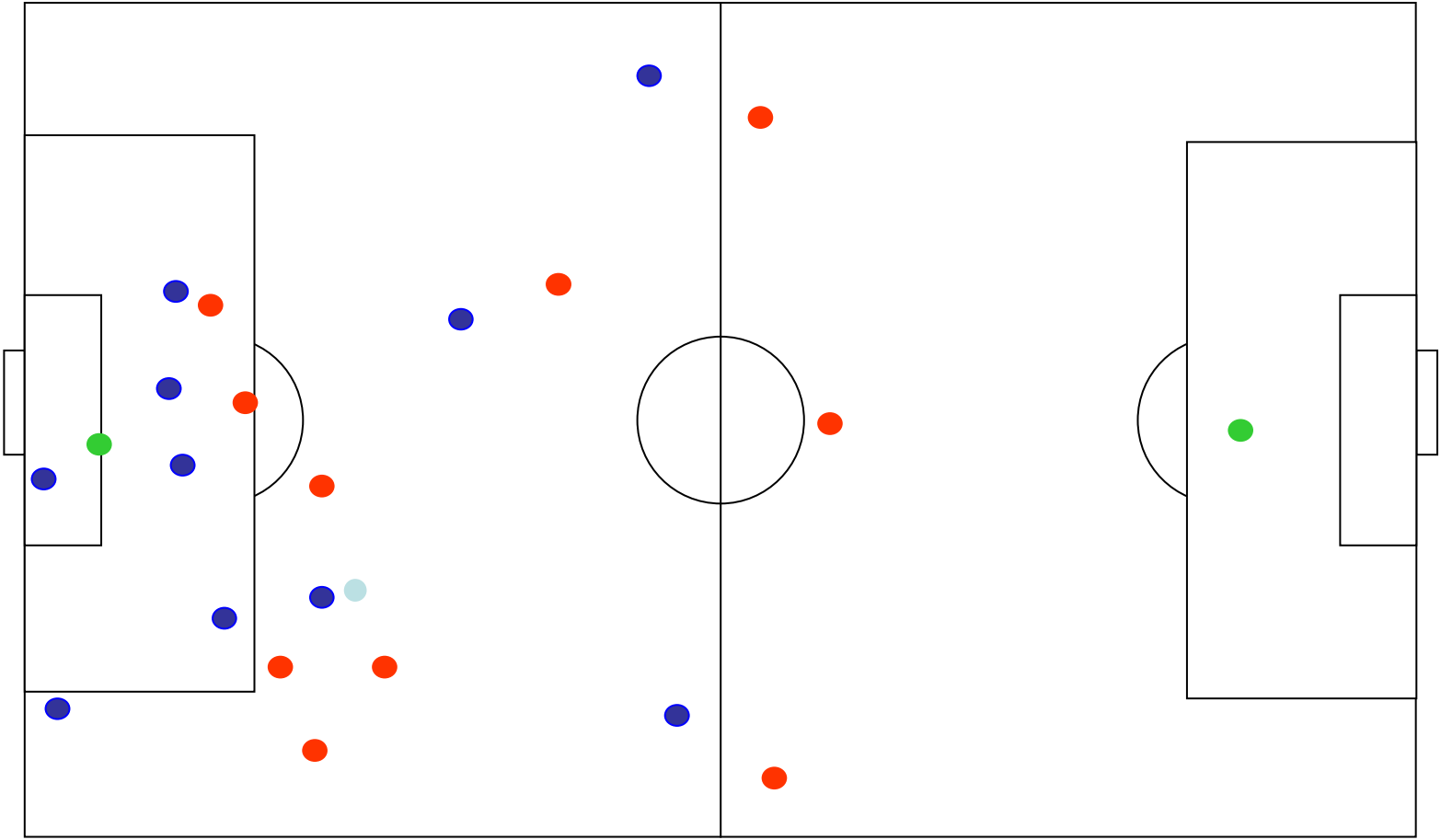


Analysis, prediction and decision rules

- Goal shots
- Covering
- Close and break
- Defense organization
- Ball repositions







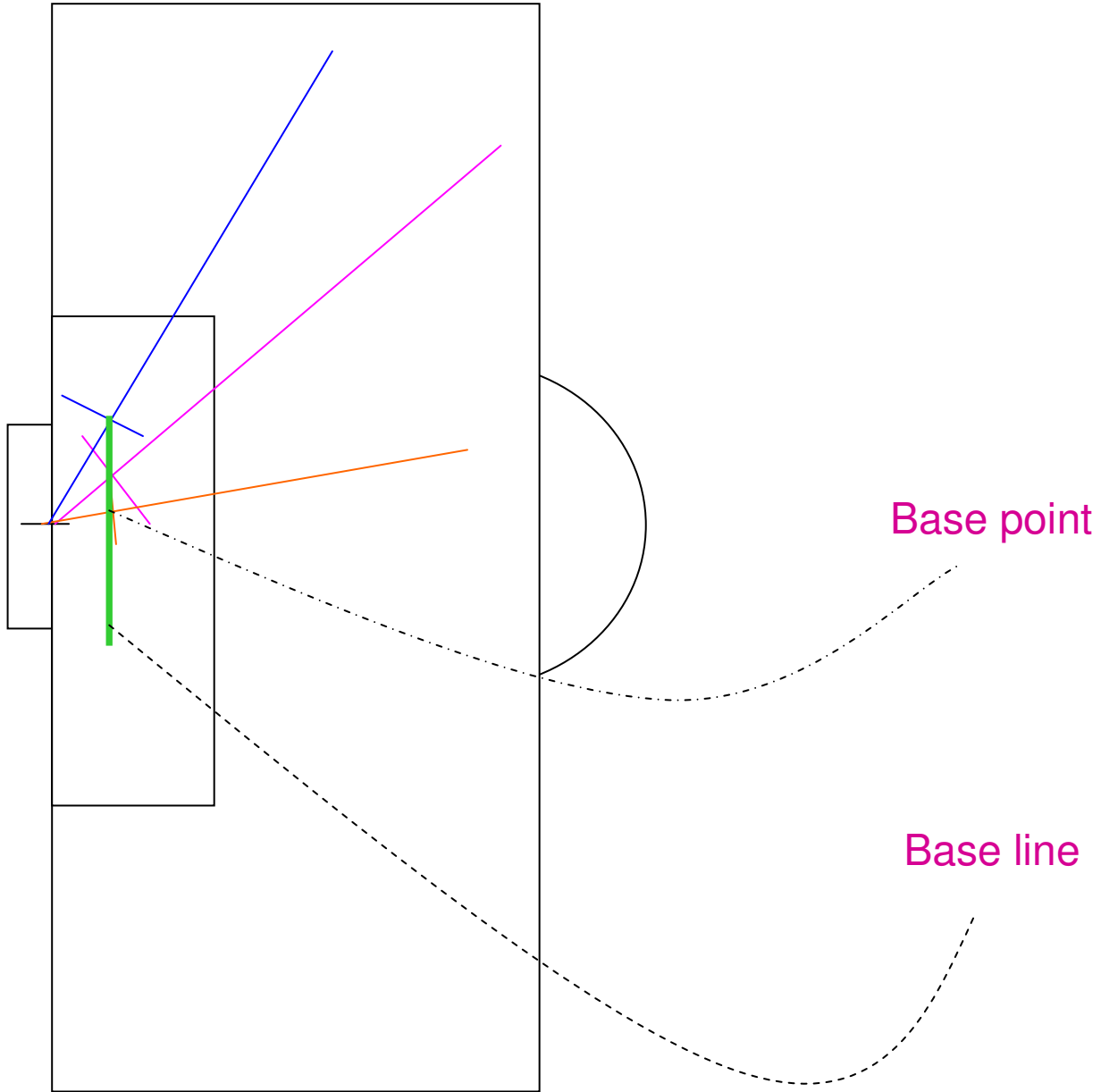
Goal keeper

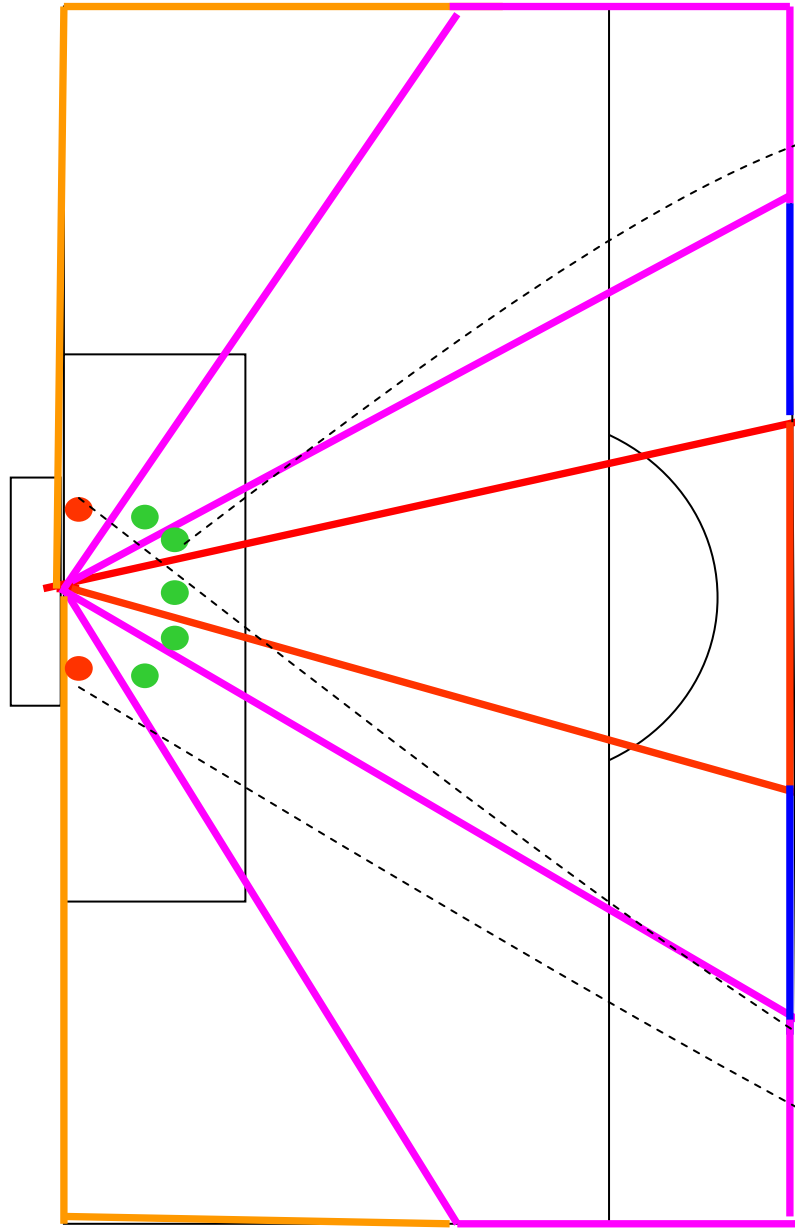
- Dictionary of actions
- Taxonomy of keeper action sequences
- Prediction and decision rules

Prediction and decision rules

- Predict the next game movements
- Choose a sequence of dictionary actions based on his prediction

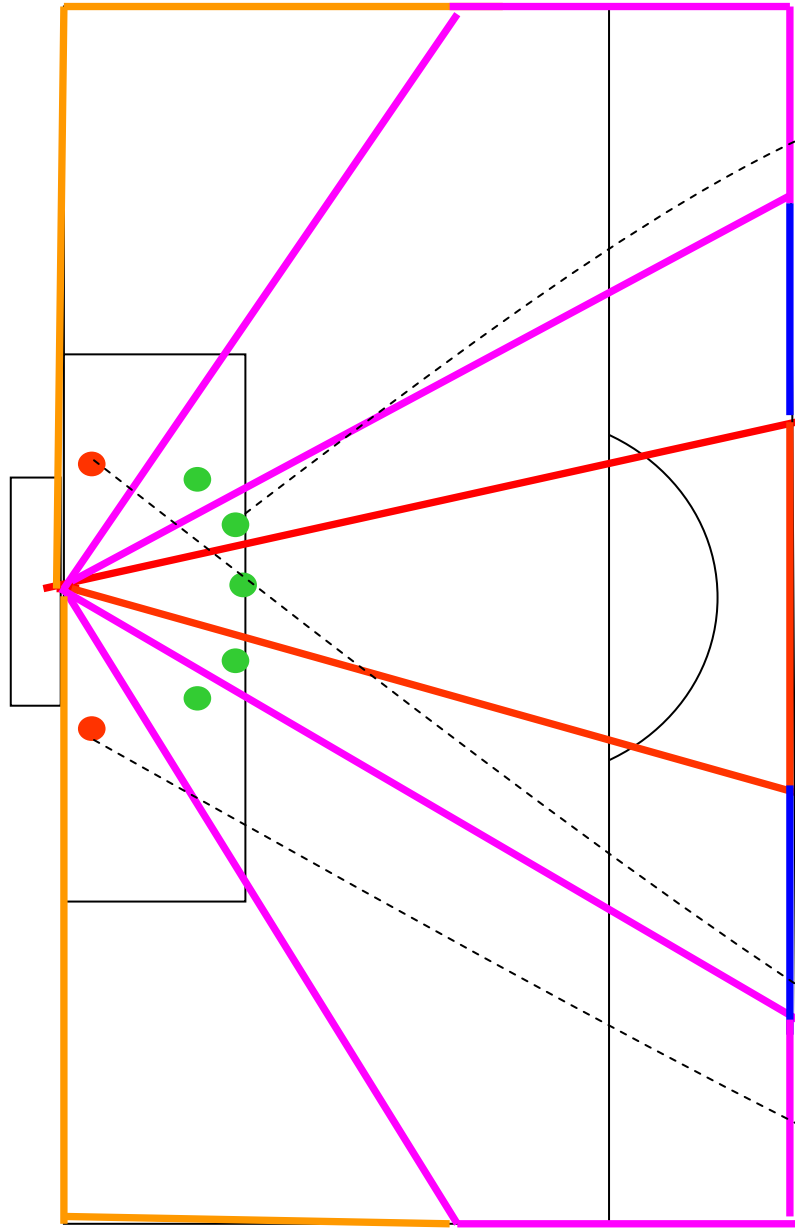
Shot positions





Low advanced points

Low lateral points



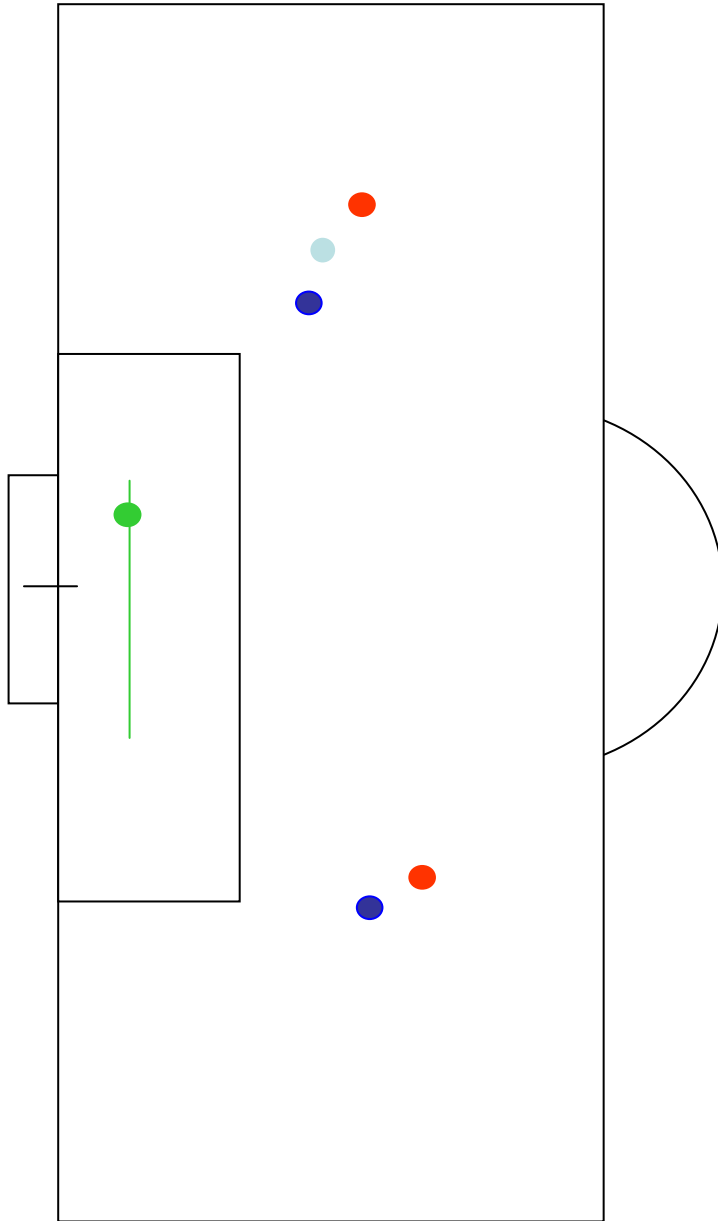
Advanced points

Lateral points

Positioning

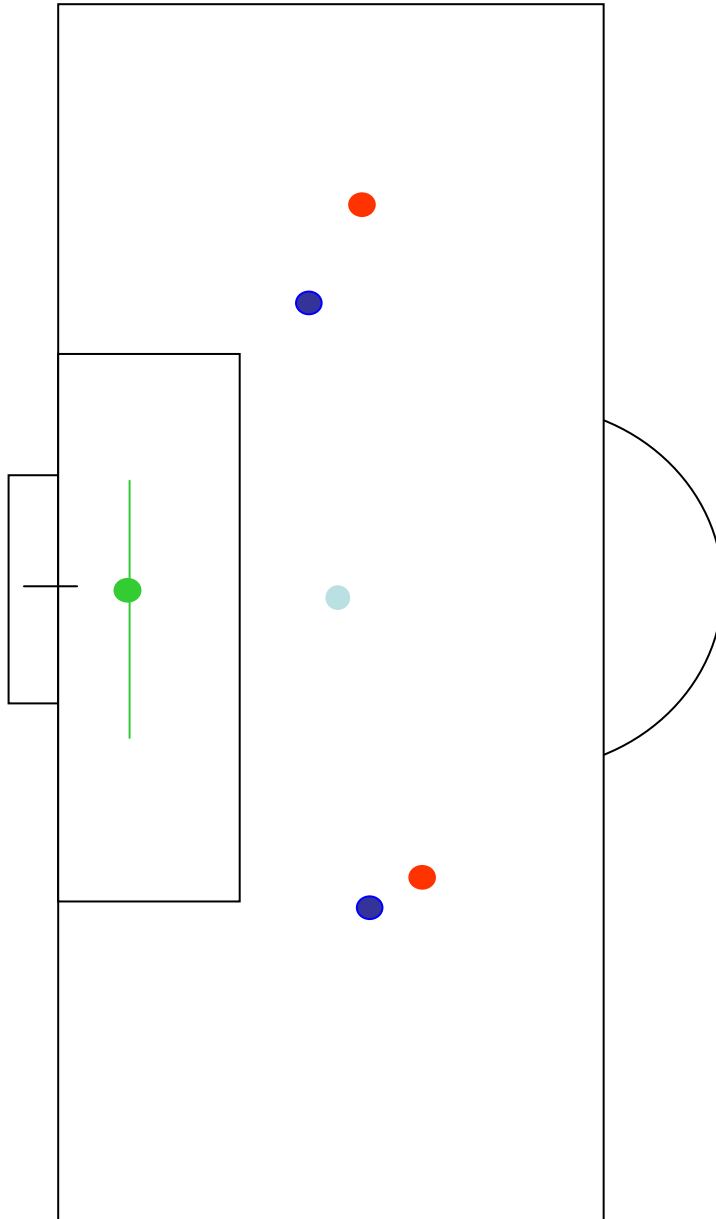
Always move to the right position before a shot

Lateral walk



1.A

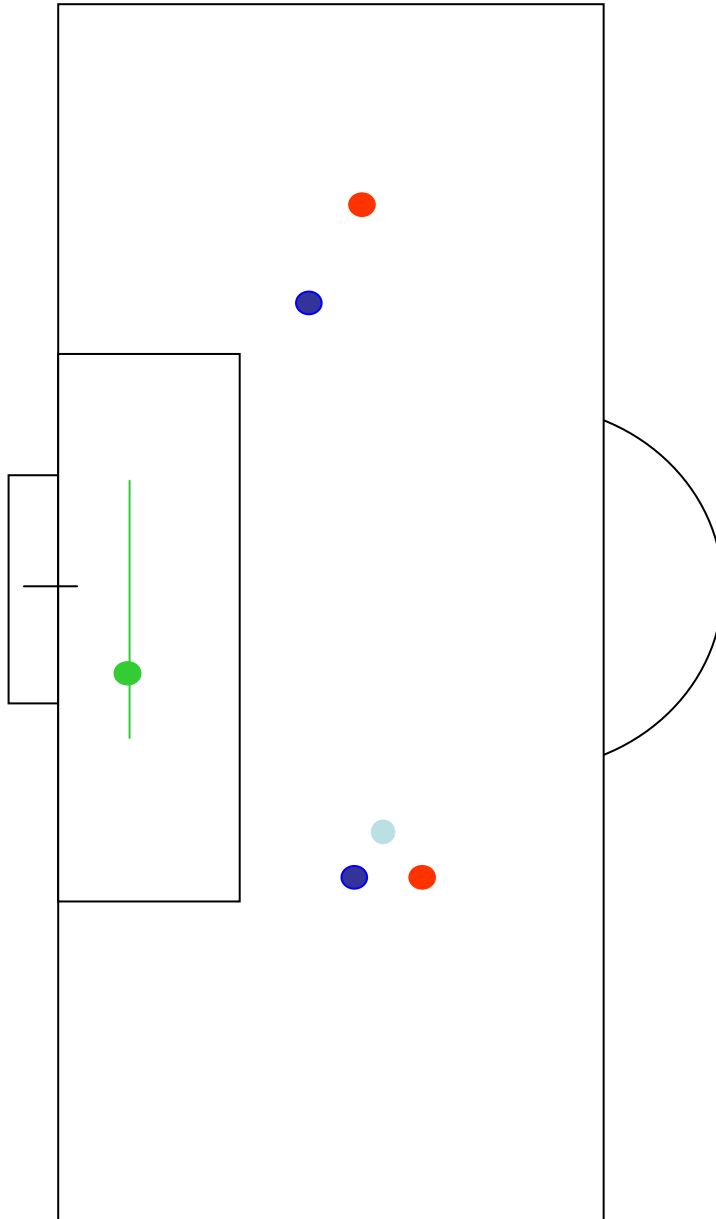
Lateral walk



- Keeper
- Defense
- Attack
- Ball

1.B

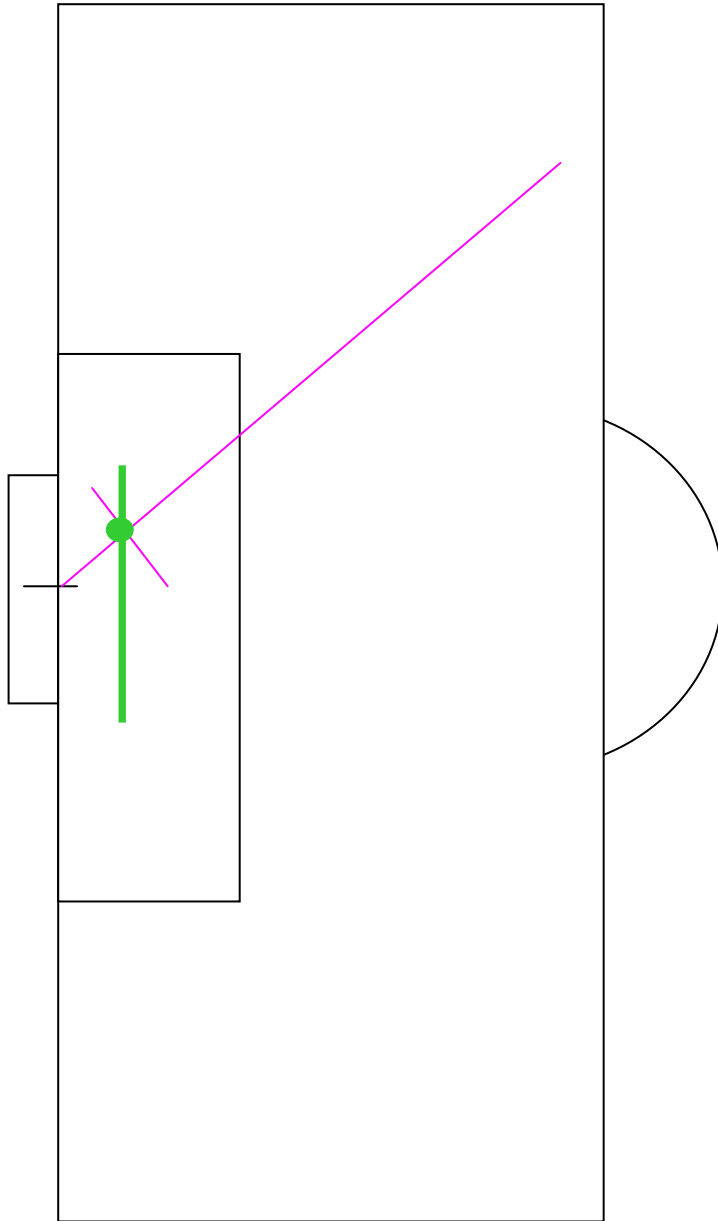
Lateral walk



- Keeper
- Defense
- Attack
- Ball

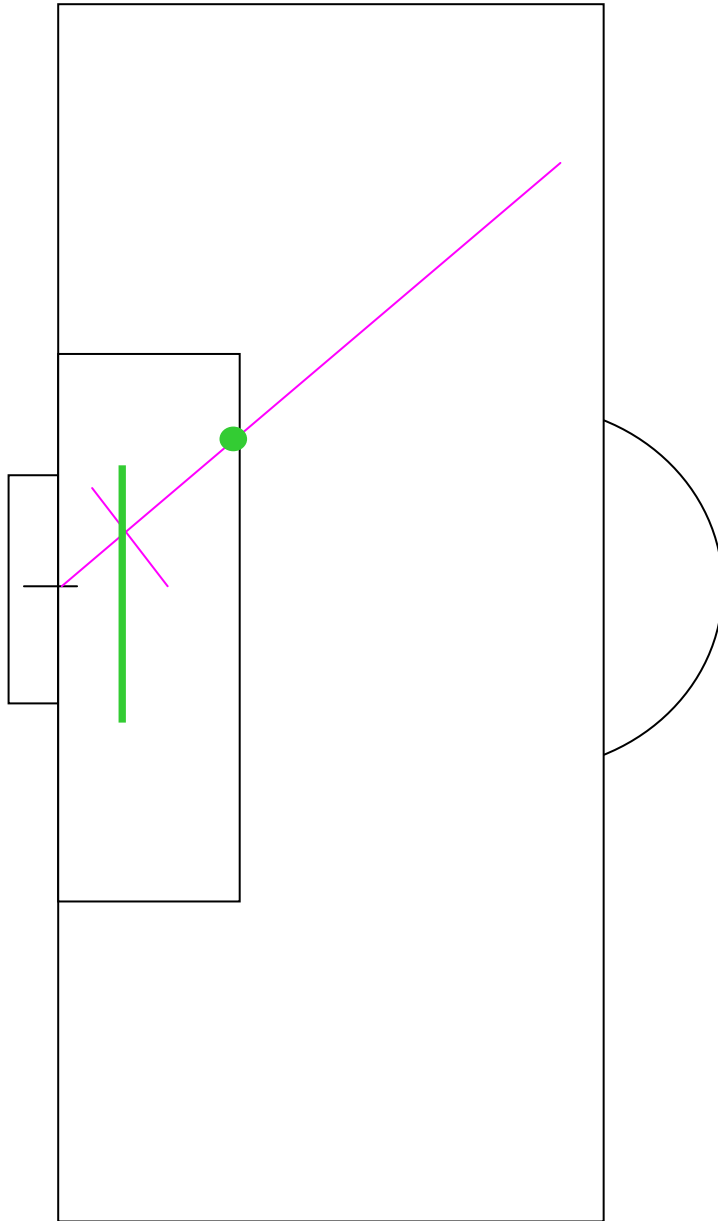
1.C

Radial walk



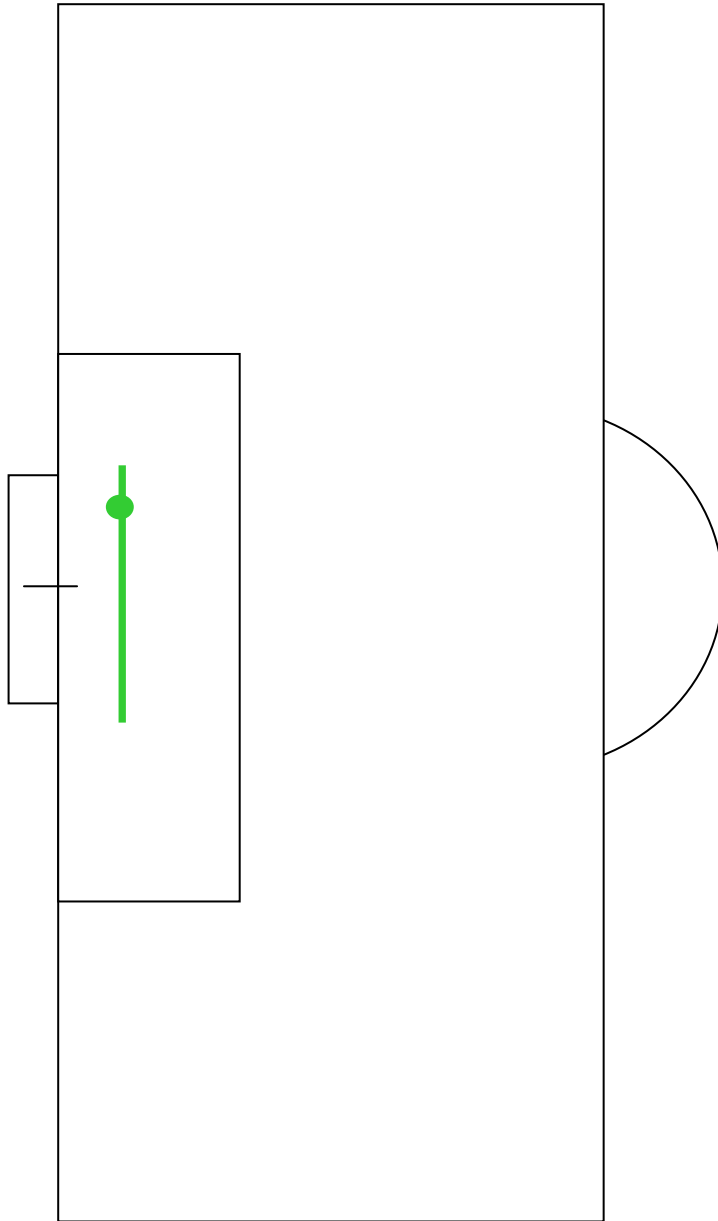
1.A

Radial walk



1.B

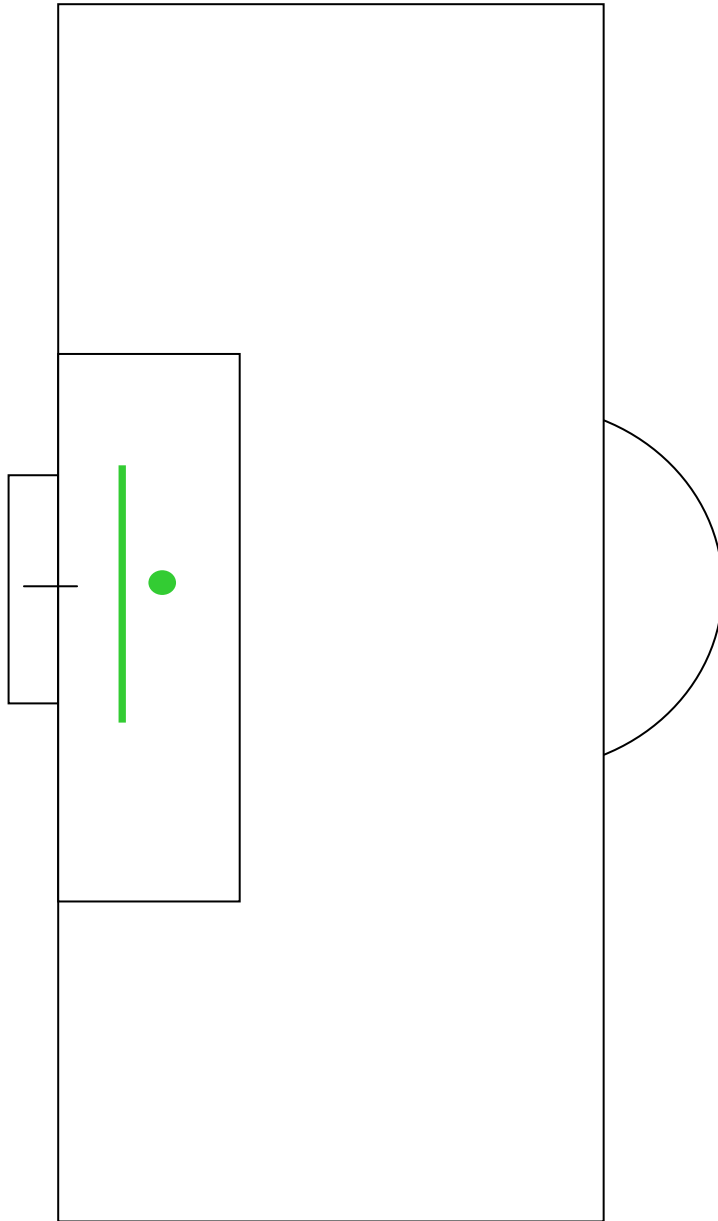
Non Radial walk



1.A

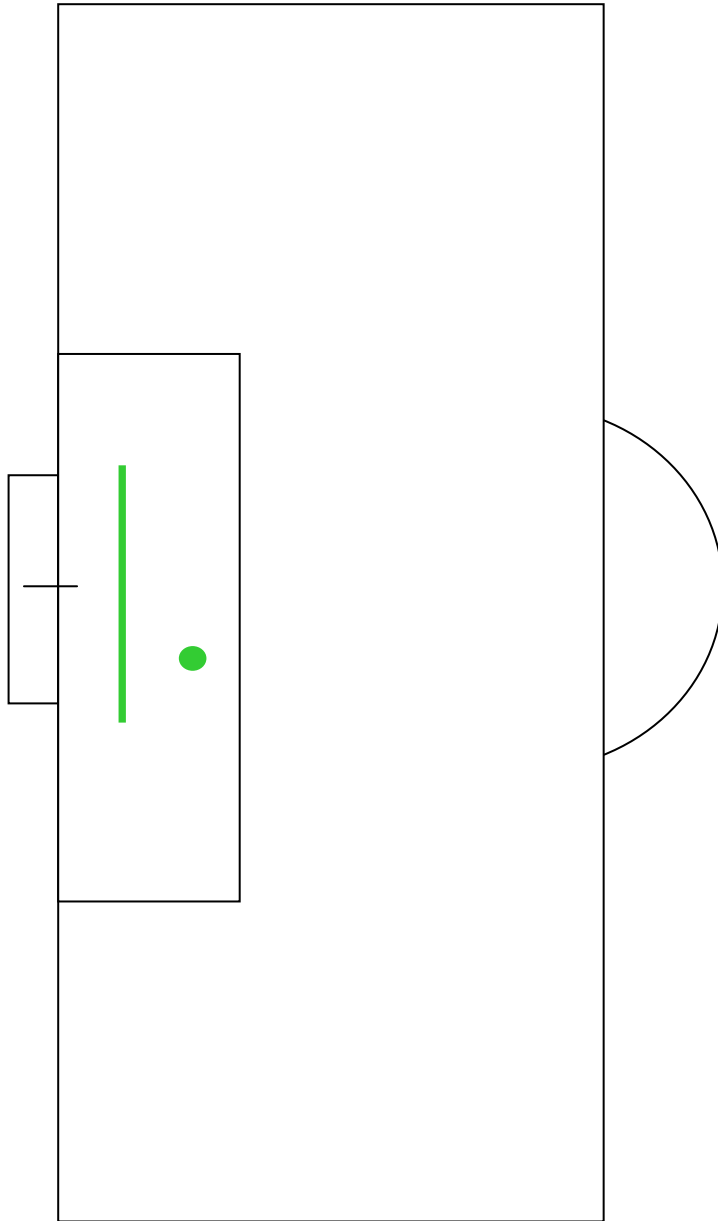
100

Non Radial walk



1.B

Non Radial walk

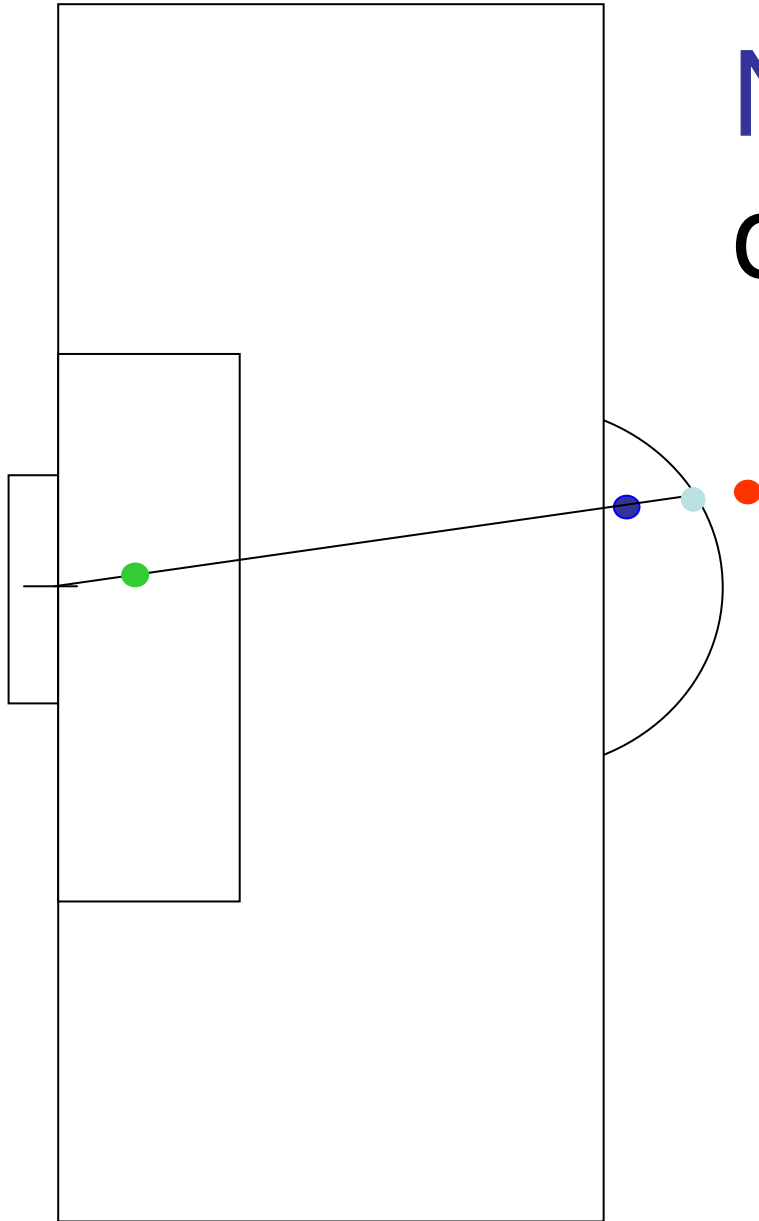


Faster, but less precise than the radial walk

1.B

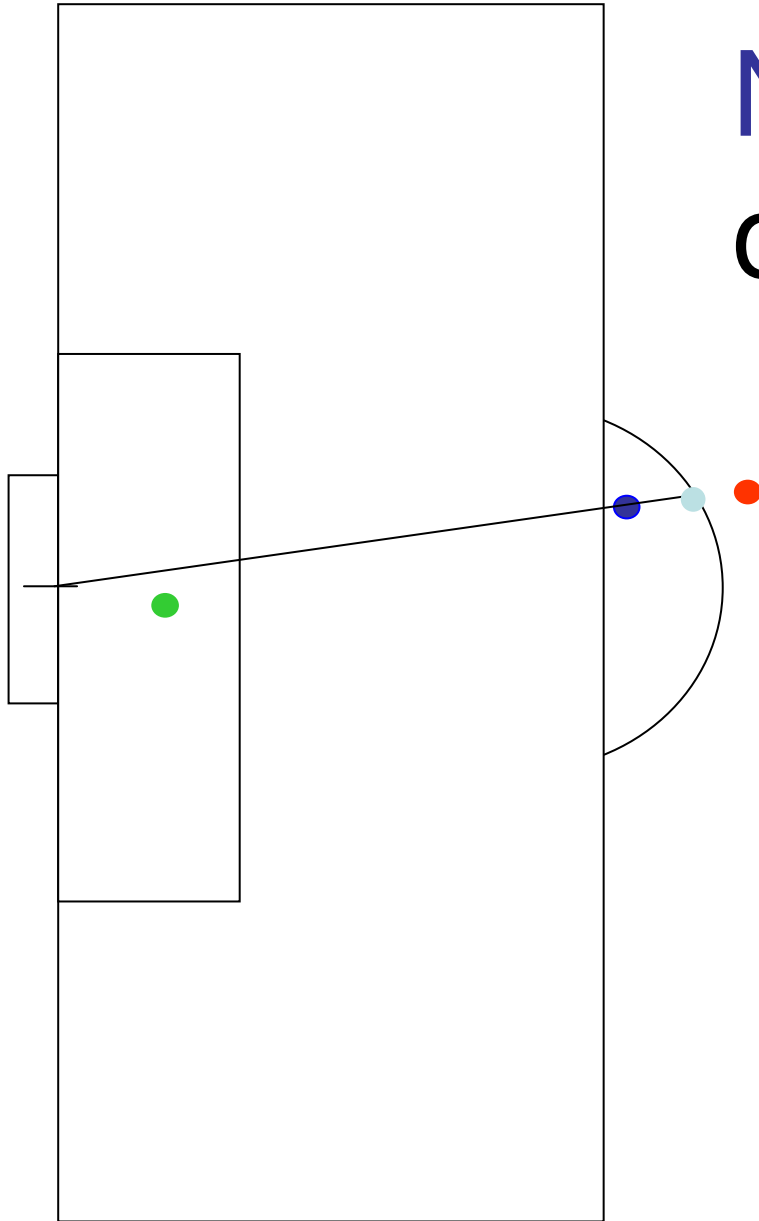
Approximate position

Non radial walk: occlusion



2A

Non radial walk: occlusion



2B

What is the right keeper position to defend a shot?

Depends on shot type

- **Straight line**
 - advance on the middle line or diagonal middle line
- **Parabolic**
 - stay on the middle line near the middle position
- **Curve**
 - stay on the middle line near the middle position

How to predict a straight line,
a parabolic, or a curve shot?

Straight Line Shots

- **Balls on the grass**
 - when the player is pressed
 - most common, because it requires less ability
 - in case of doubt, it should be your choice
- **Kicking balls**
 - when the foot does not make an up movement

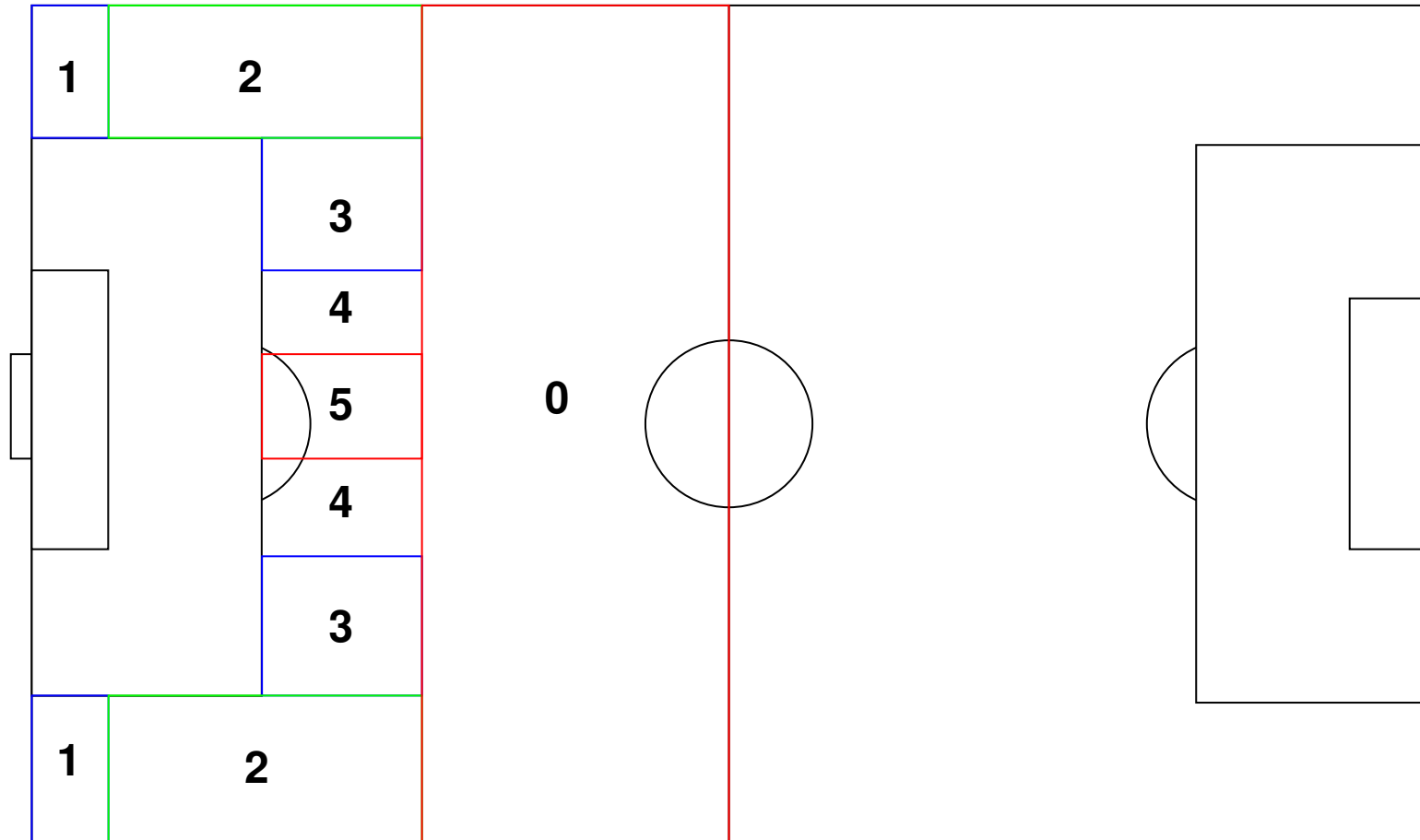
Parabolic Shots

- **Balls on the grass**
 - when the player is not pressed
 - it requires some ability
 - knowledge about the player would help
- **Kicking balls**
 - when foot makes an up movement
 - the most common shot

Curve Shots

- **Balls on the grass**
 - when the player is not pressed
 - requires a lot of ability
 - knowledge about the player would help
- **Kicking balls**
 - only in occasional shots

Faults

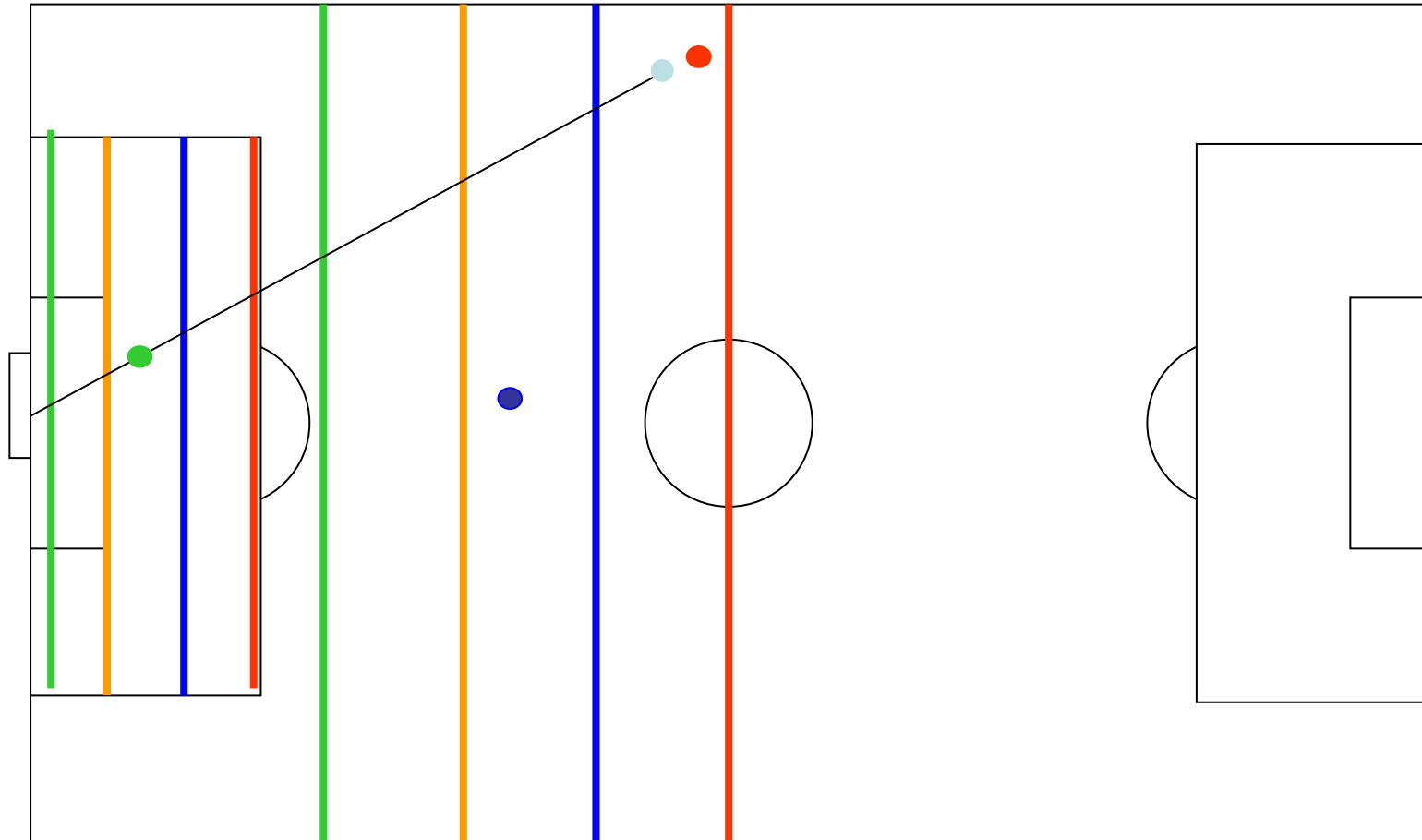


Men in the defenders line and shot angle

Diagonal Faults

- Balls above defenders line
 - left lateral movement
- Parabolic balls beside defenders line
 - right lateral movement
- Straight line balls beside defenders line
 - diagonal movement

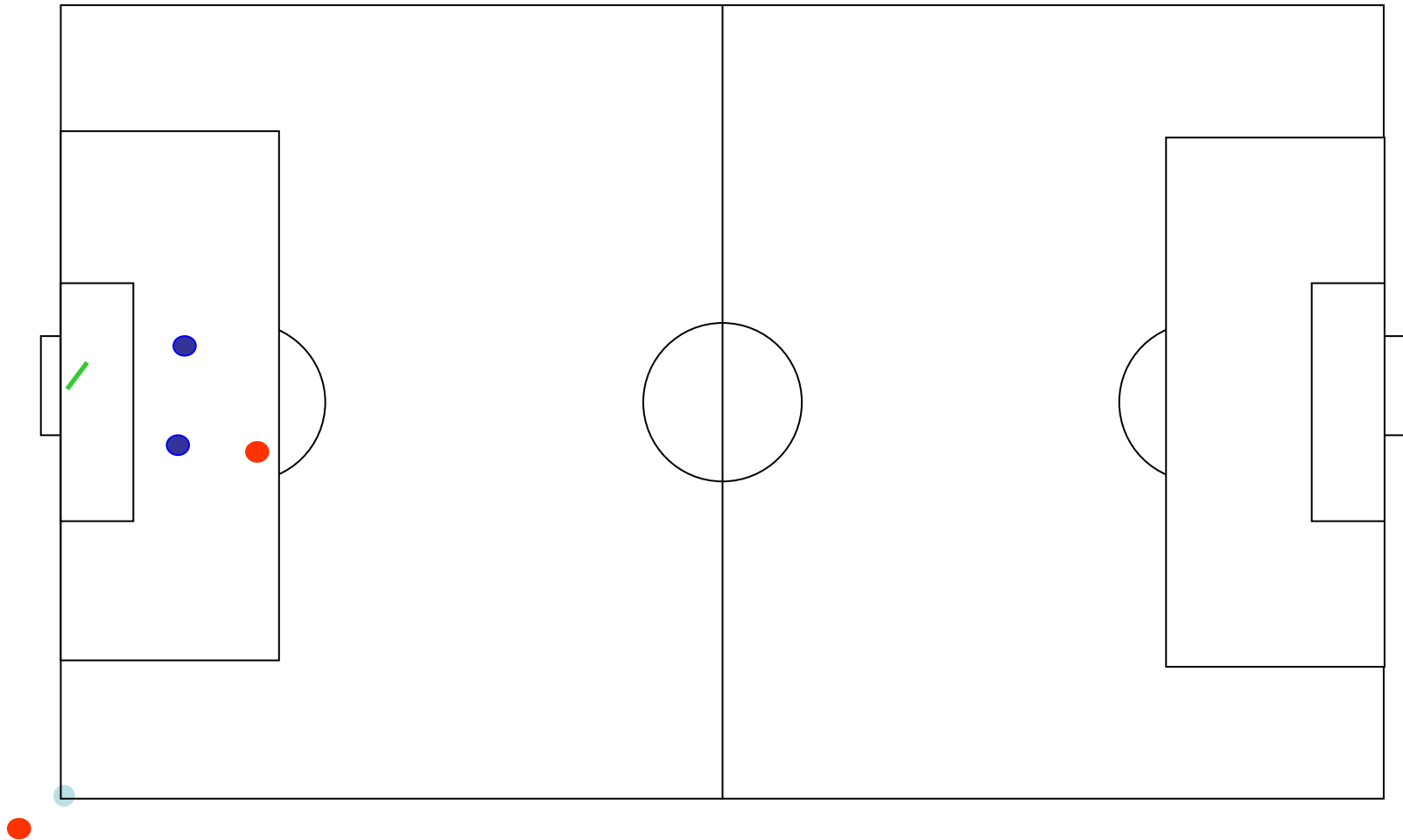
Defending back attacks



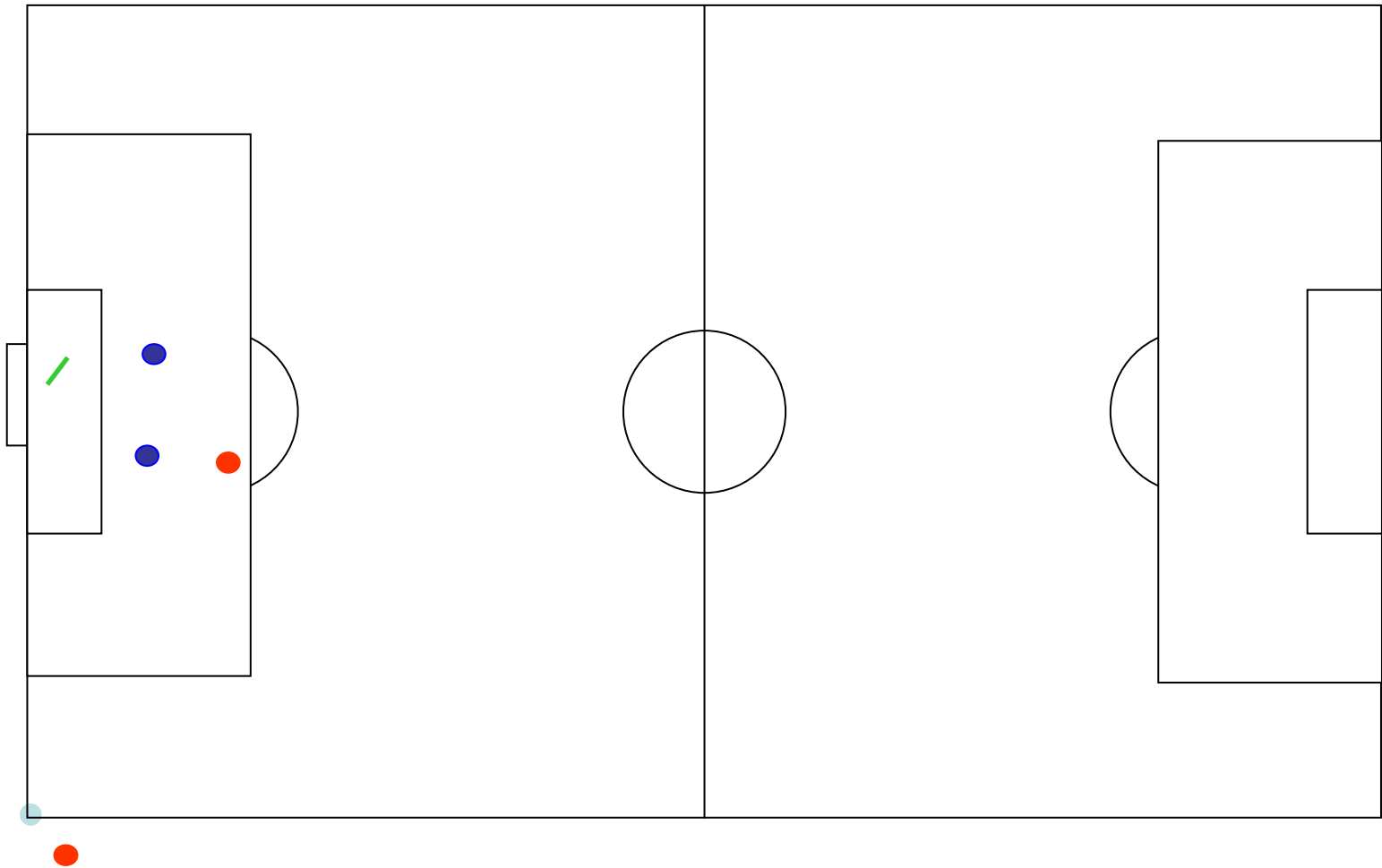
Basic cover position

Crosses

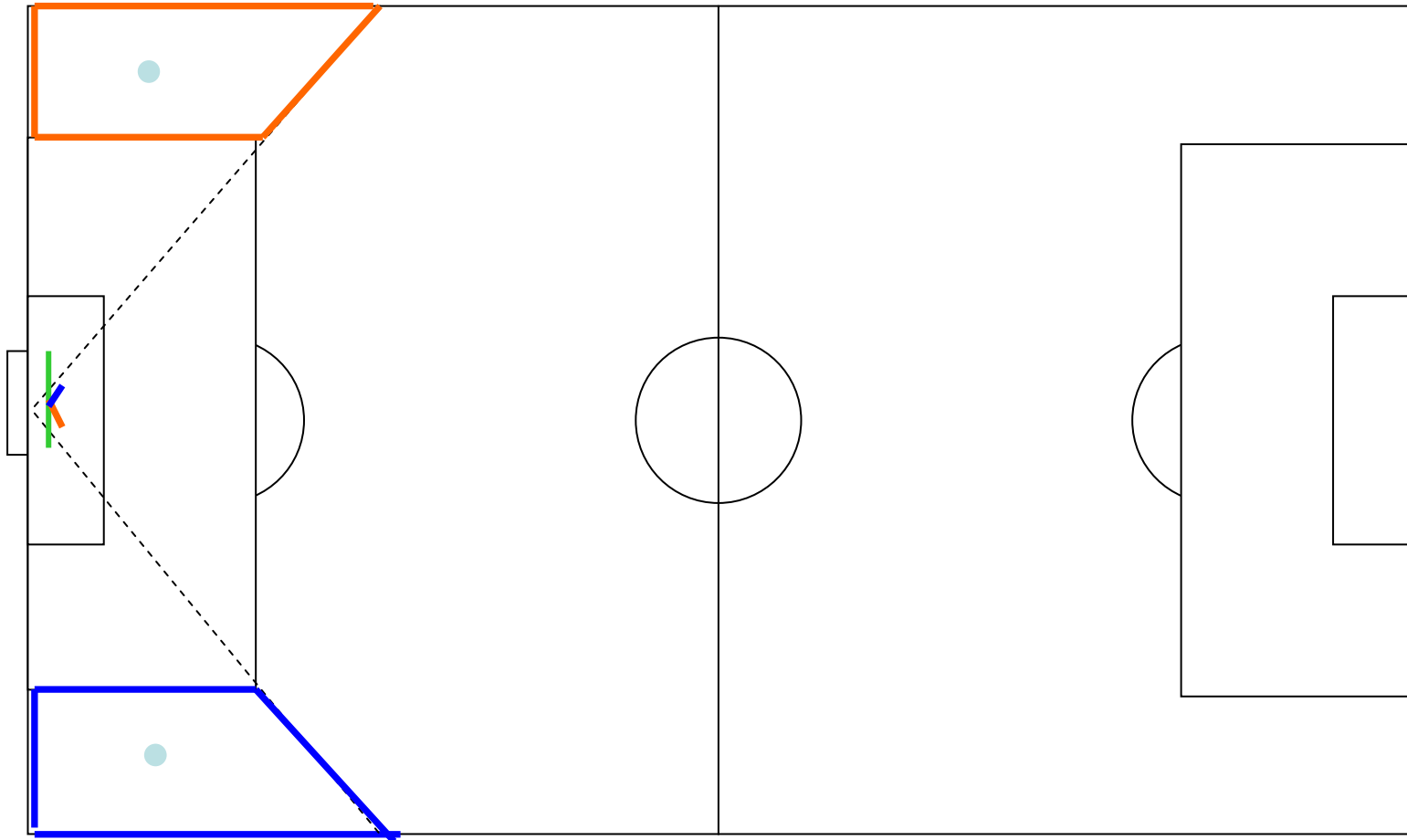
Corner: closed cross



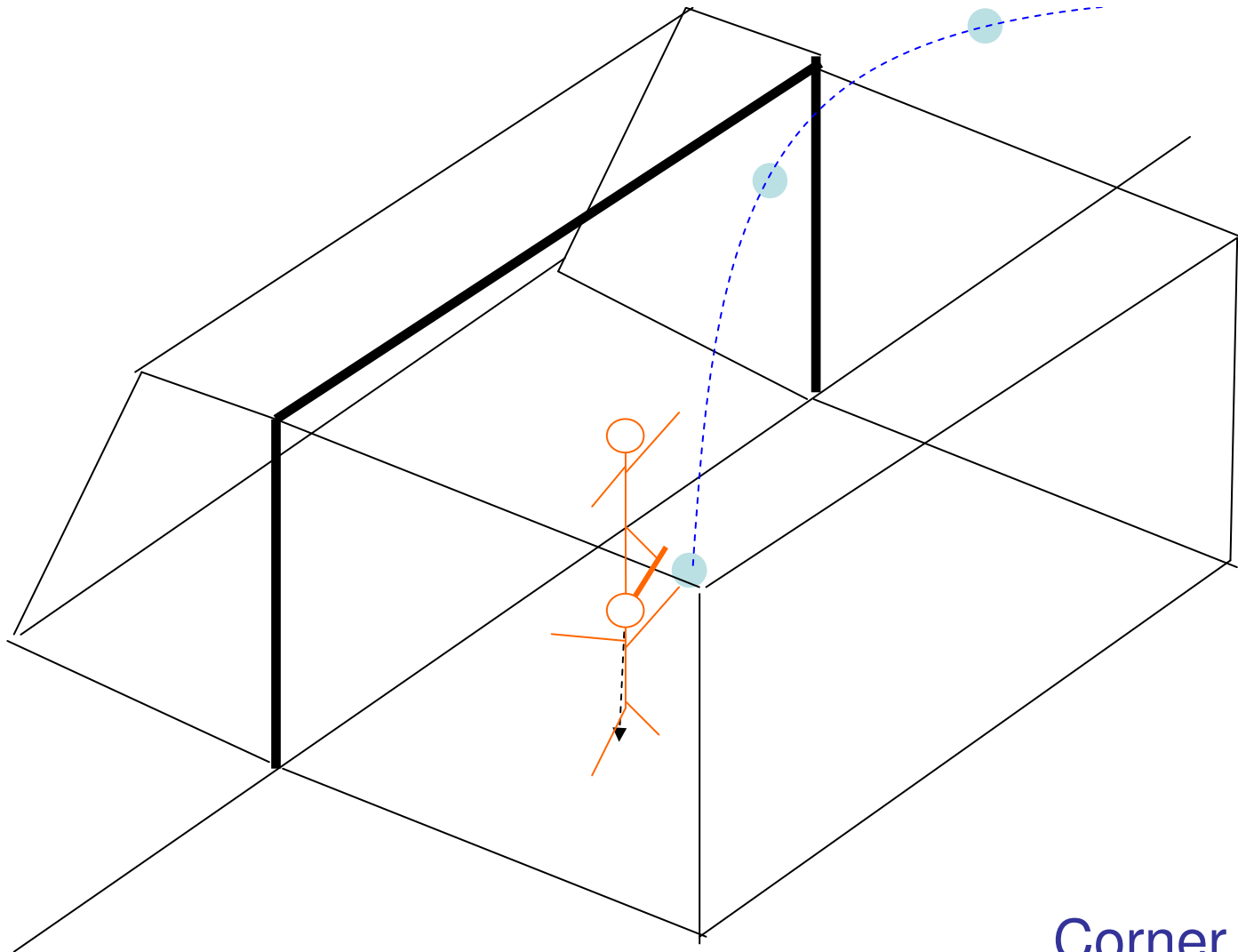
Corner: opened cross



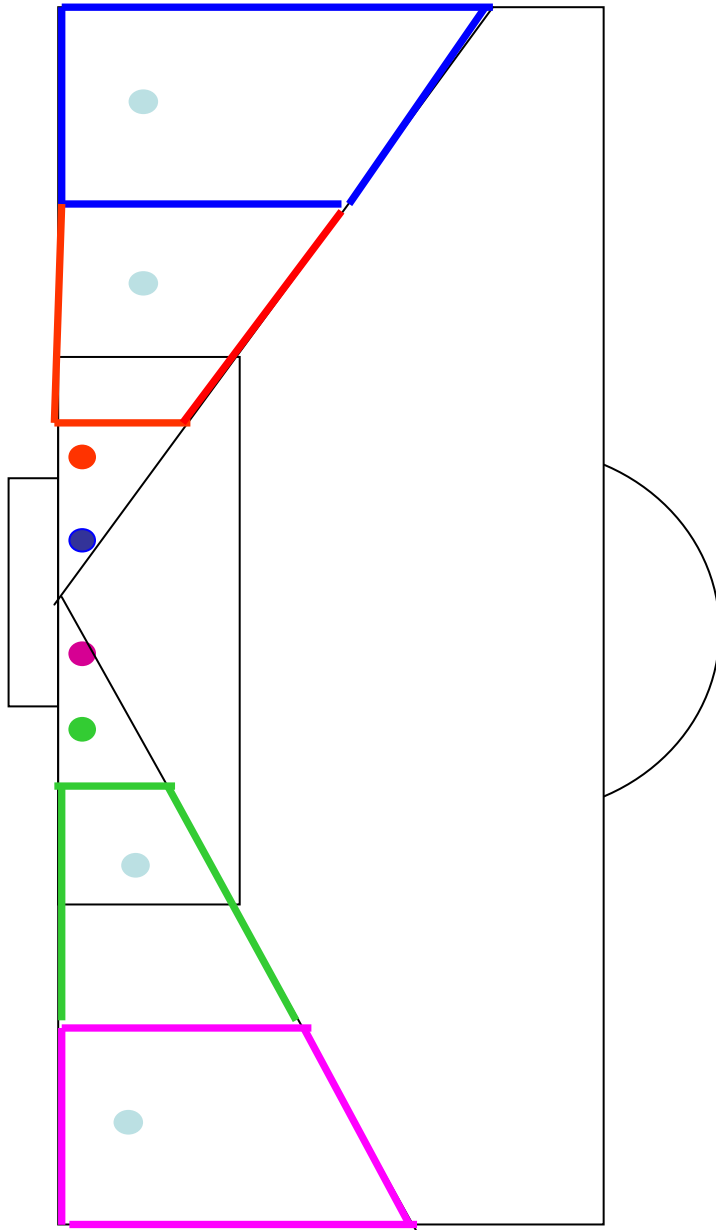
Long Cross



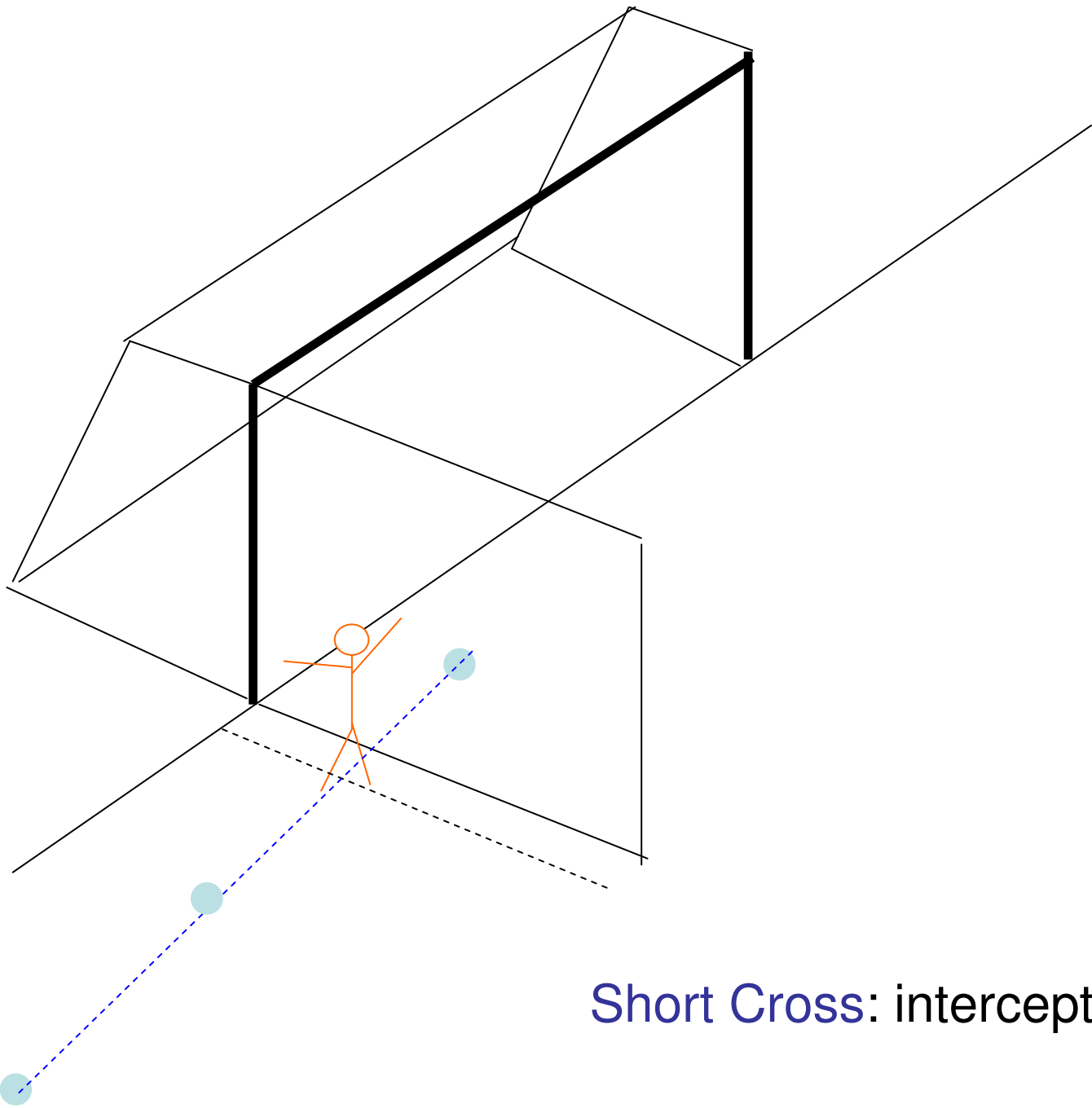
Same position and movement of corners



Corner

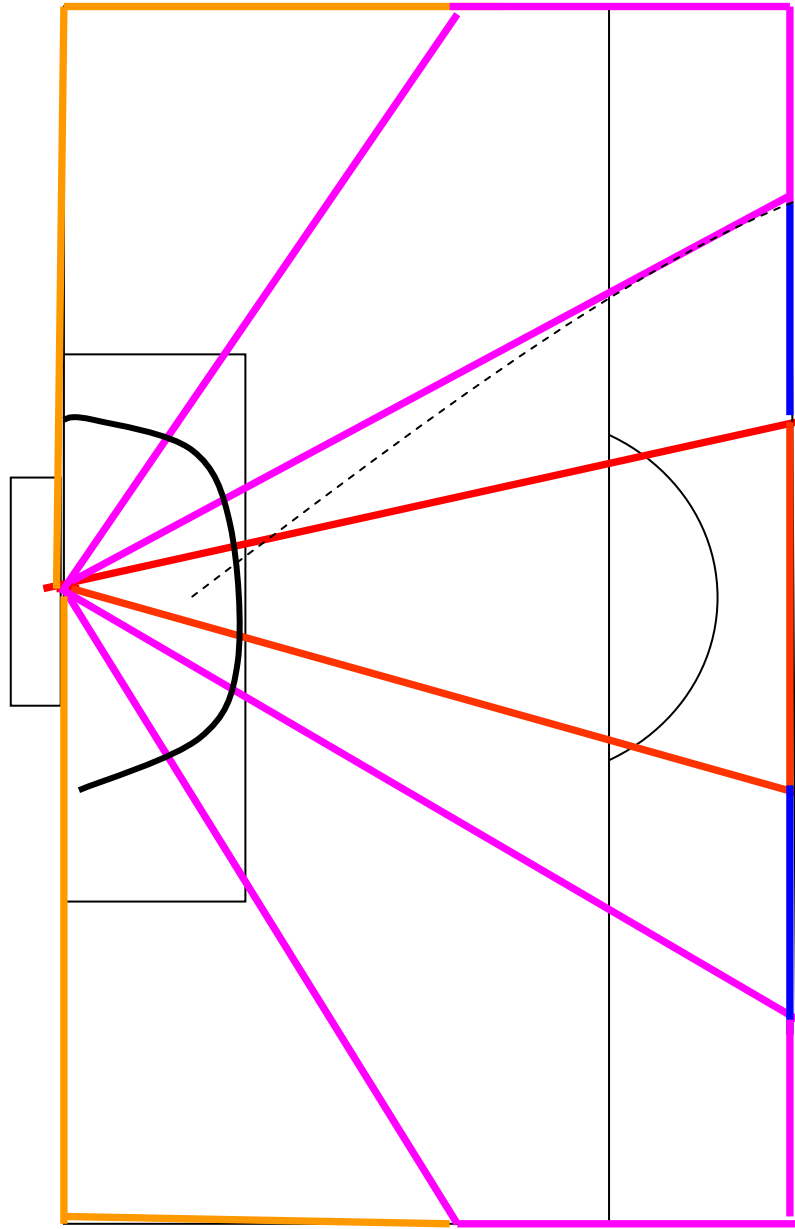


Short Cross

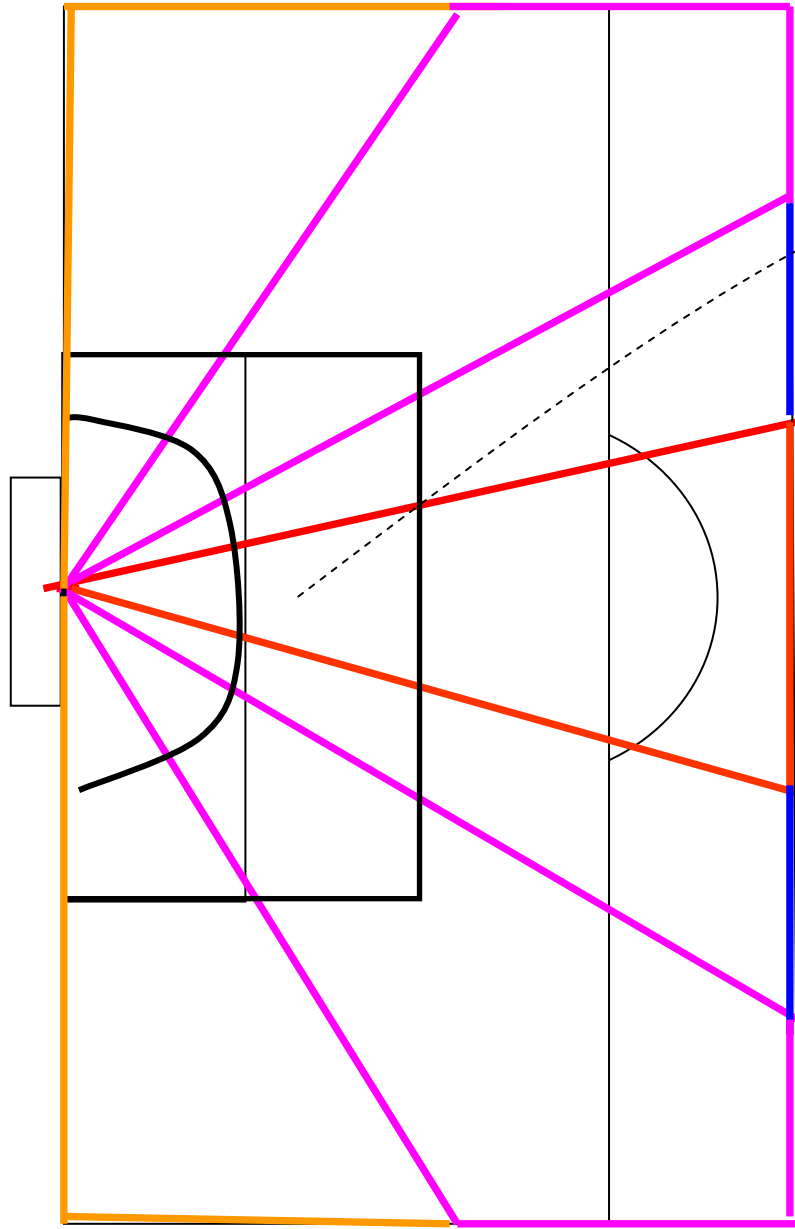


Short Cross: interception

Close and break



Unconditional
close zone



Conditional
close zone

Close

- Player in the unconditional close zone
 - always make a close
- Player in the conditional close zone
 - close just if there is a single adversary
 - pay attention with kicking balls

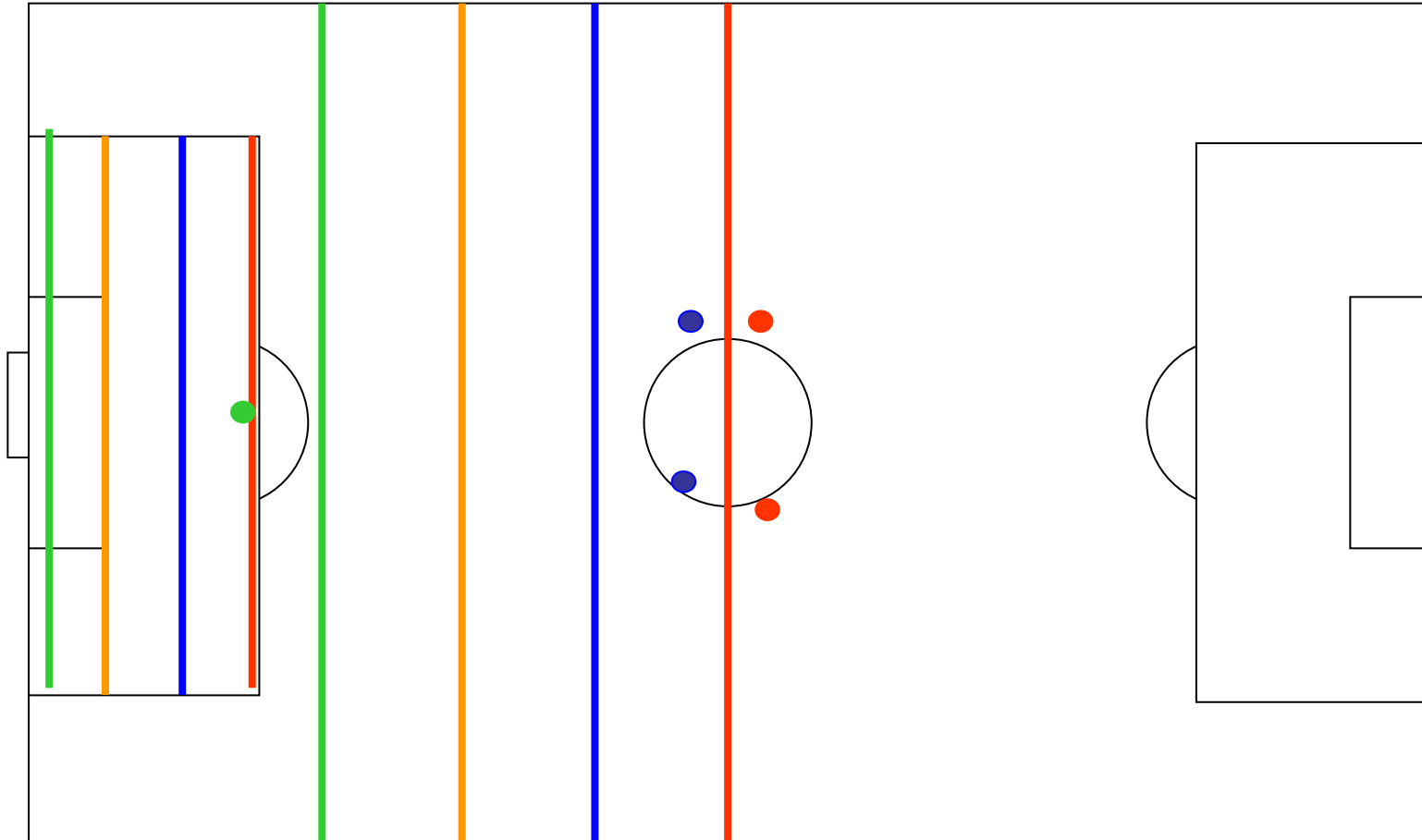
Break

When ball is a bit far from the player make a break instead of a close

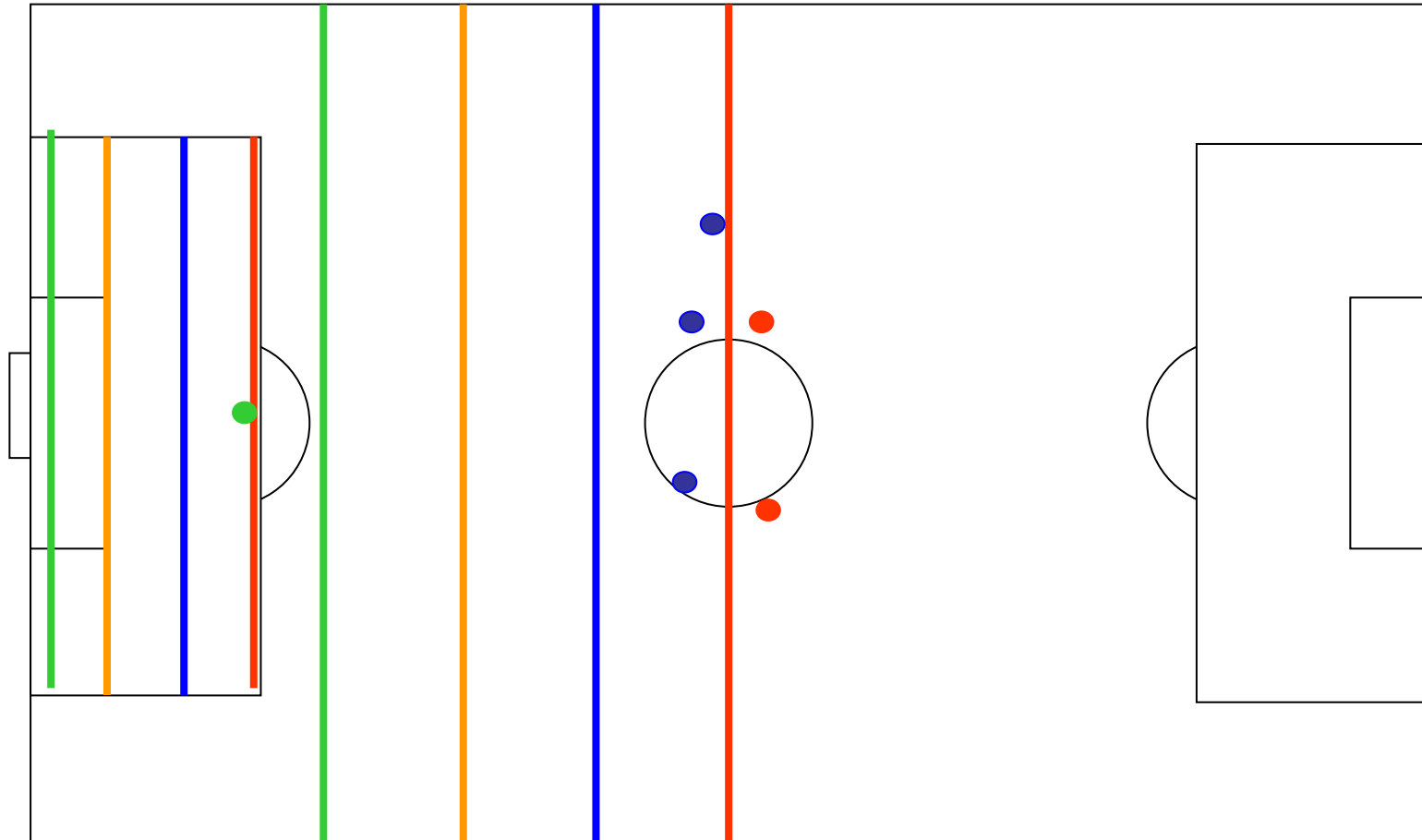
Defense organization

Preventing back attacks

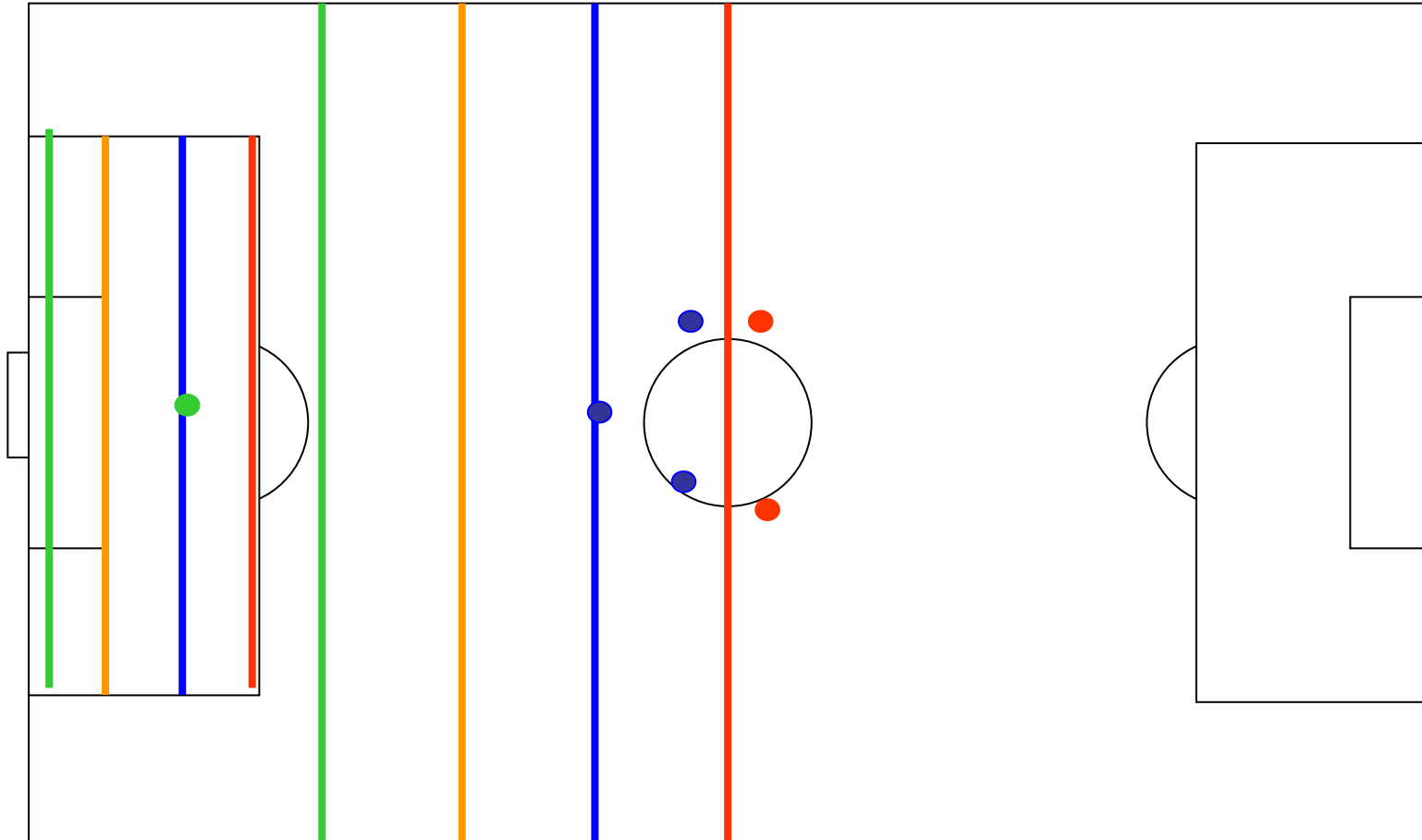
Wrong



Wrong

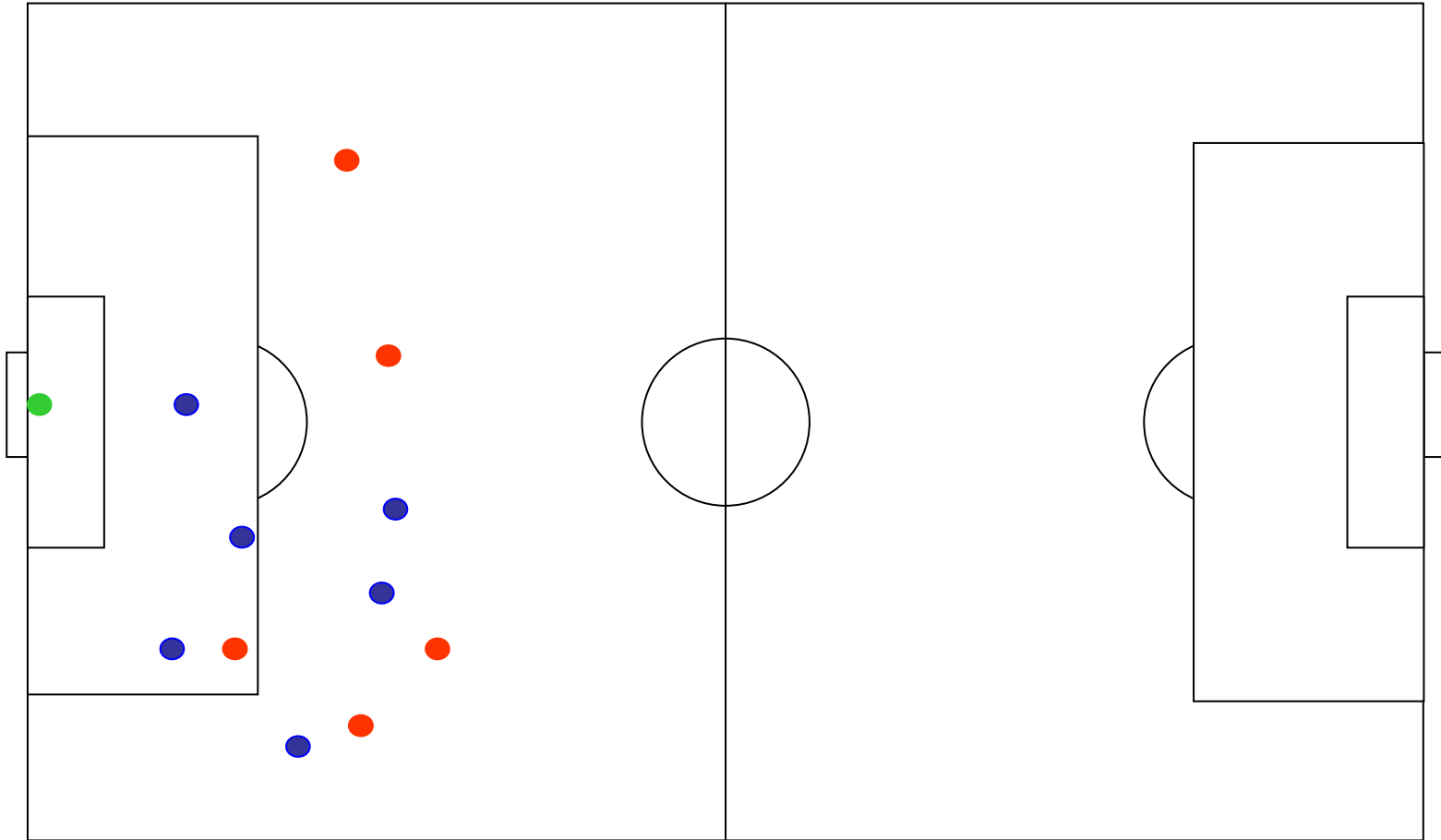


Right

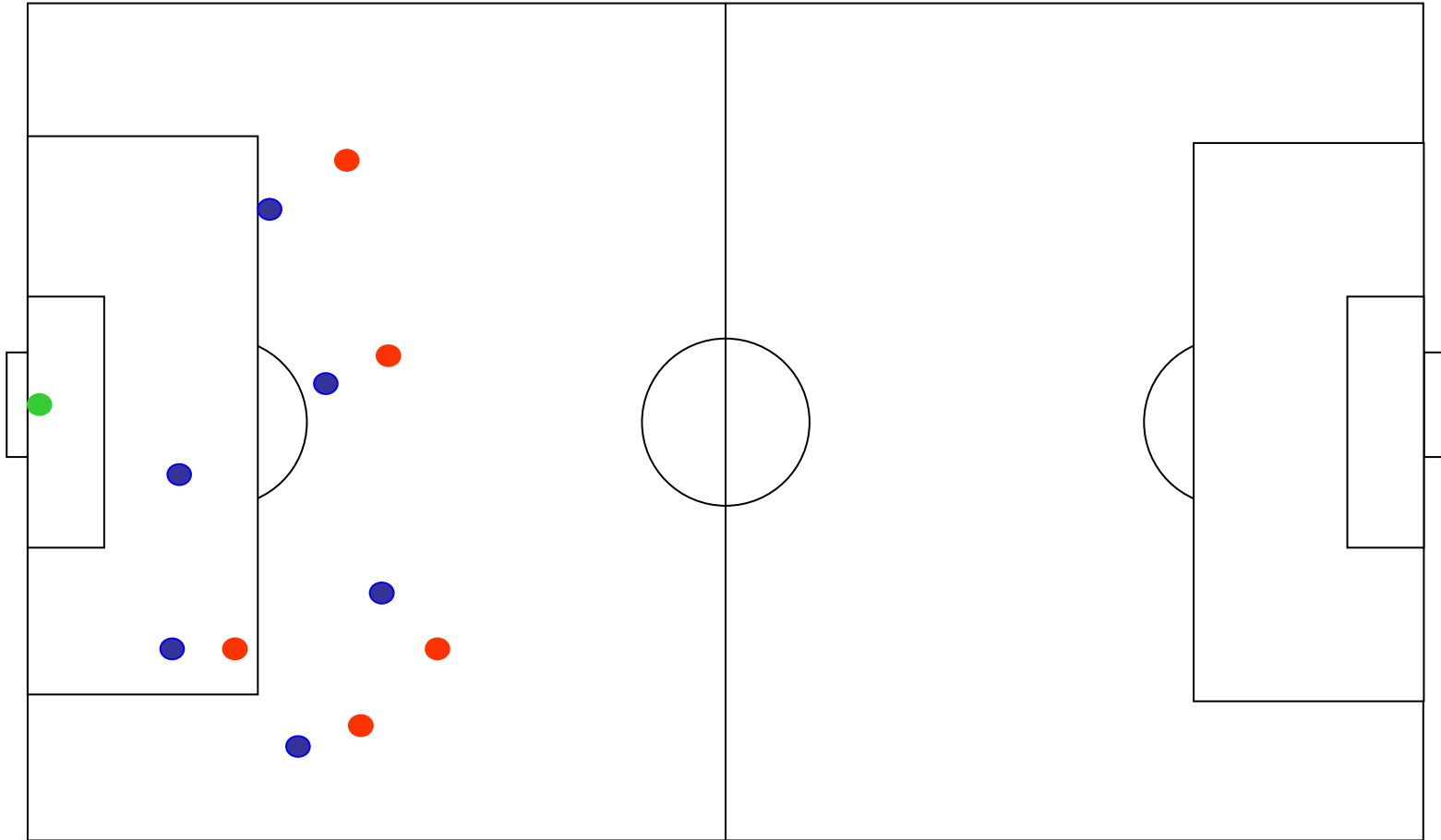


Repositioning

Wrong

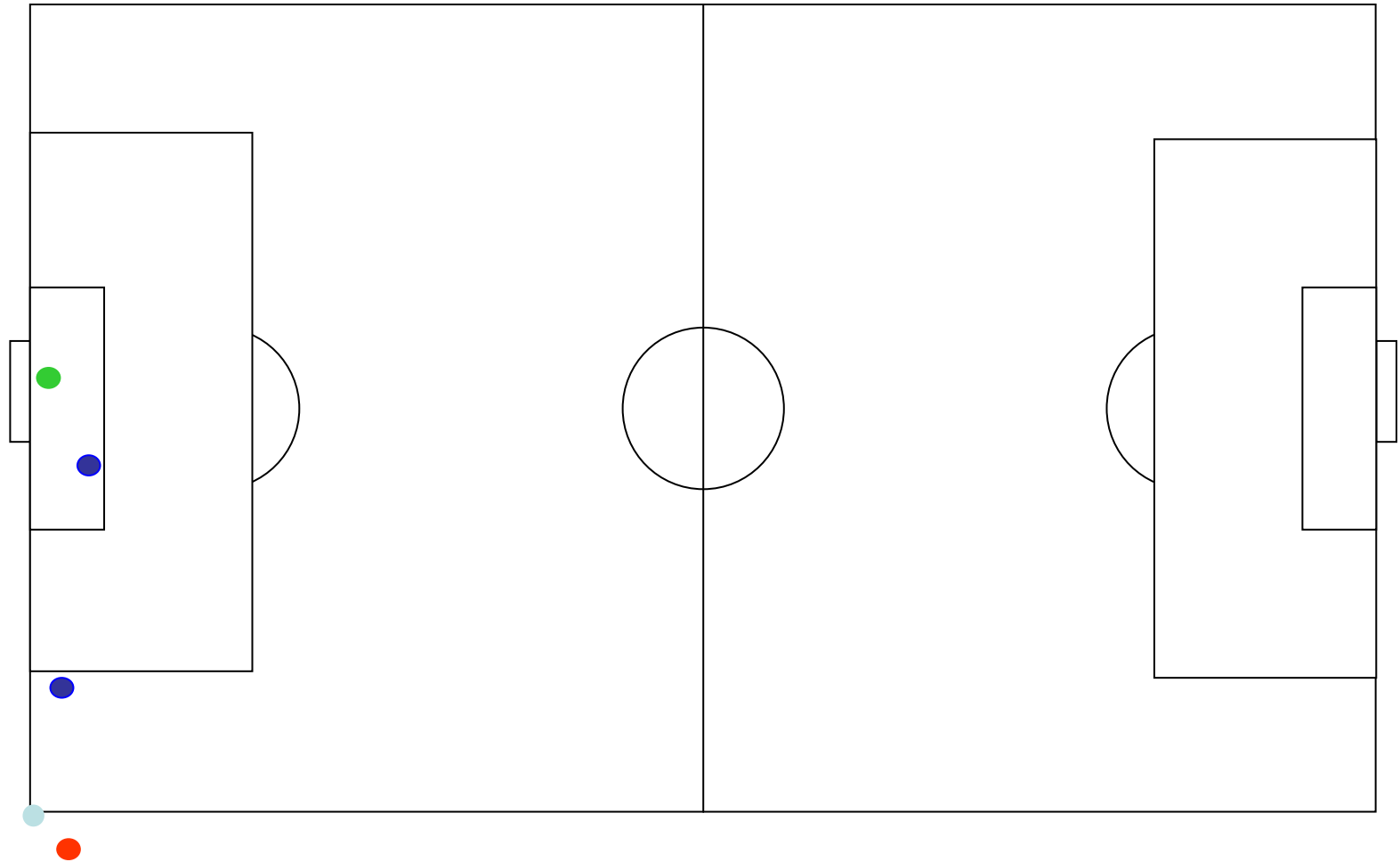


Right



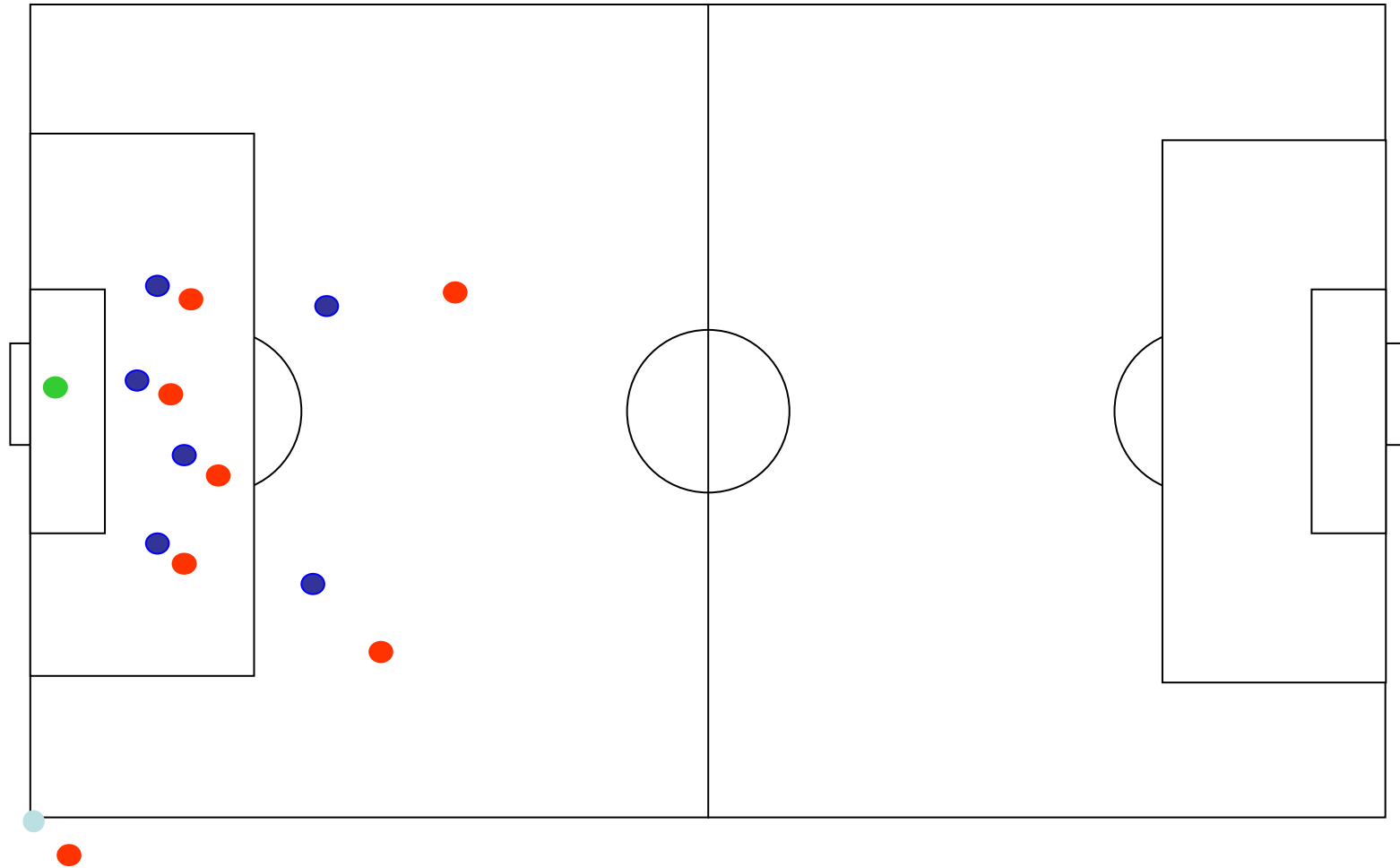
Corners

Corner defense position



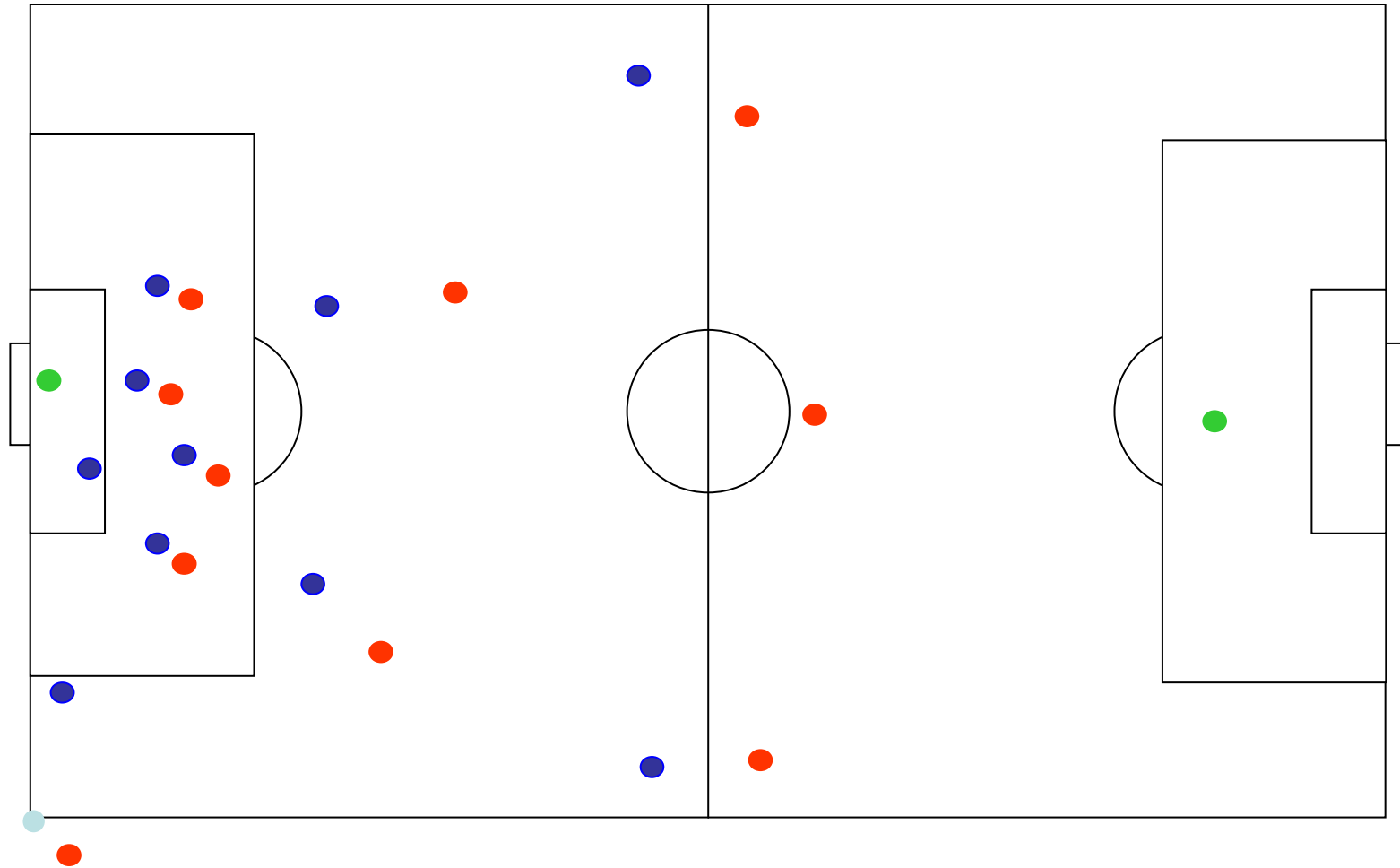
Ball men

Corner defense position

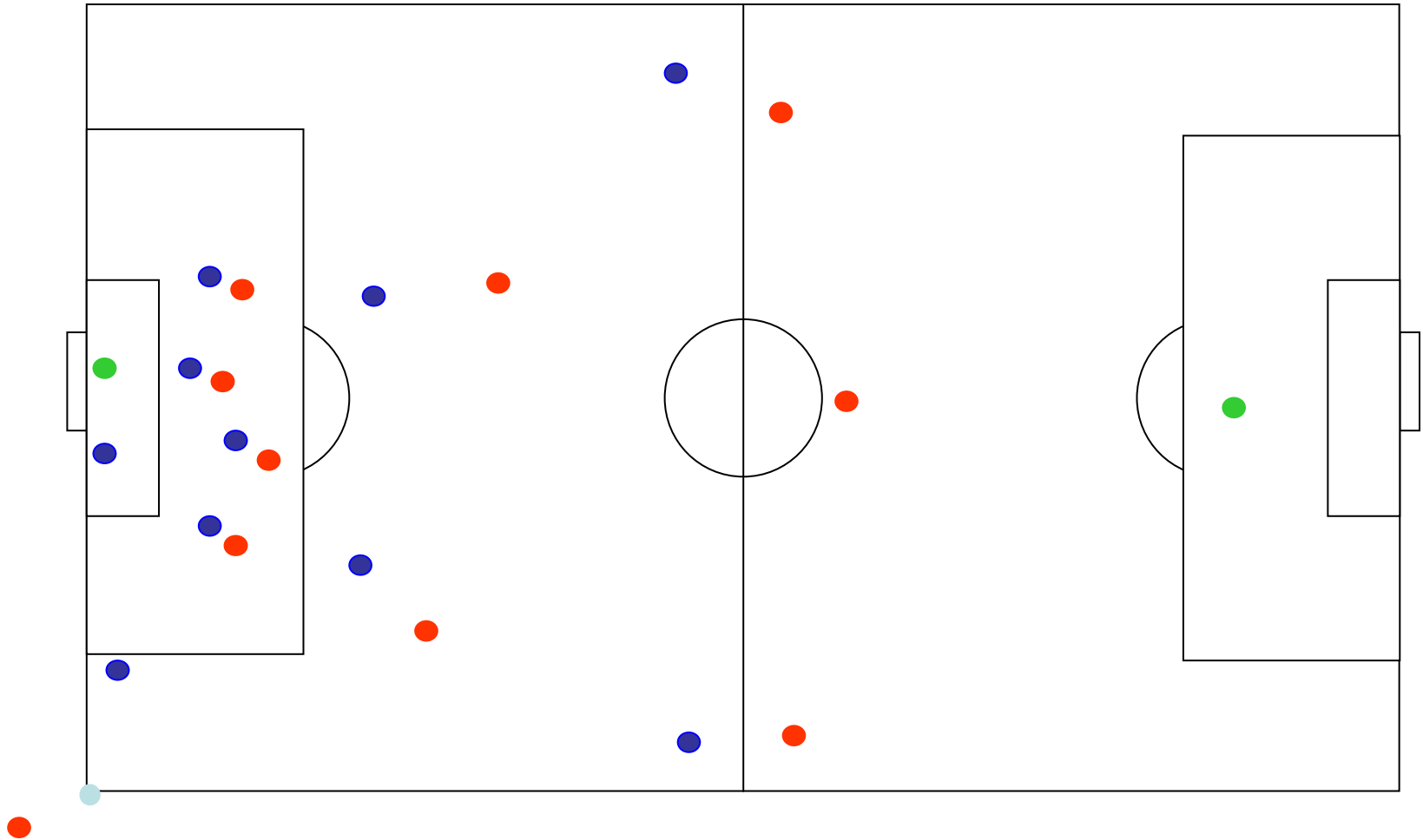


Players men

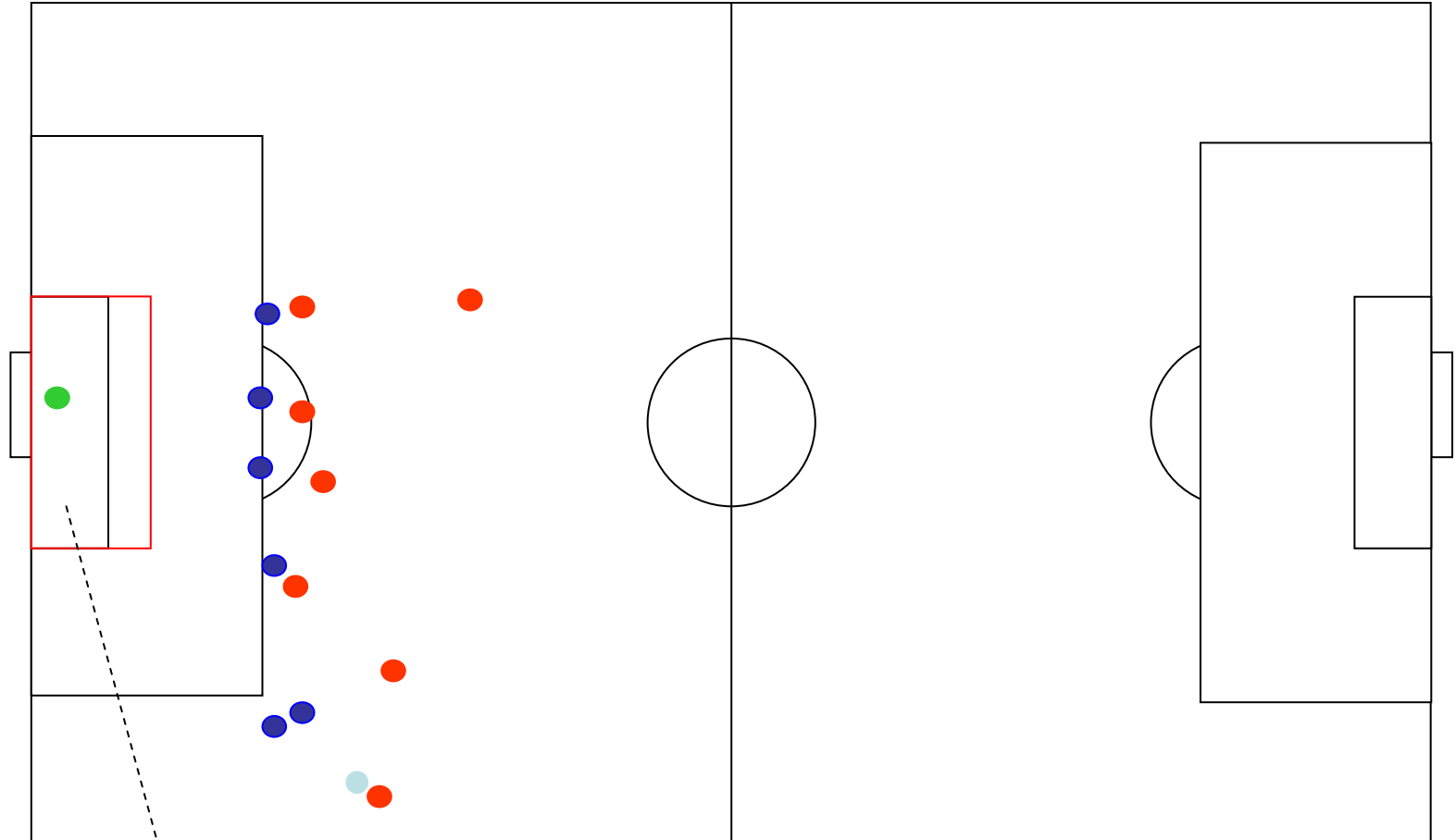
Open corner position



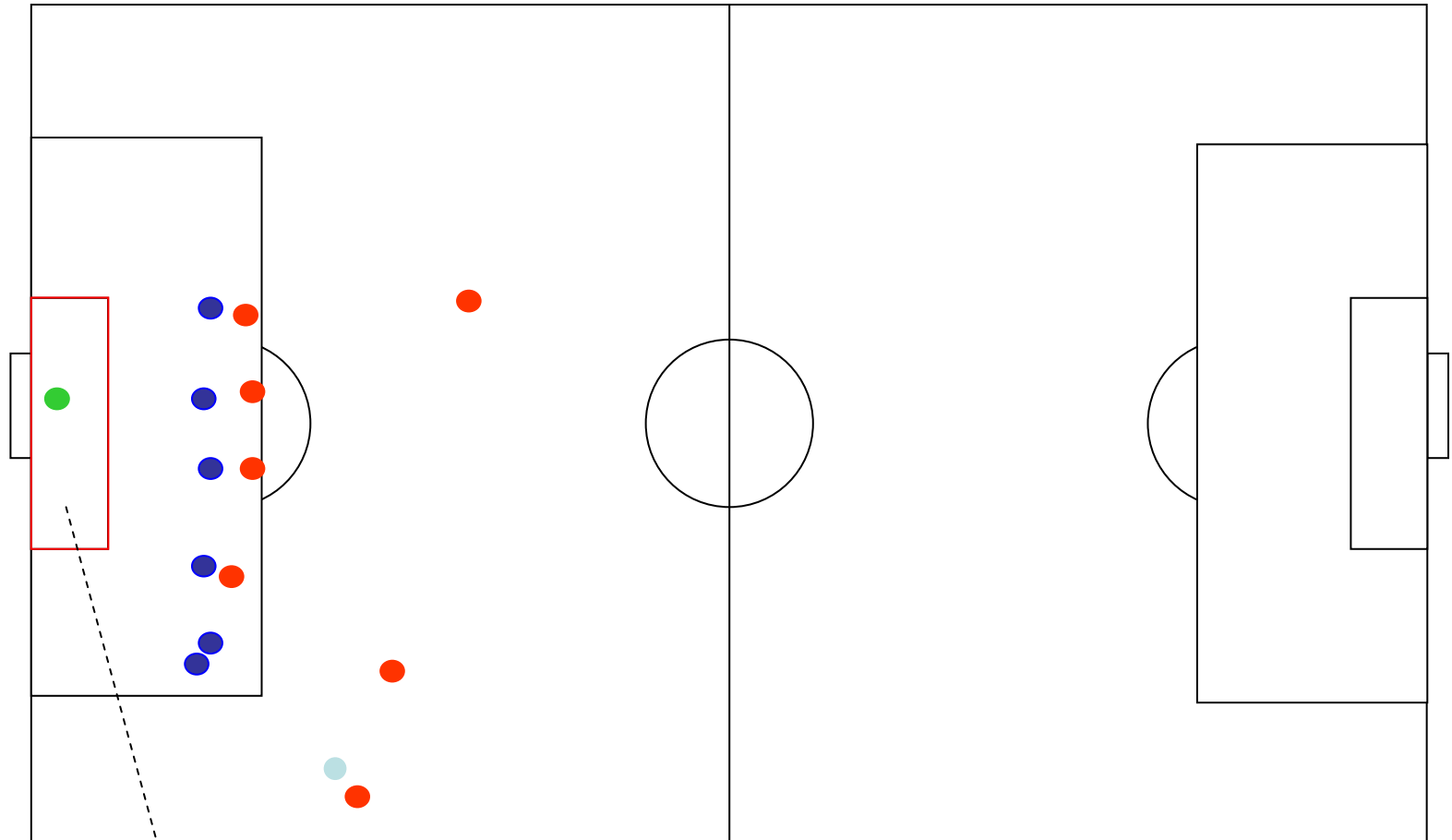
Closed corner position



Crosses

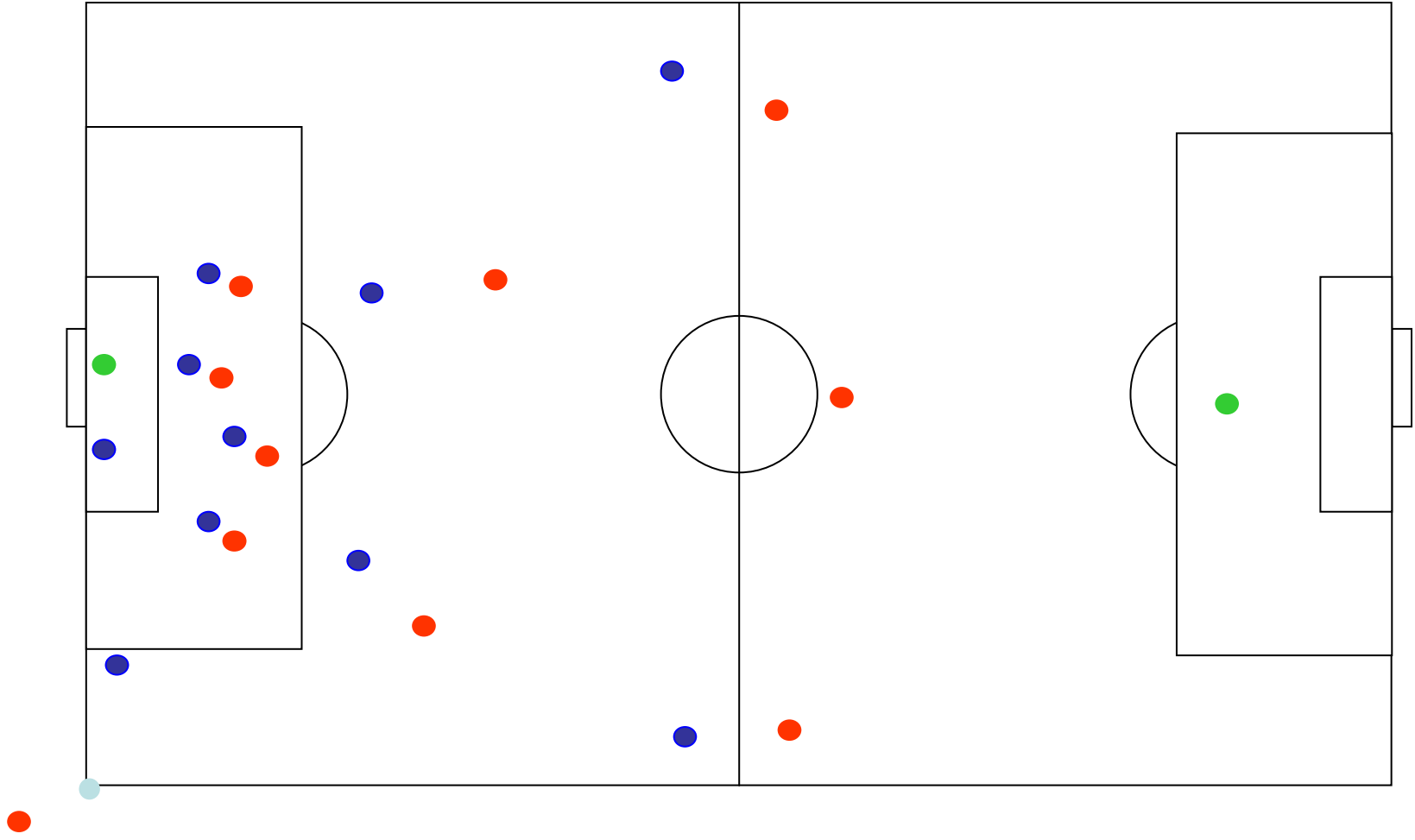


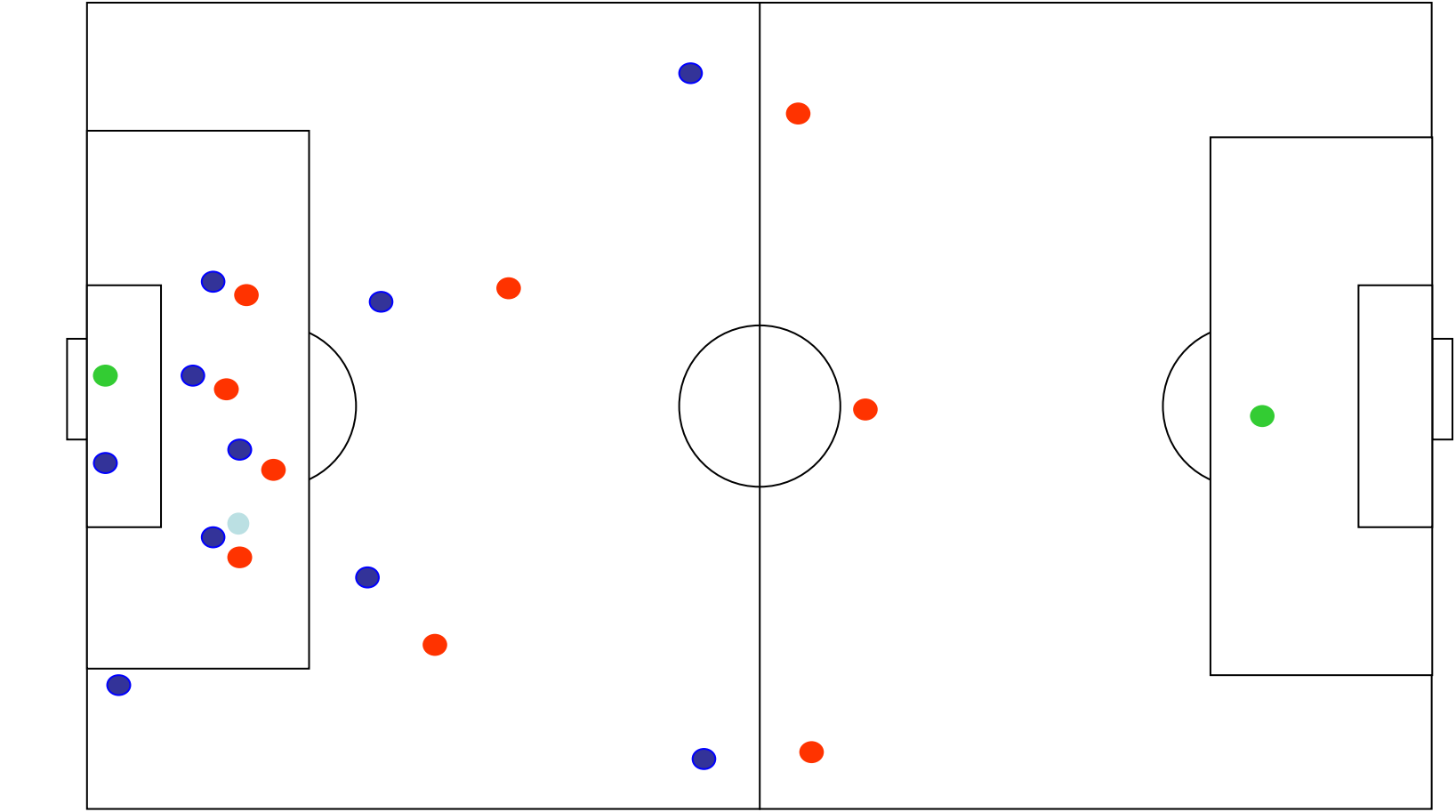
Keeper action zone

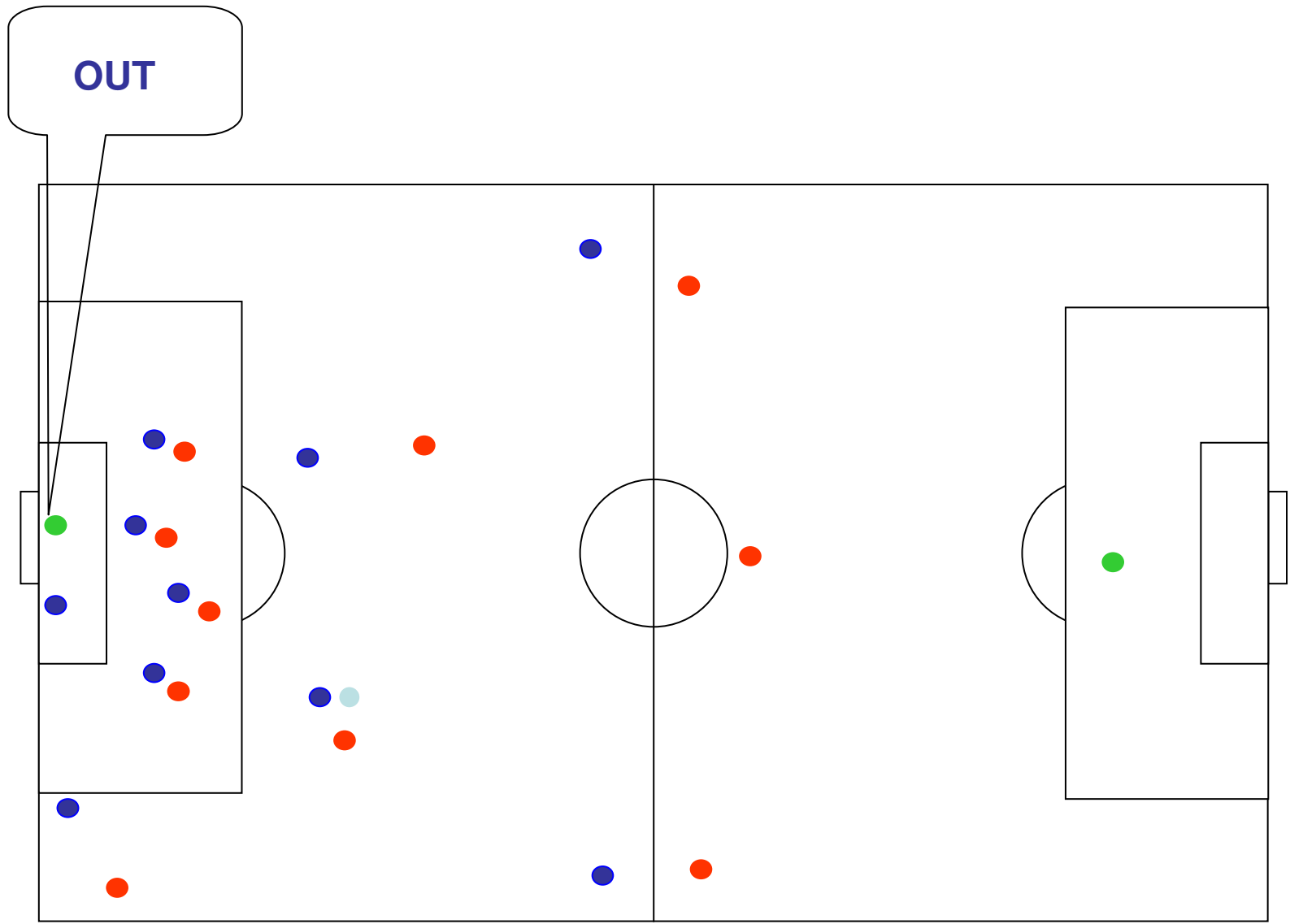


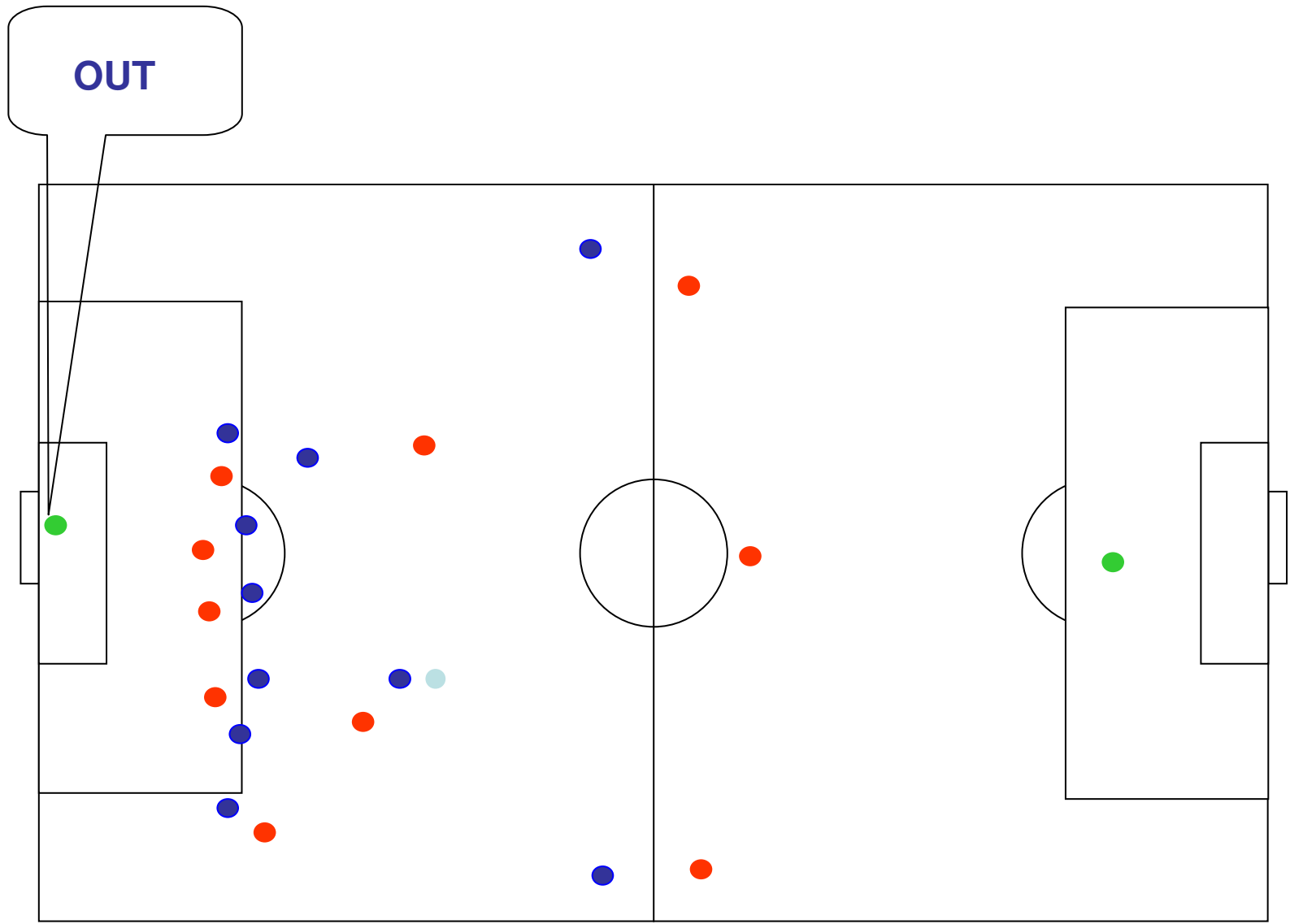
Keeper action zone

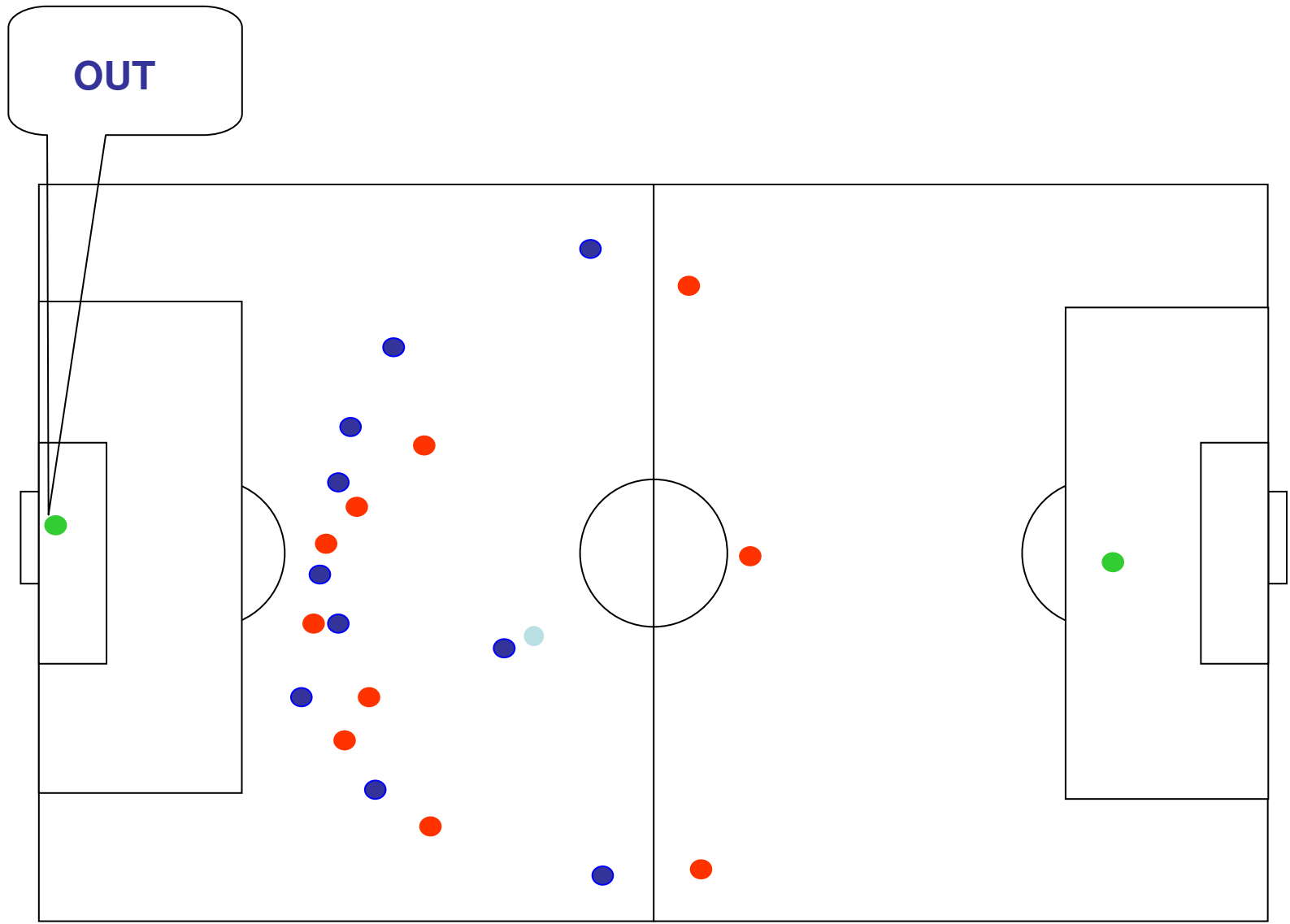
Off side

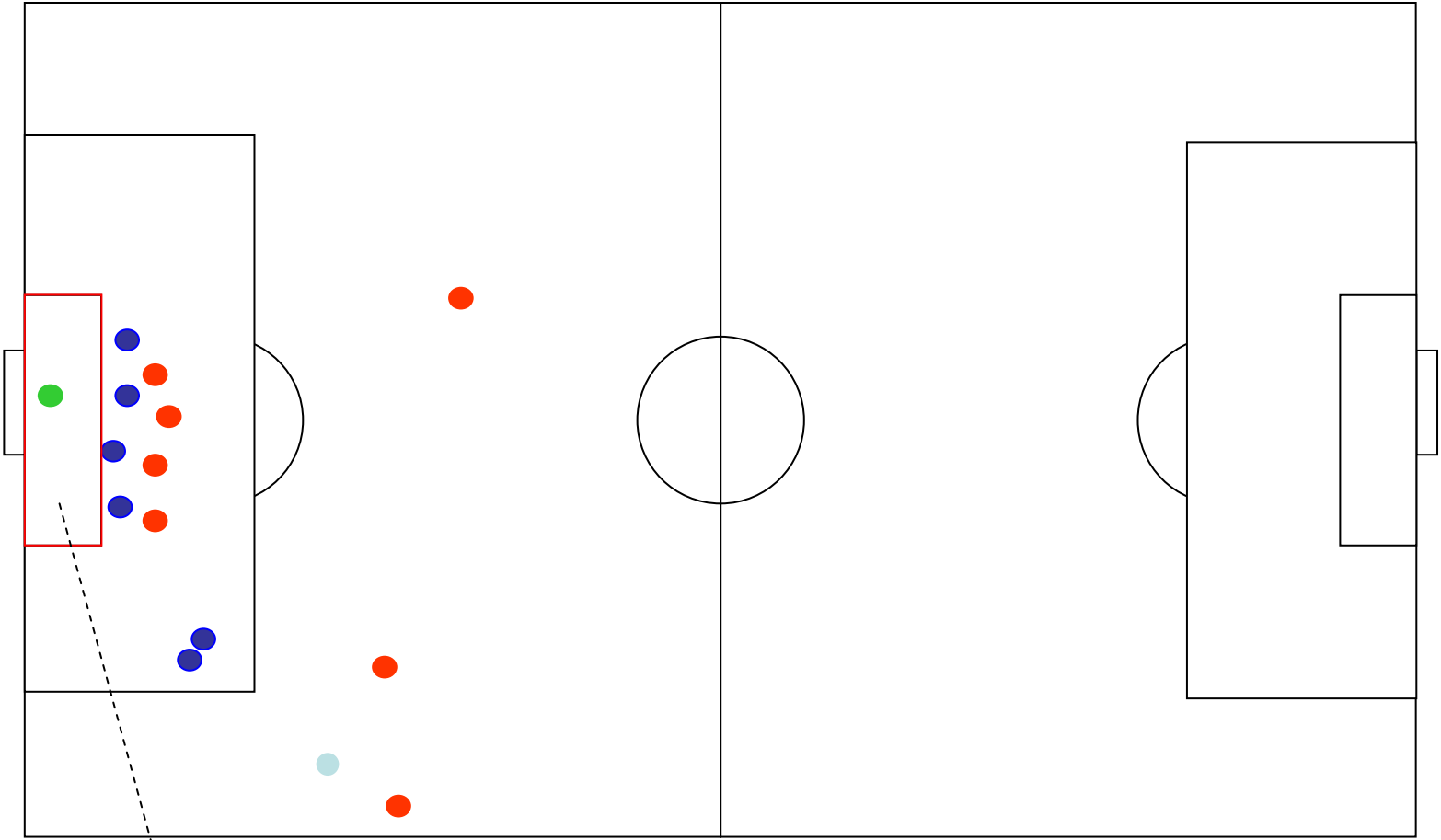




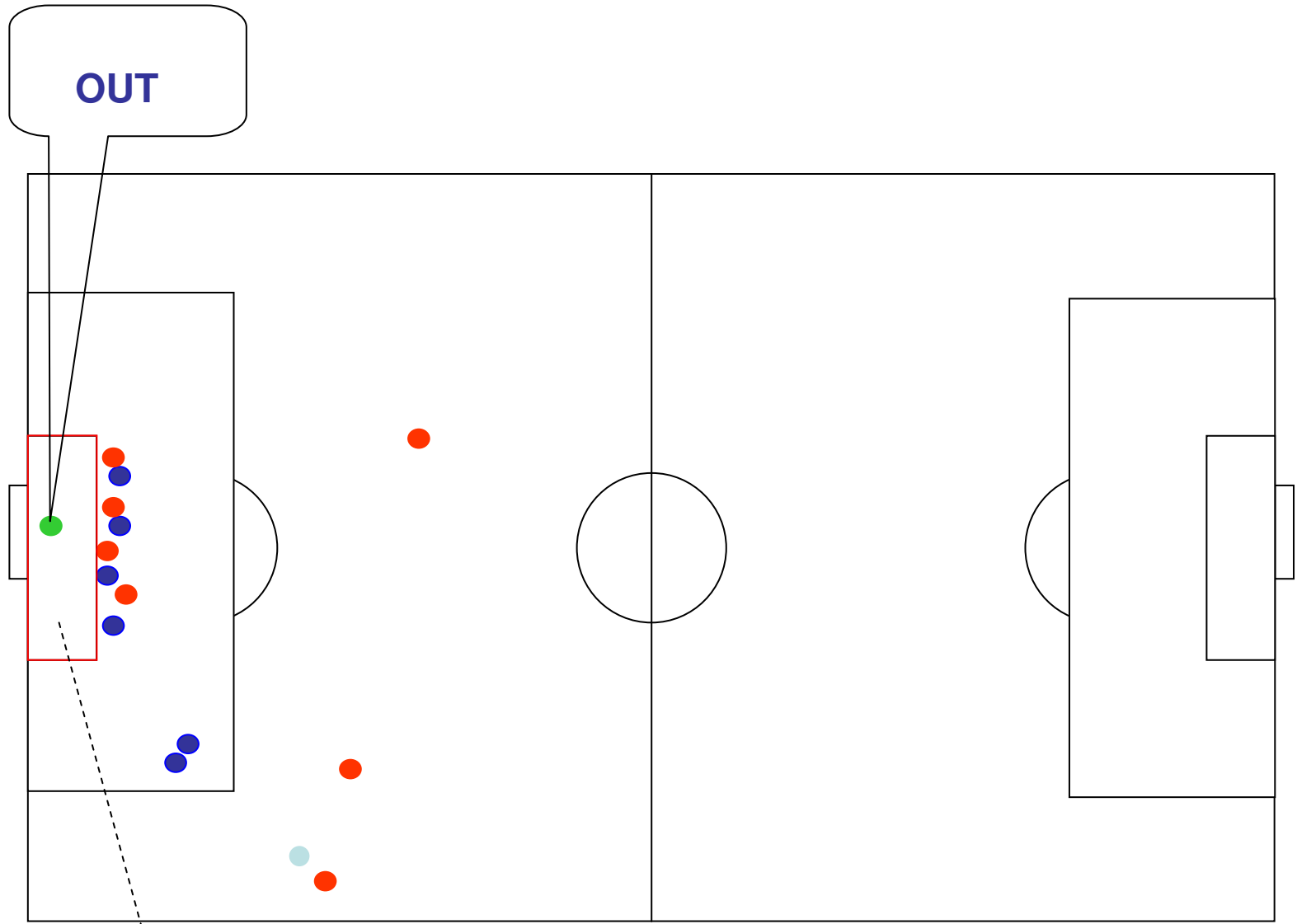




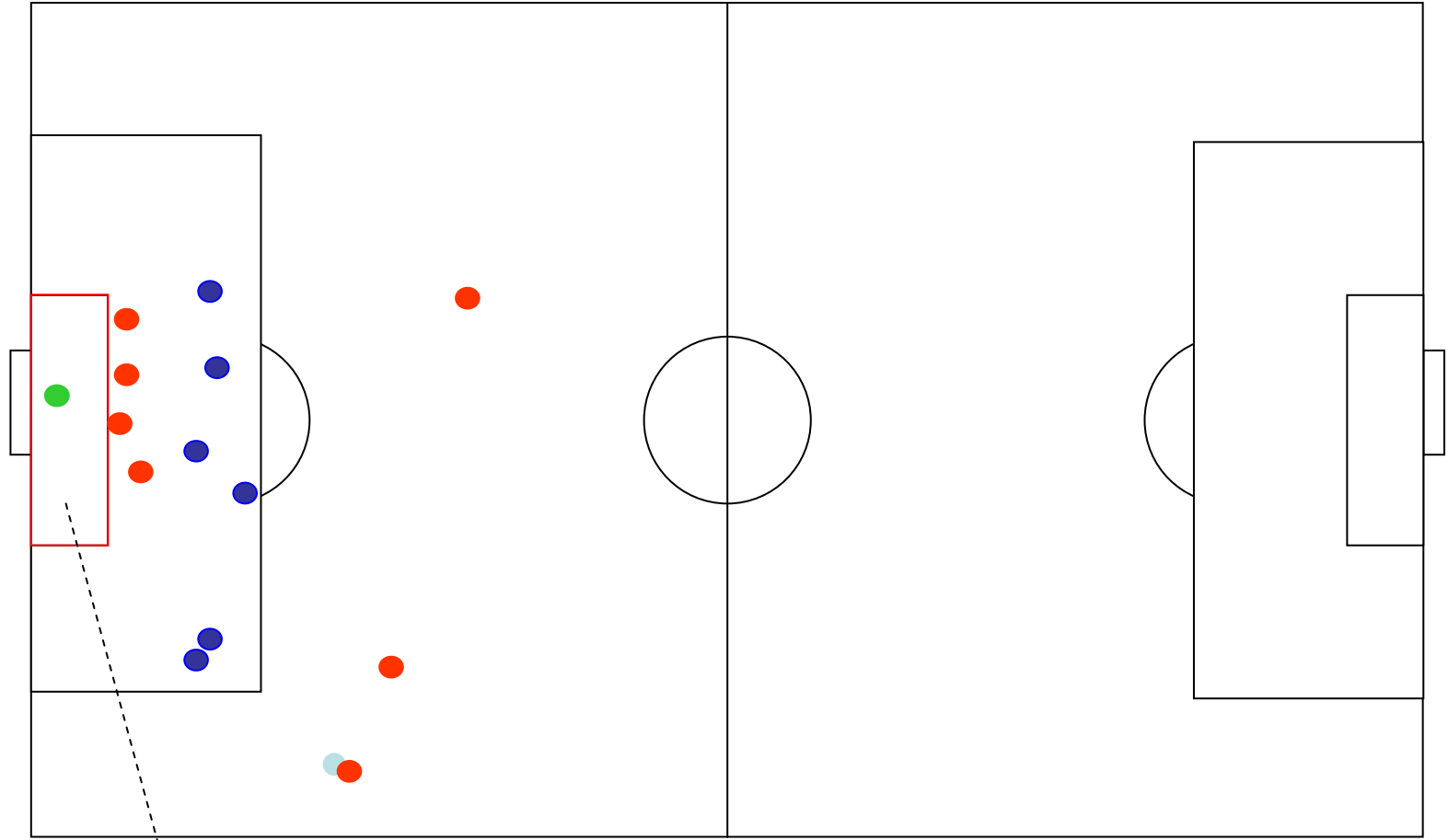




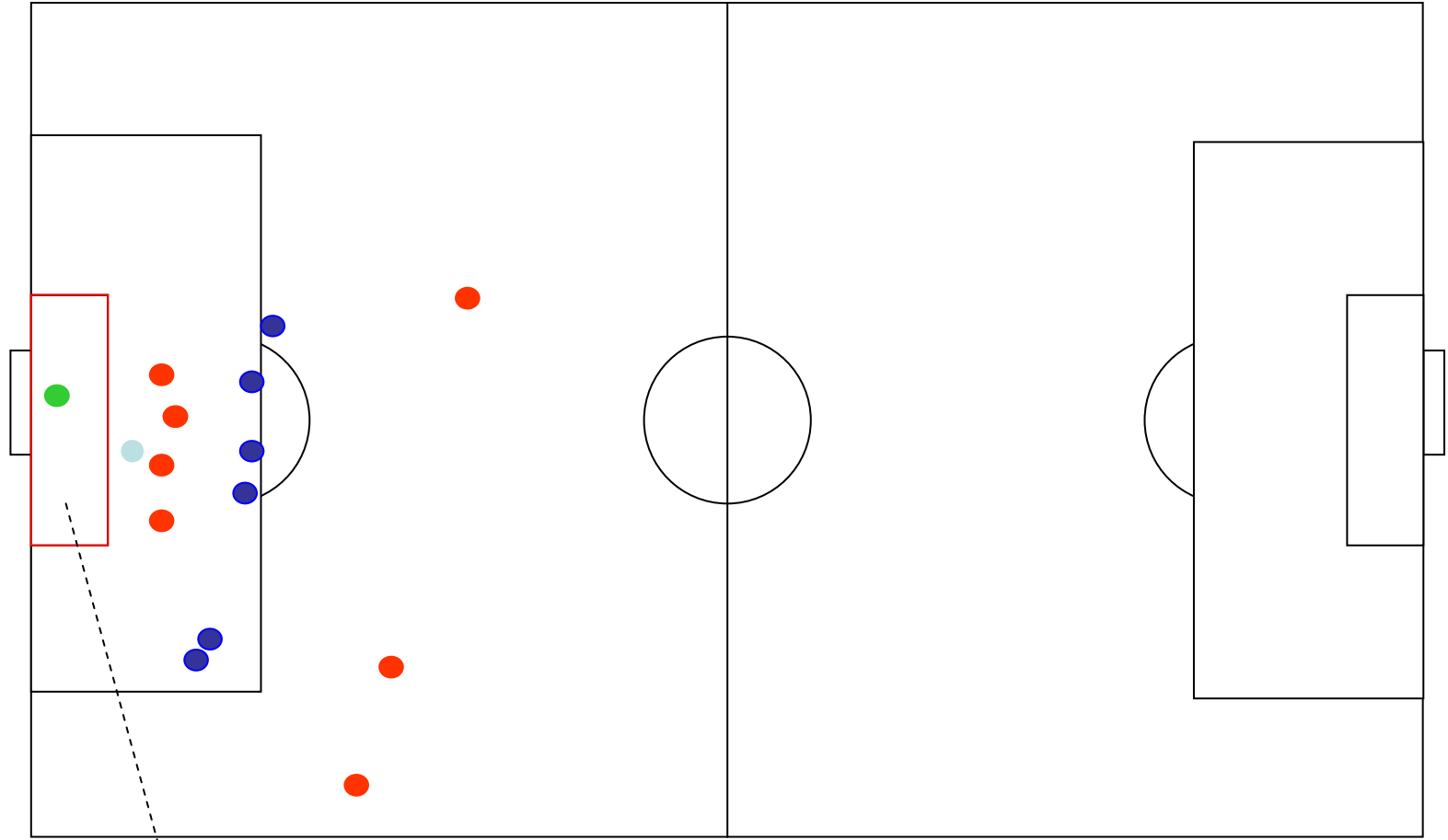
Keeper action zone



Keeper action zone



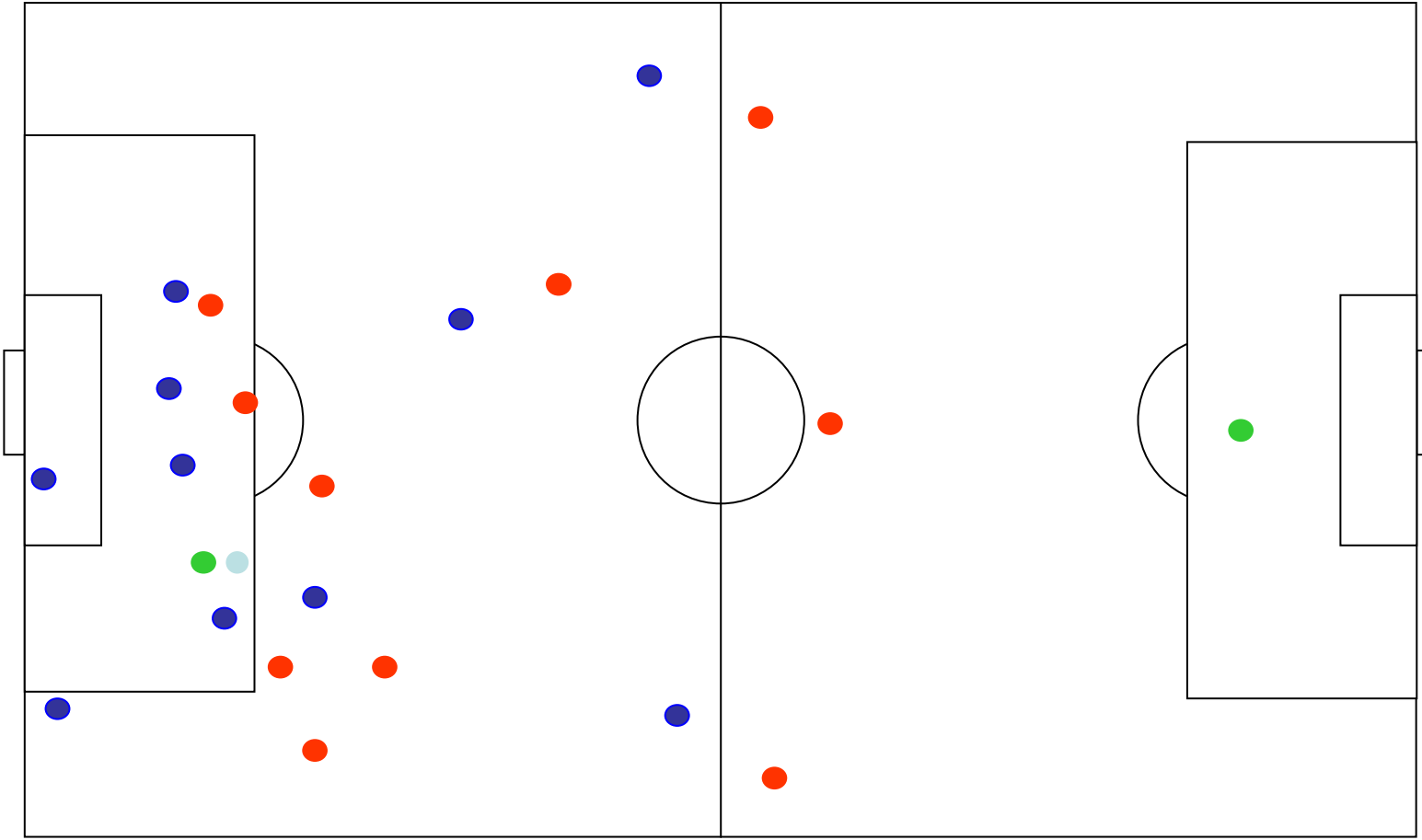
Keeper action zone

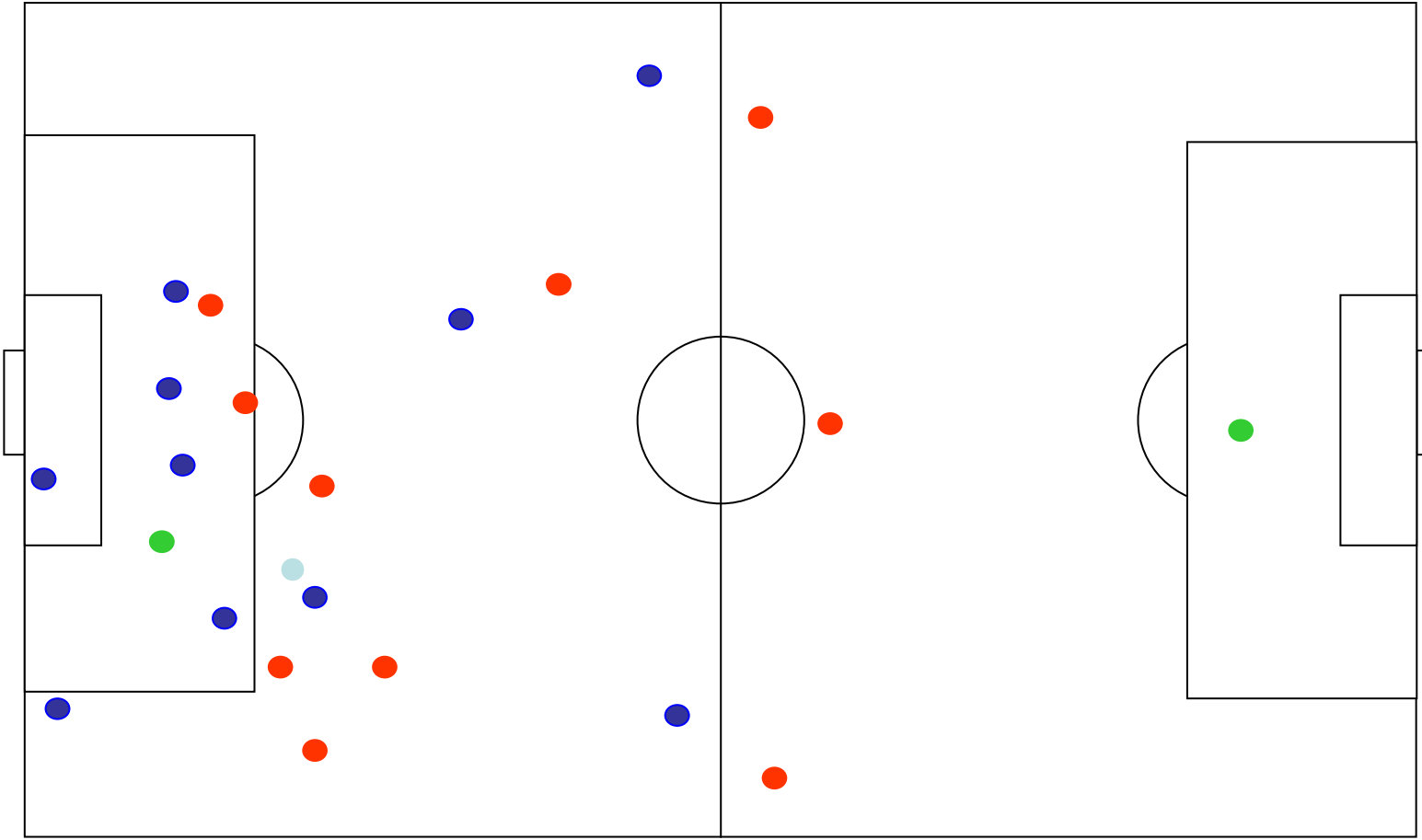


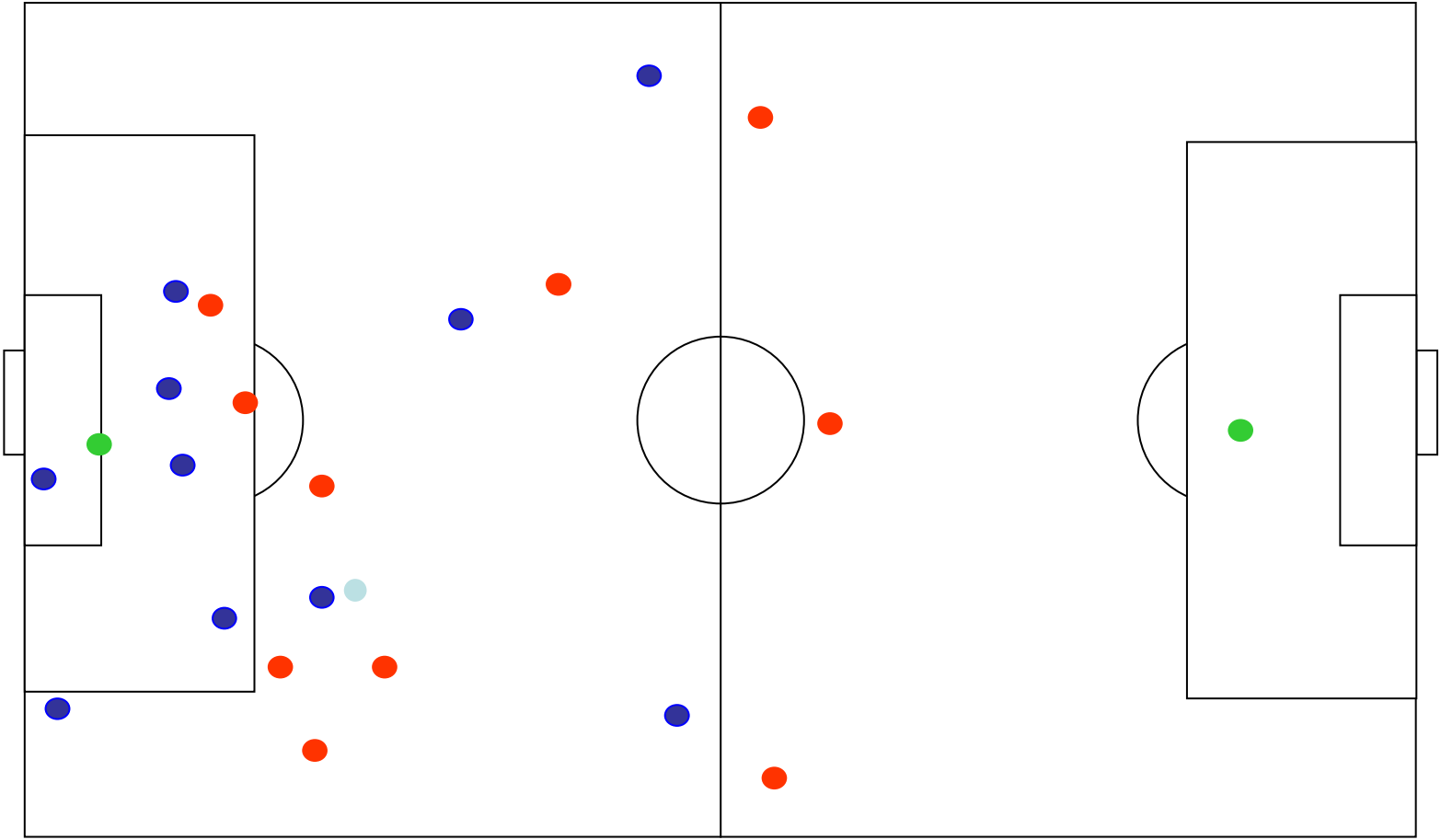
Keeper action zone

Ball reposition

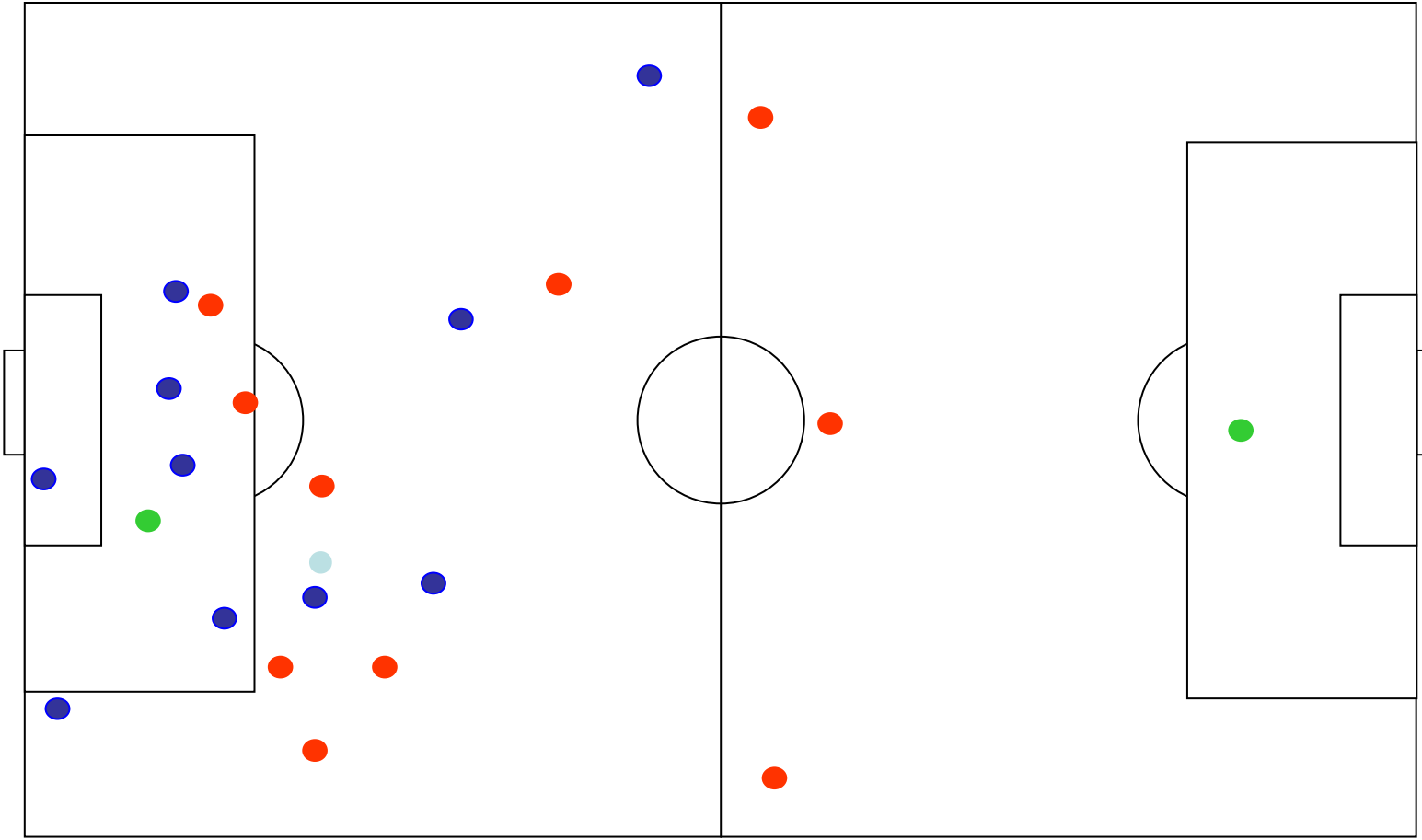


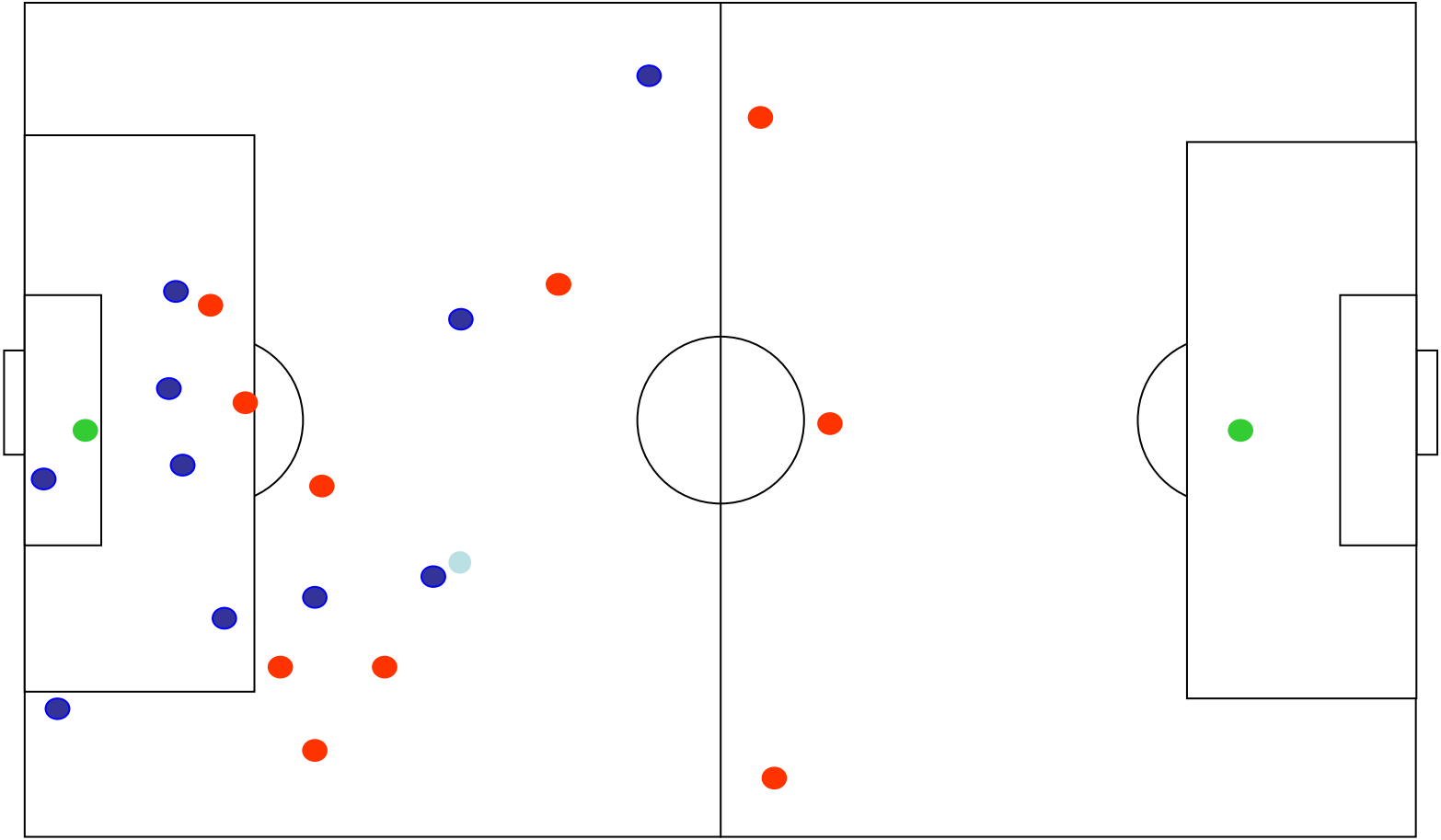


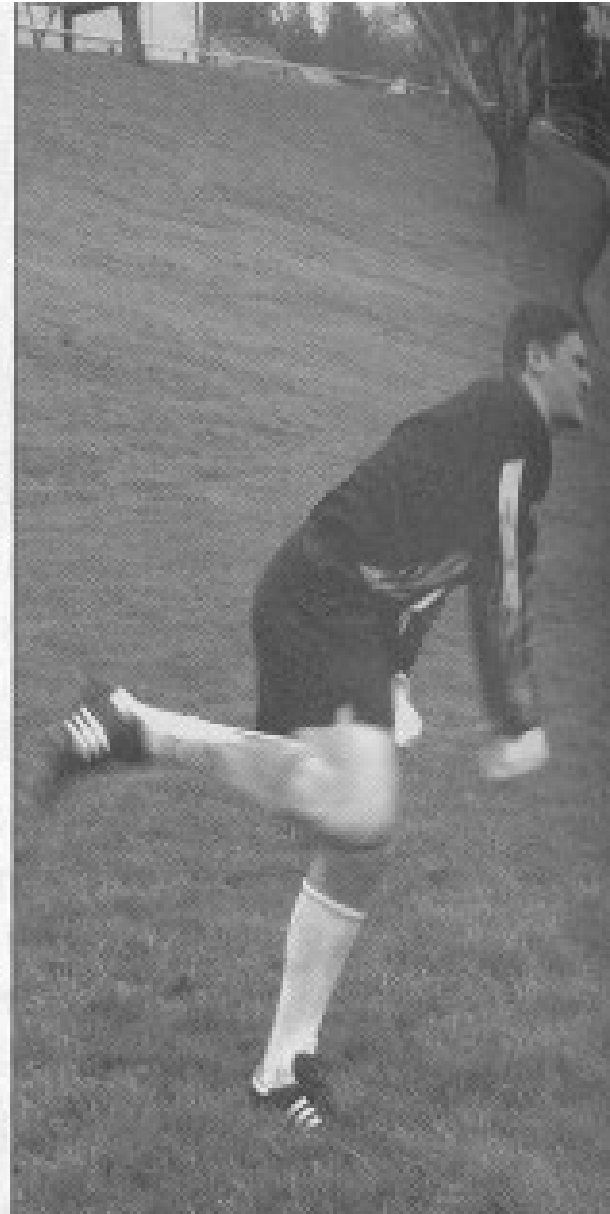


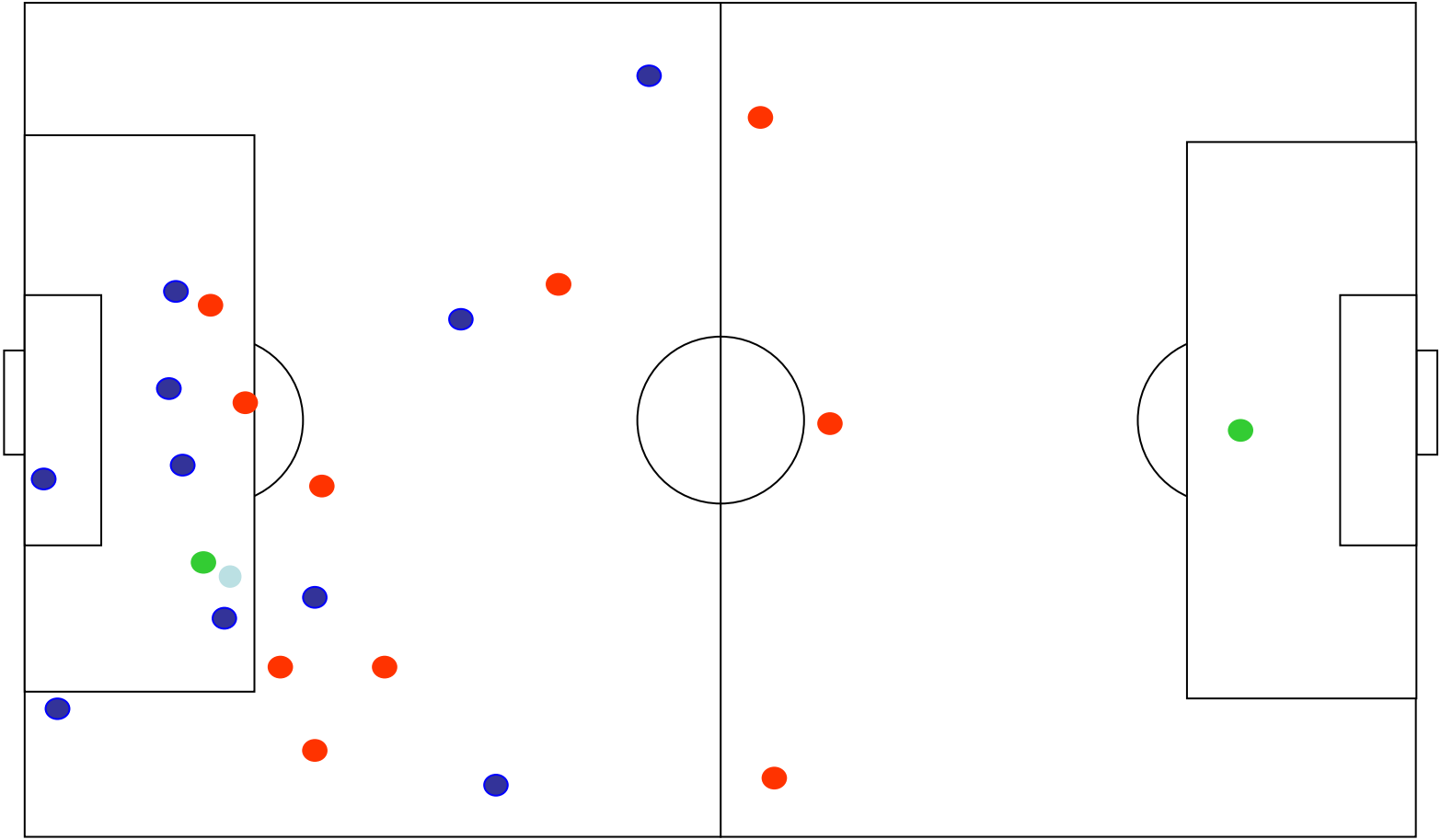


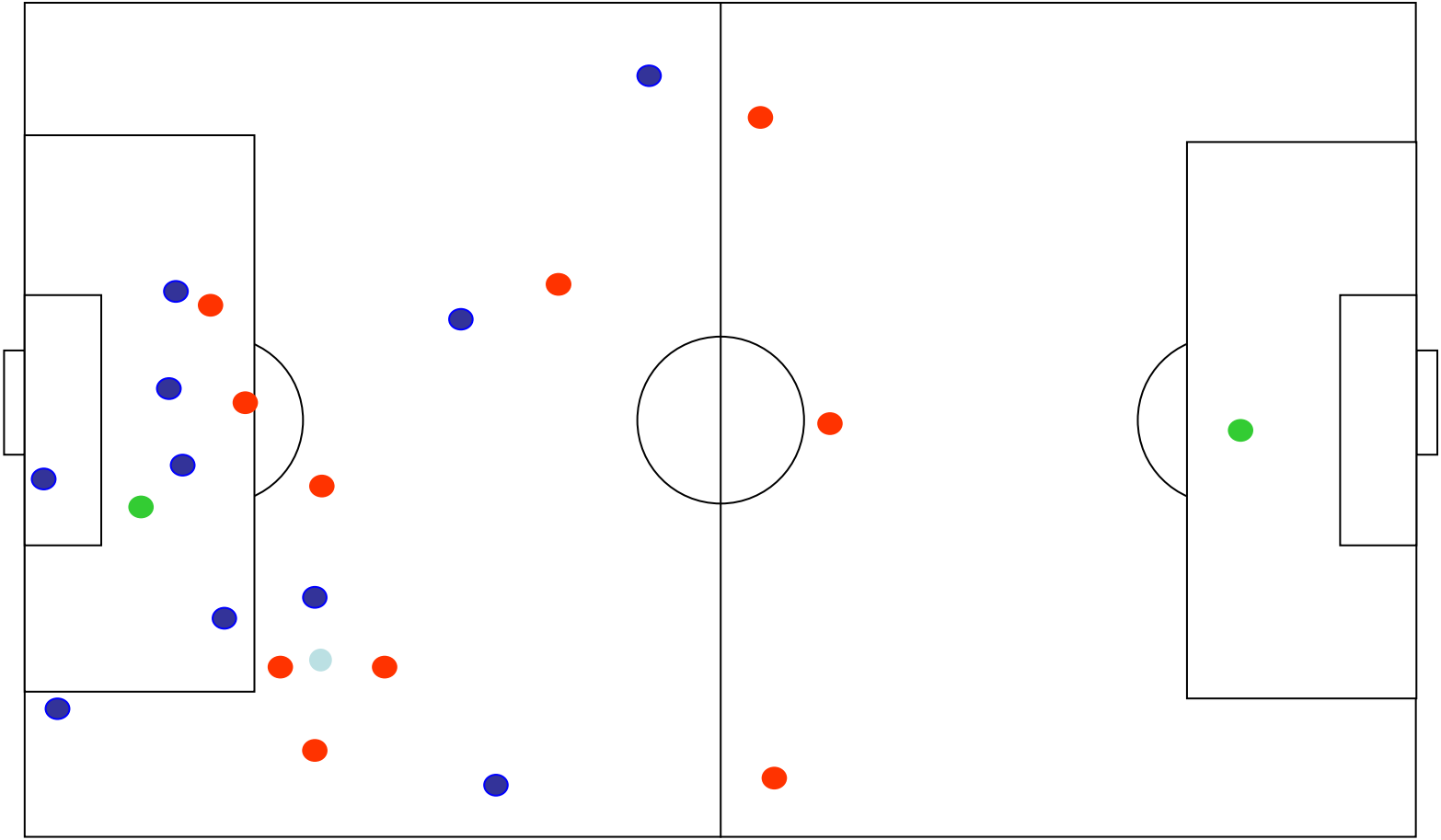


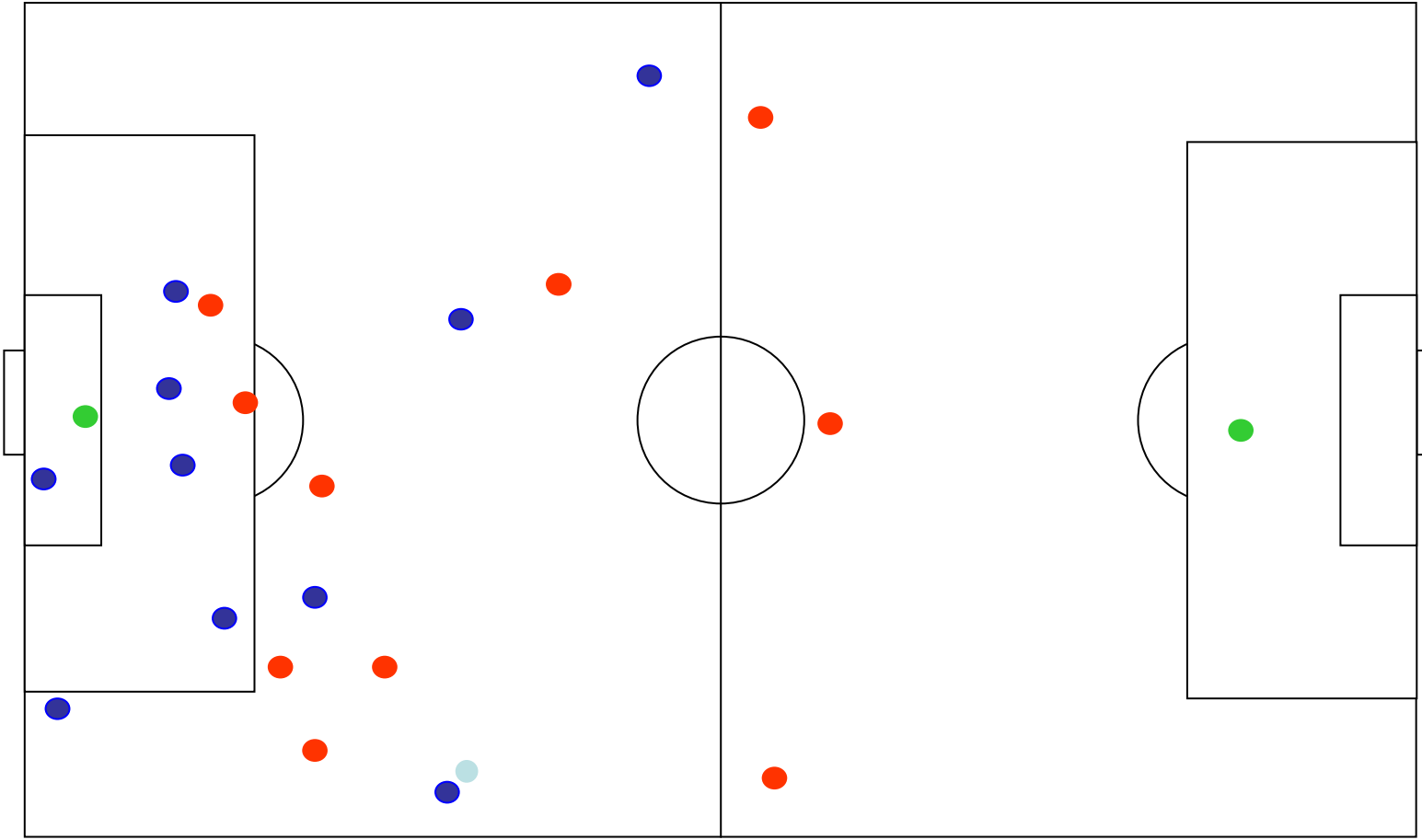




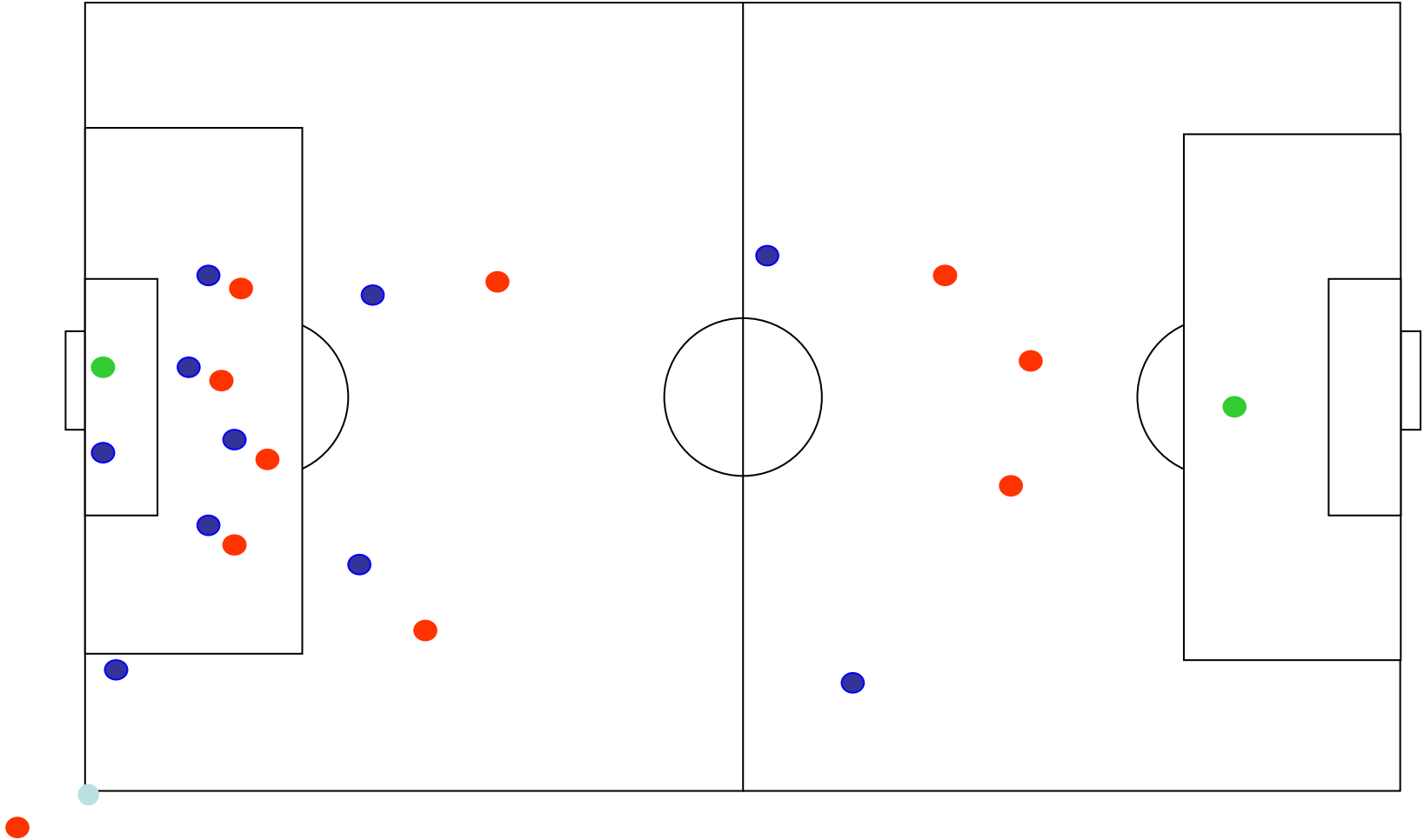


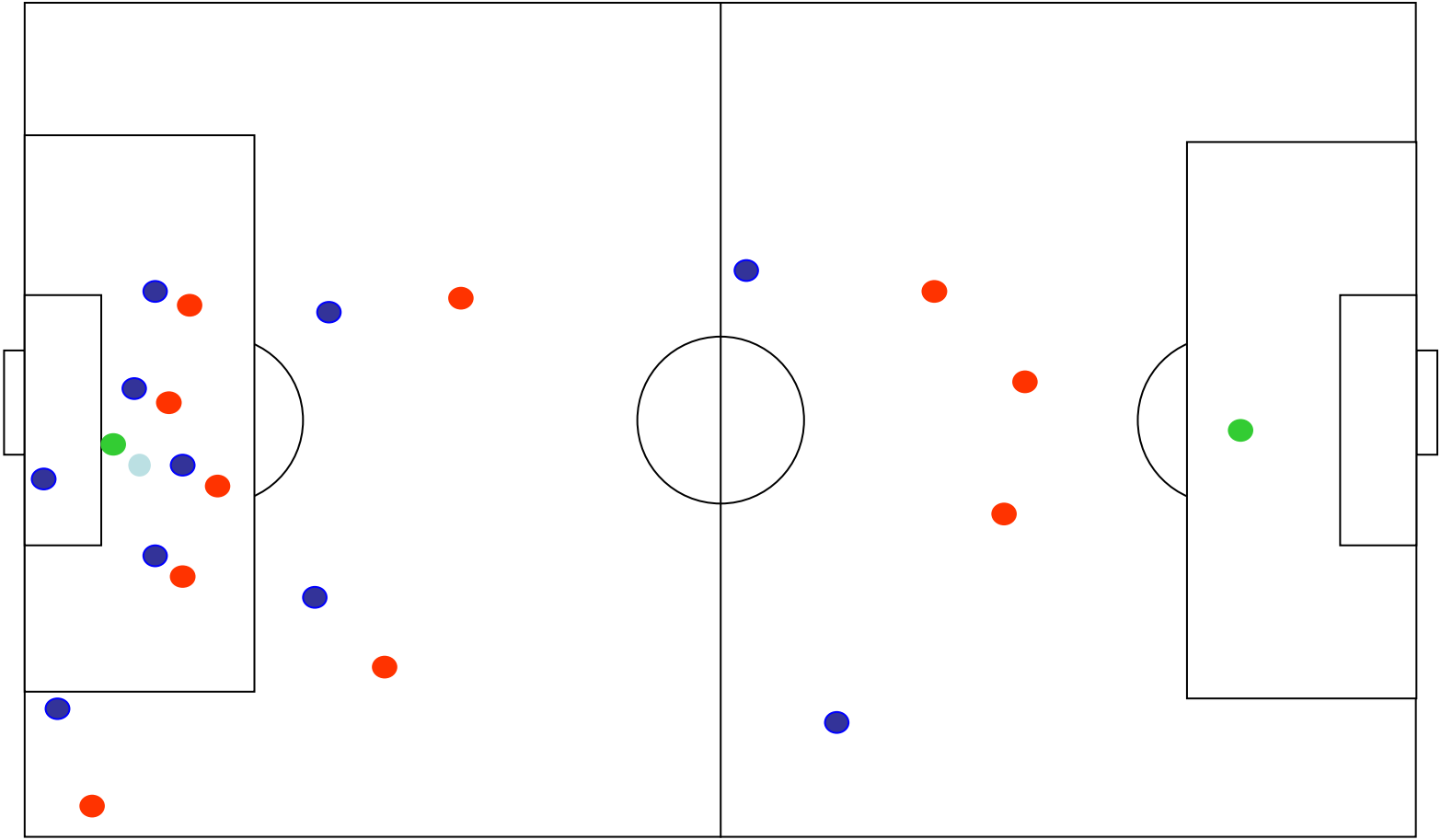


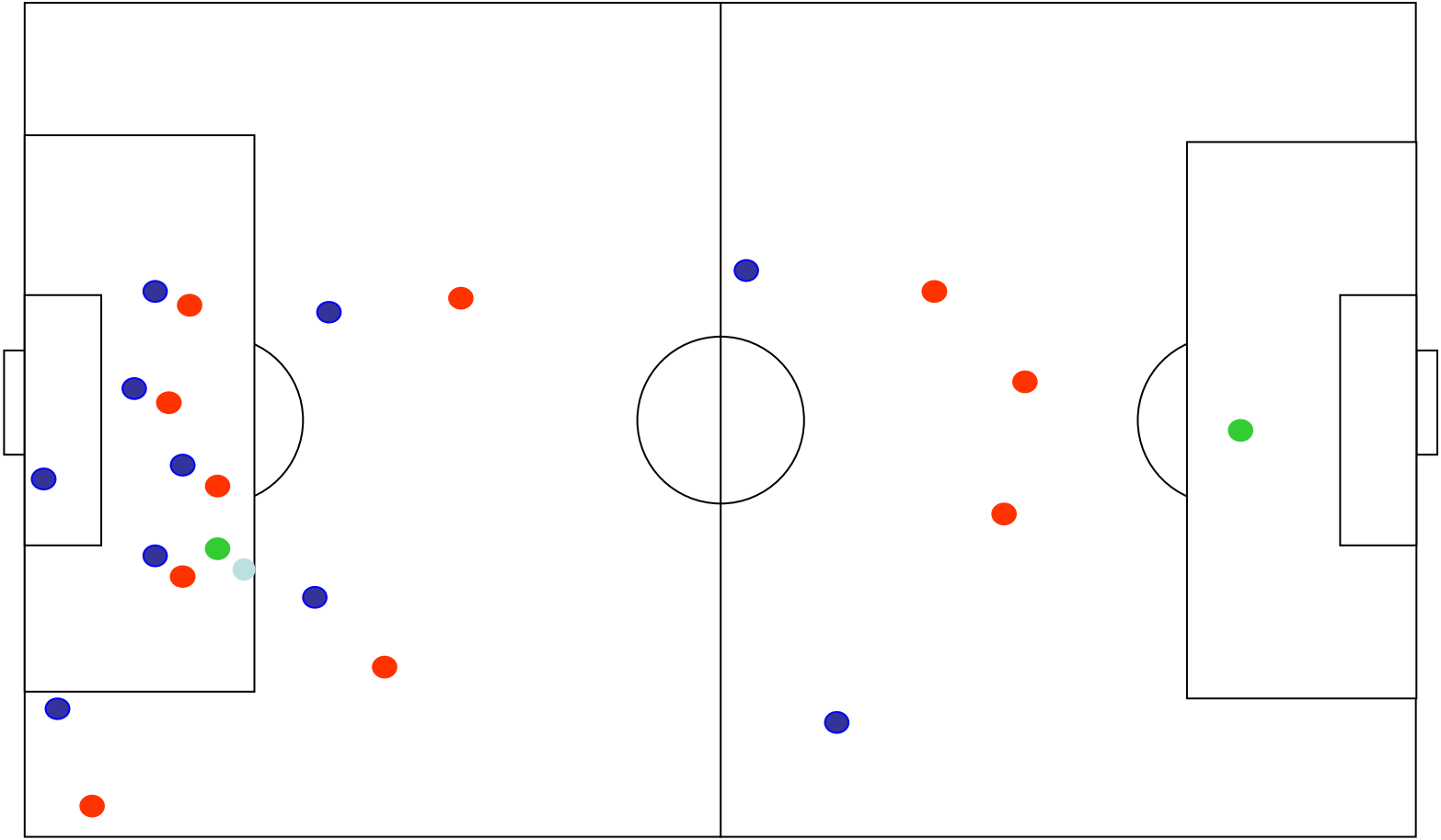


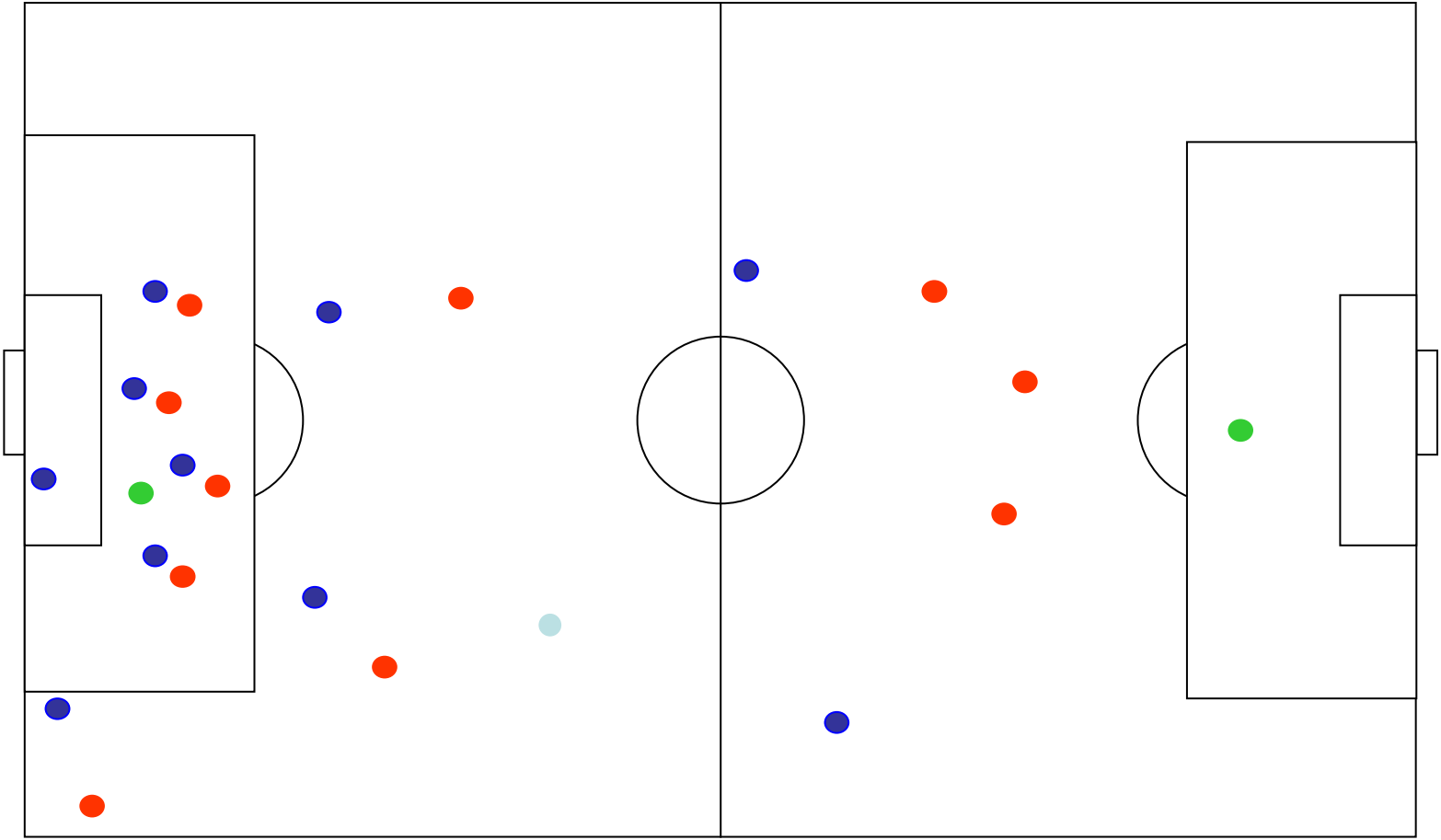


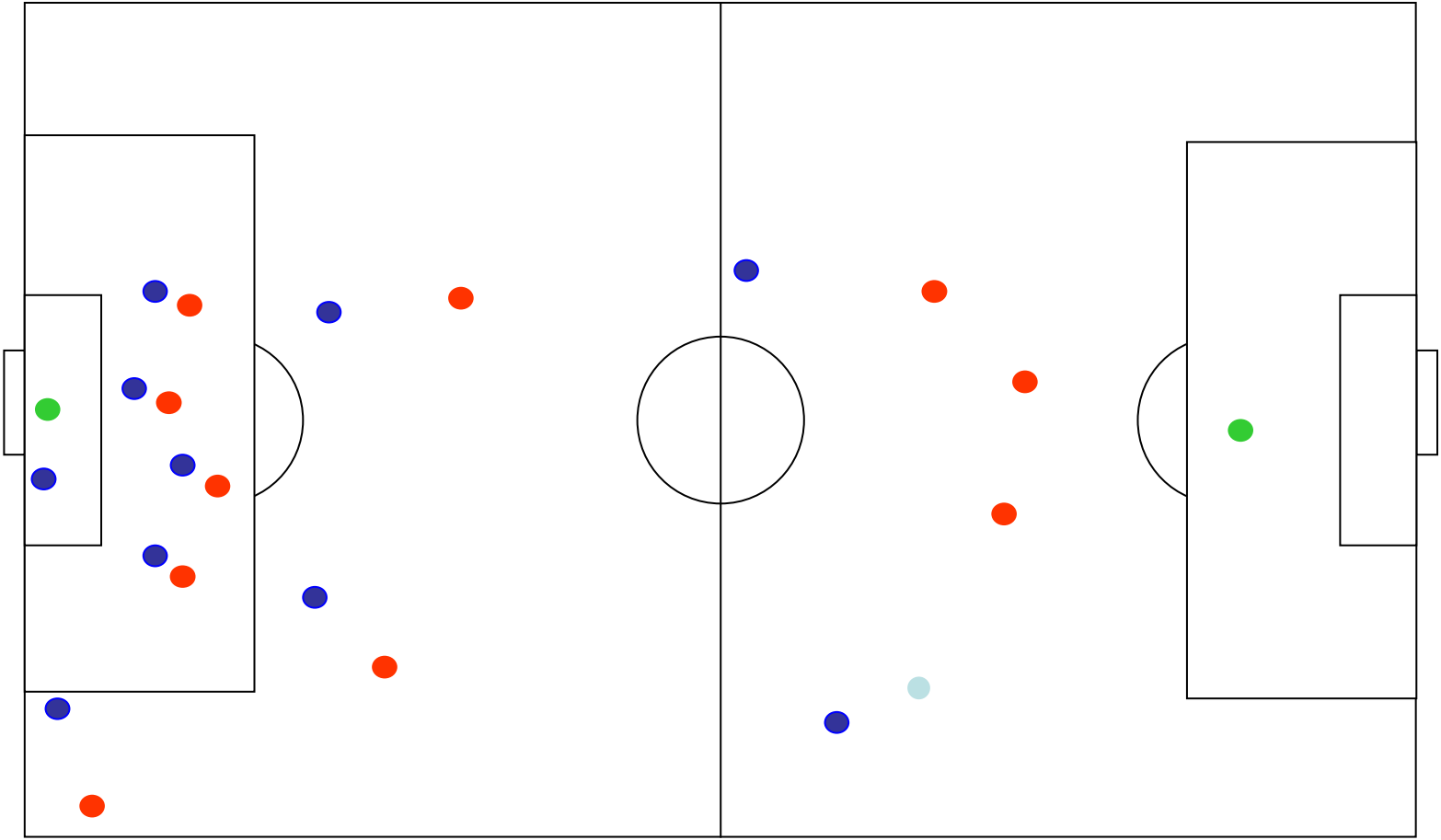




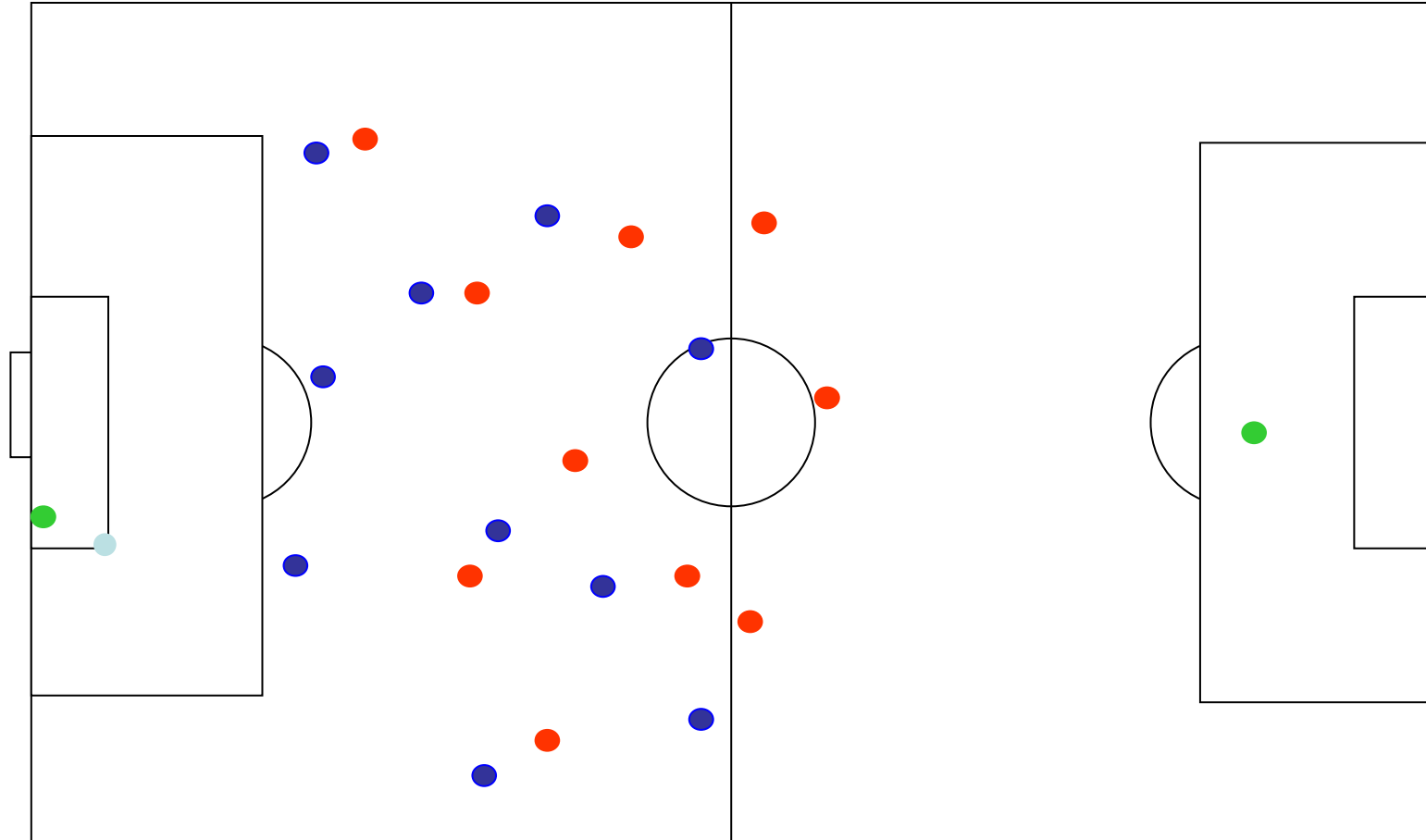


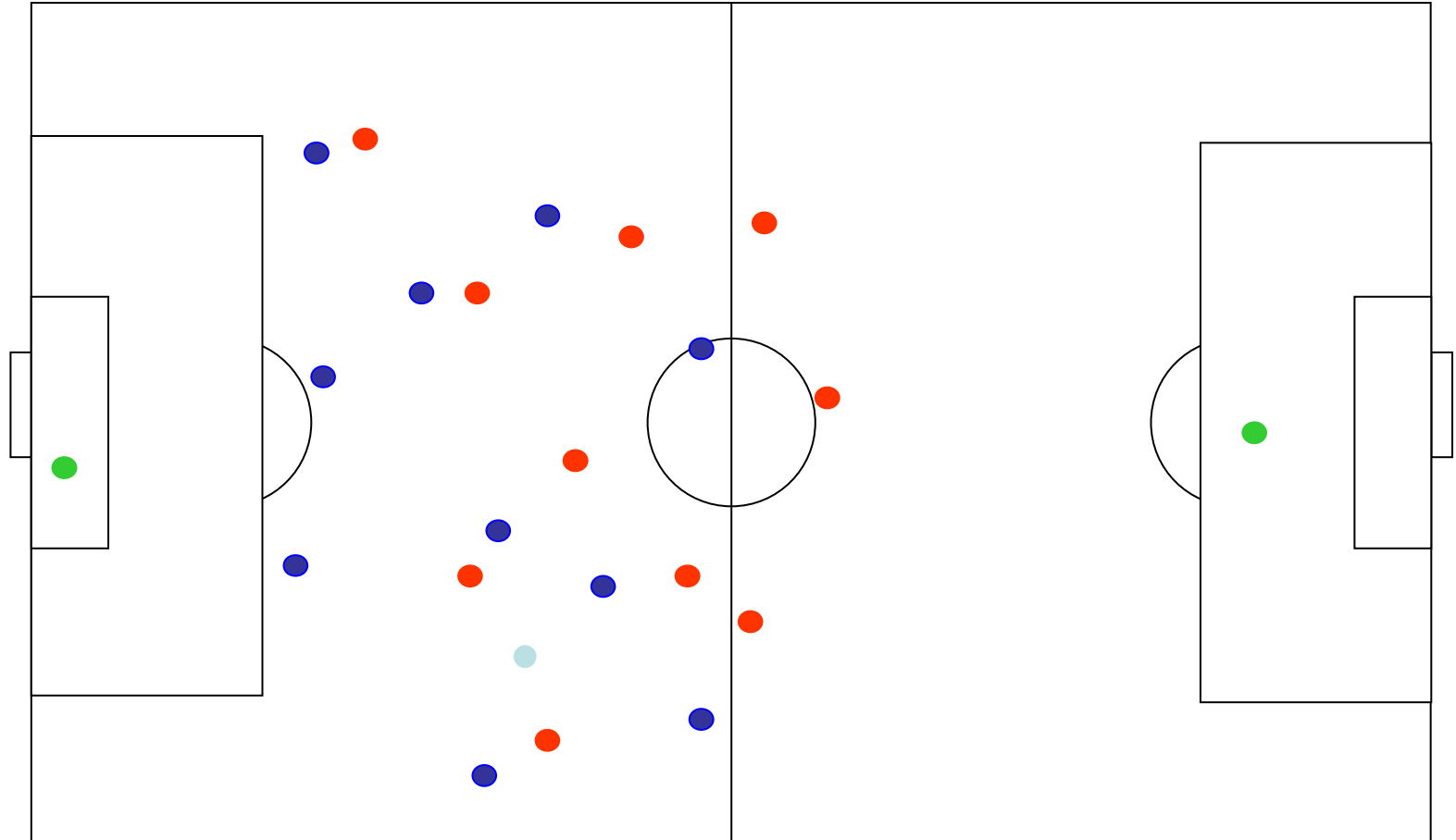


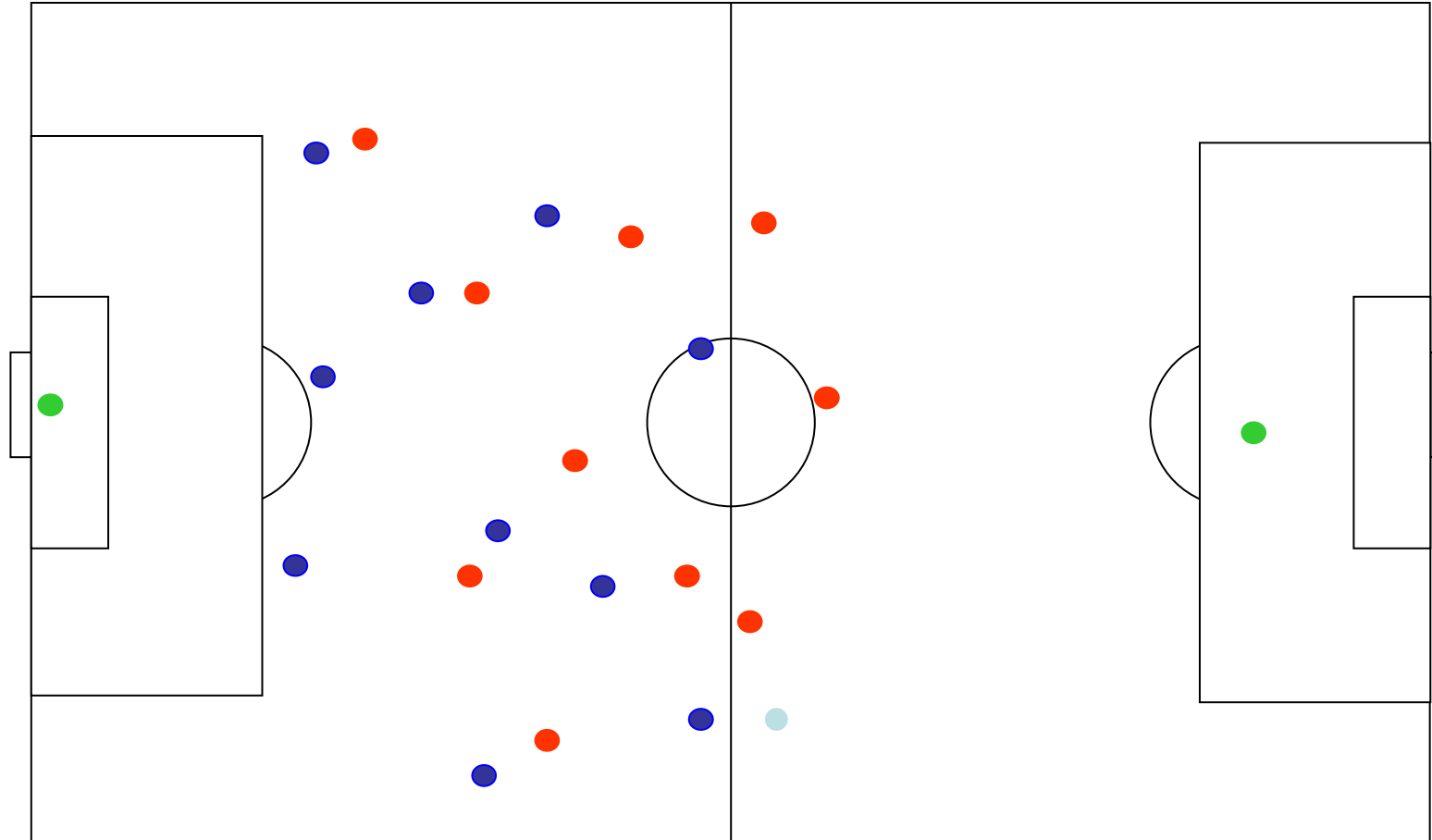




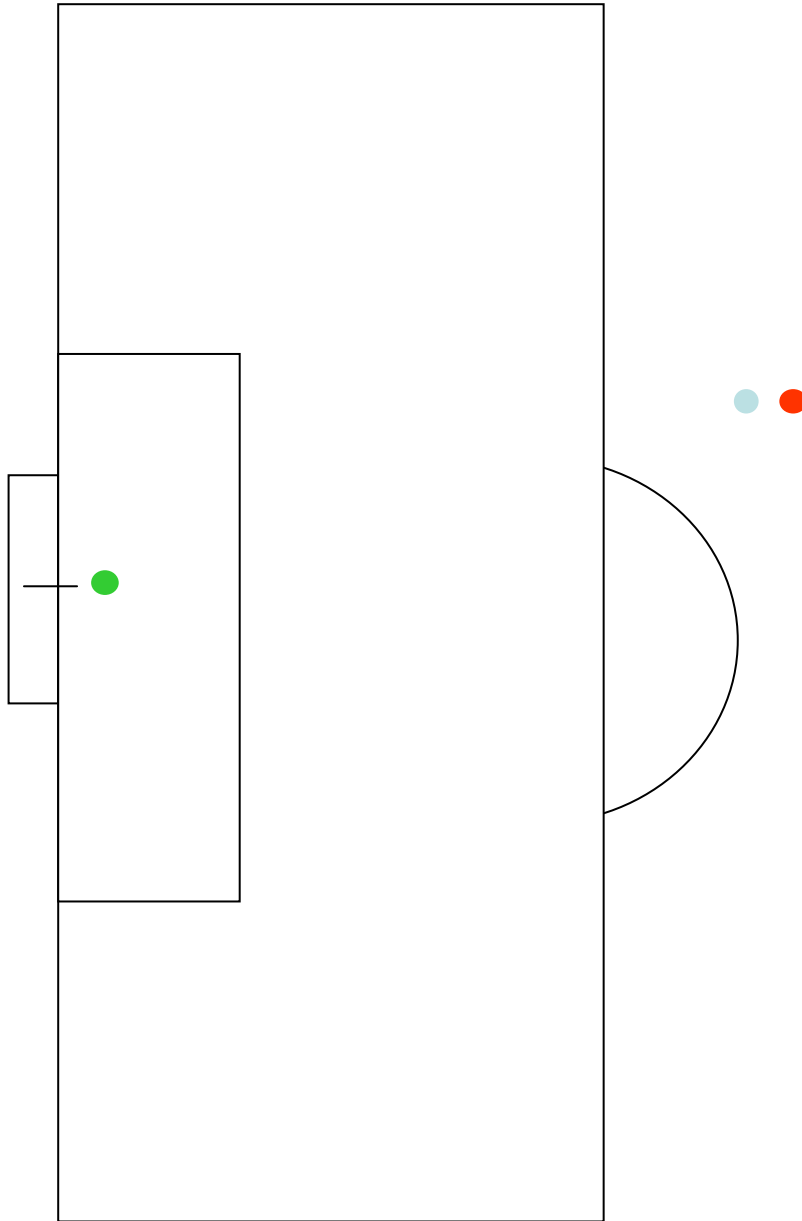








Application of the rules



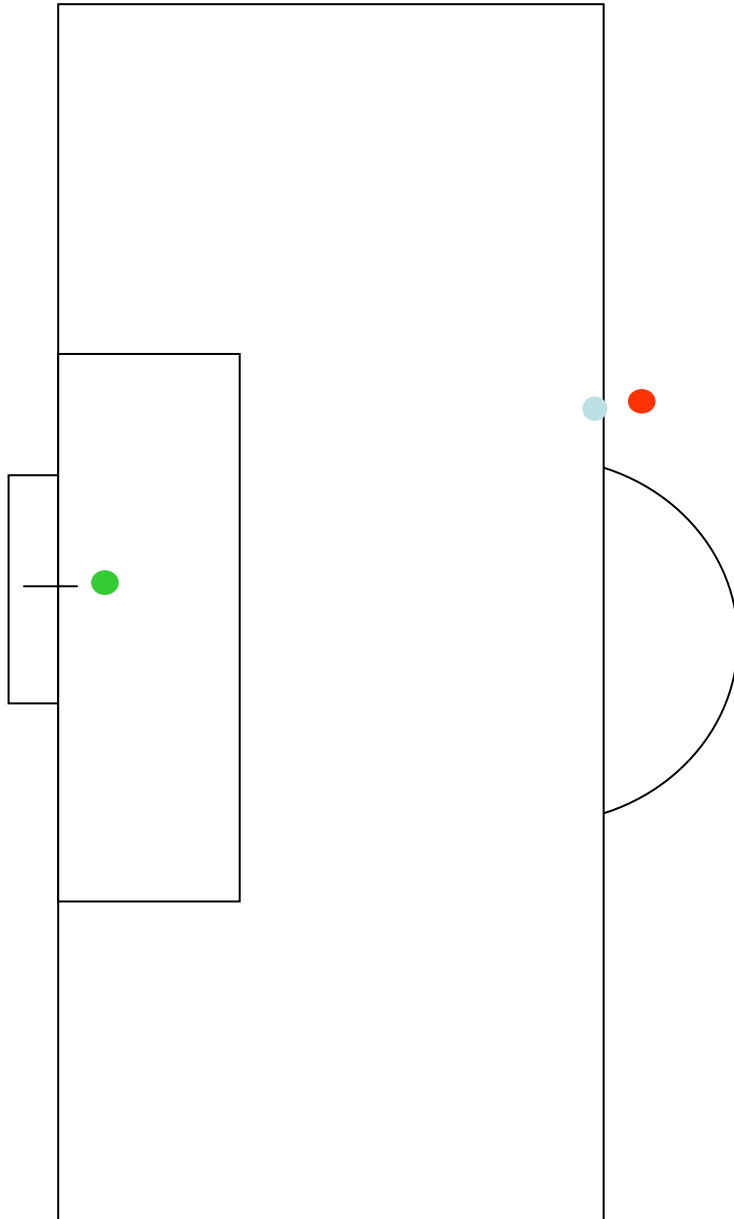
Ball on the grass and
player running alone,

break

Ball kicking, be careful.

1.A

179

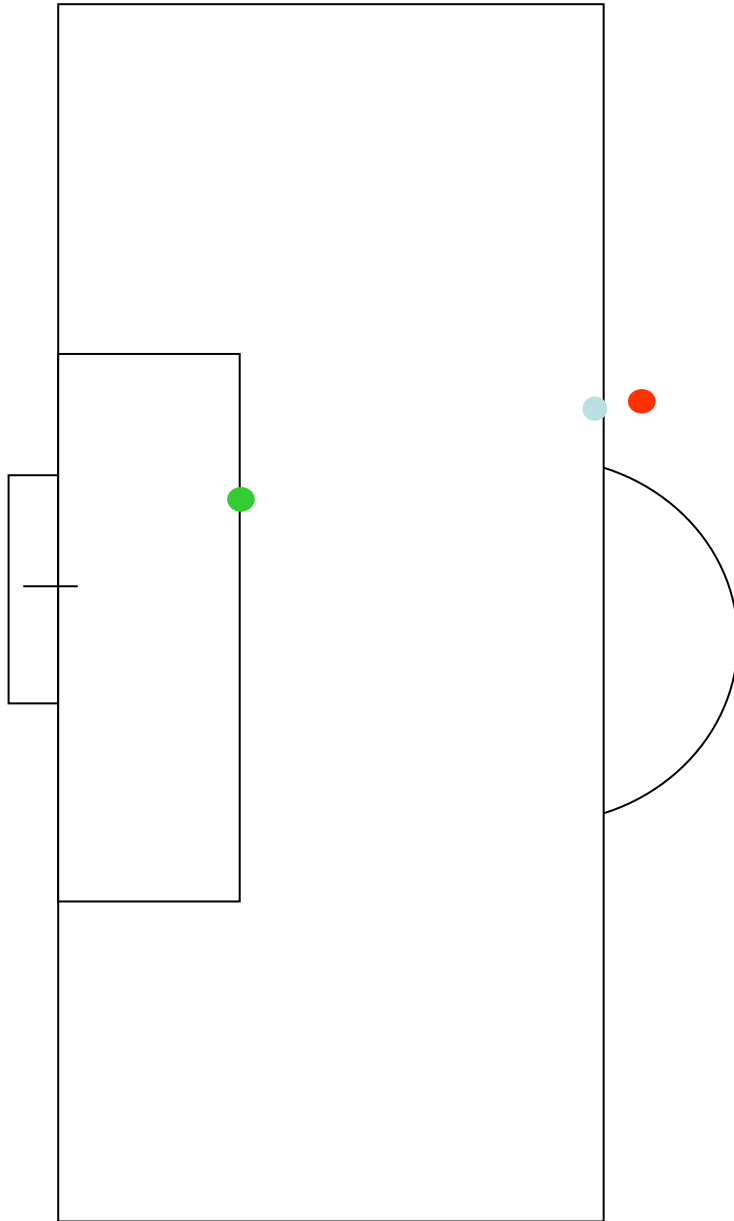


Ball on the grass and
player running alone,
break

Ball kicking, be careful.

1.B

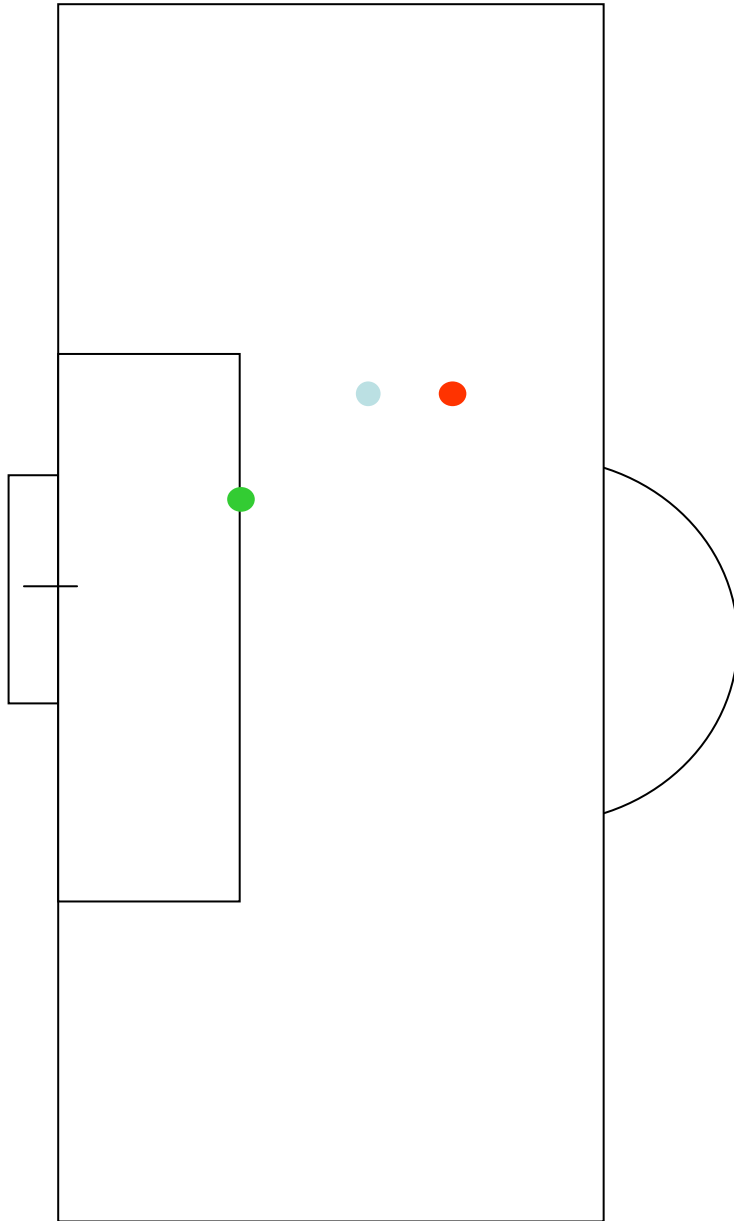
180



Ball on the grass and
player running alone,
break

Ball kicking, be careful.

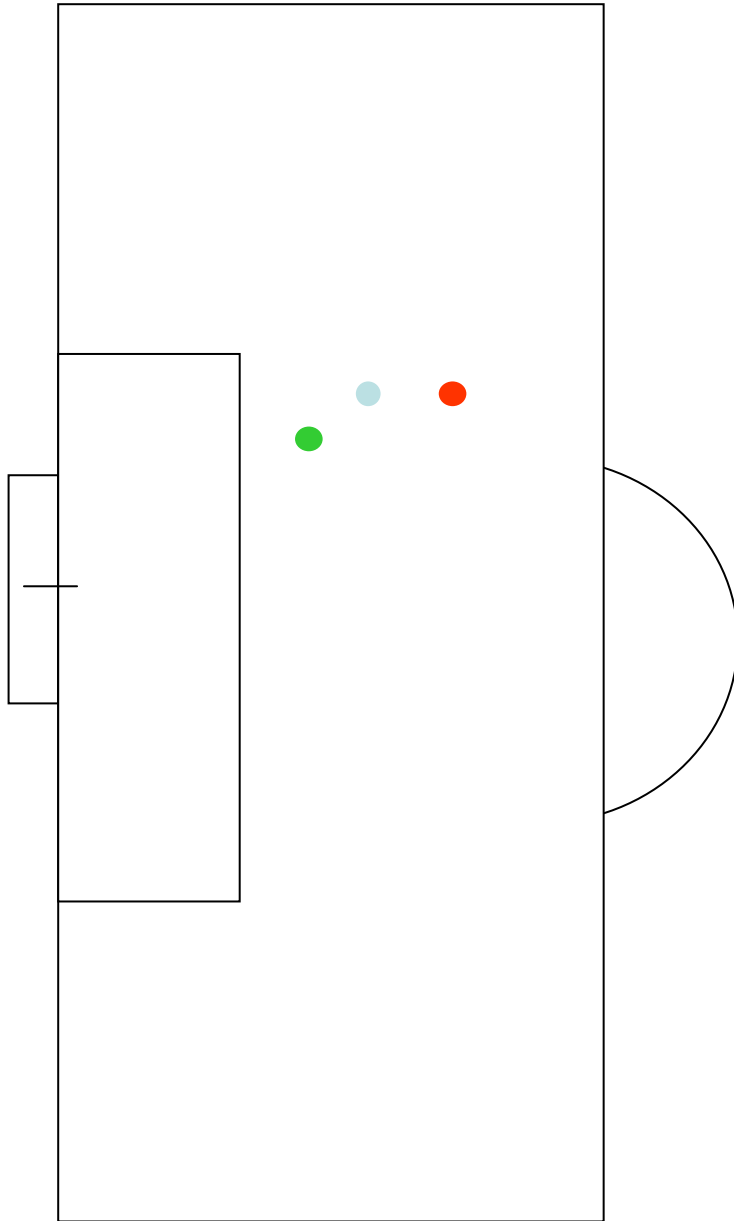
1.C



Ball on the grass and
player running alone,
break

Ball kicking, be careful.

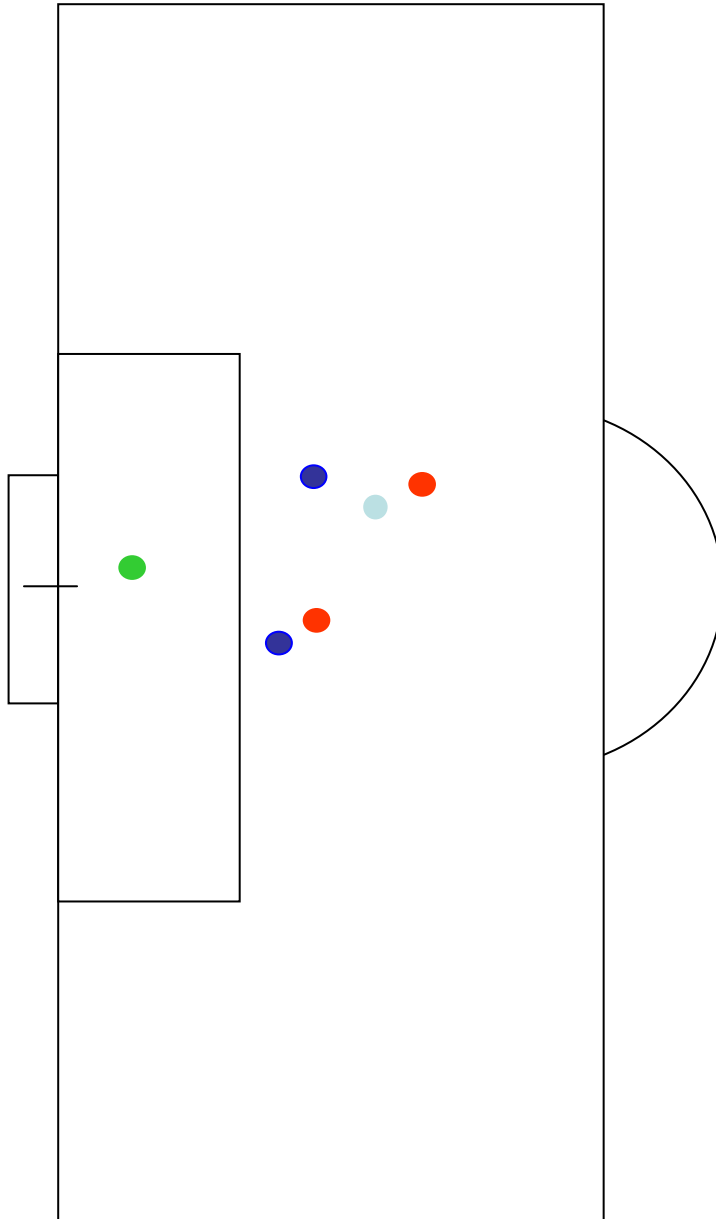
1.D



Ball on the grass and
player running alone,
break

Ball kicking, be careful.

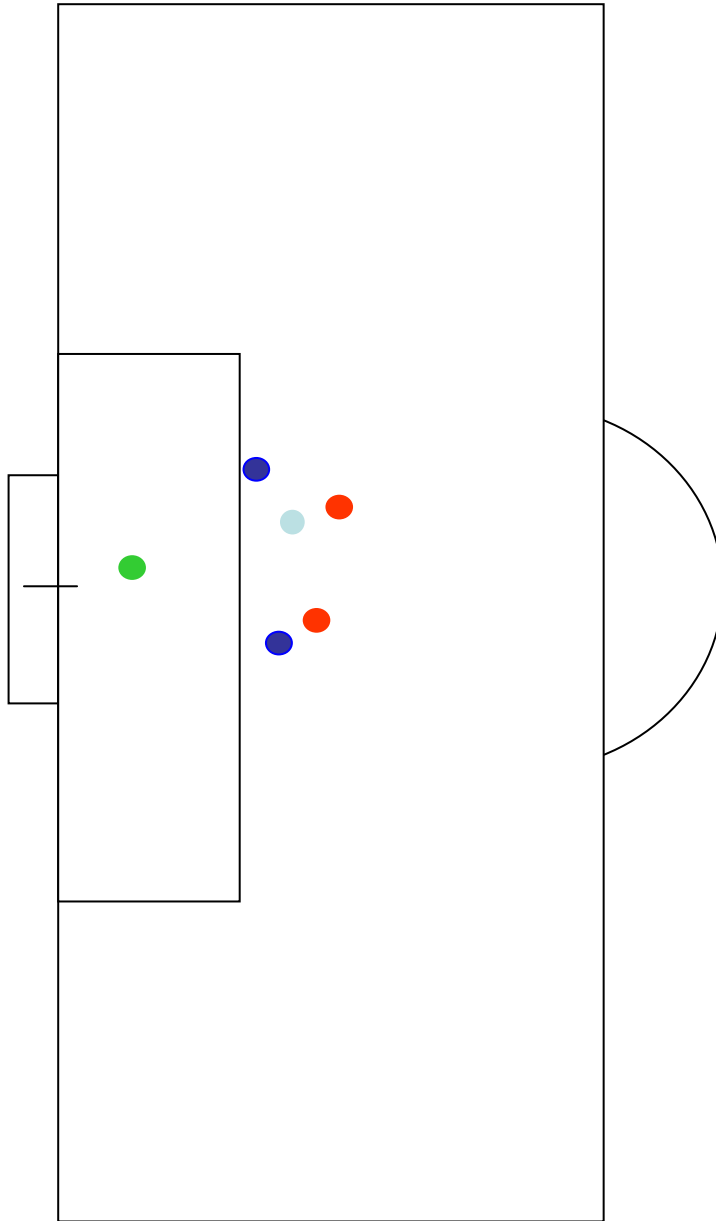
1.E



Ball on the grass and
player low pressed,
break

Ball kicking, stay a bit
more on the base line

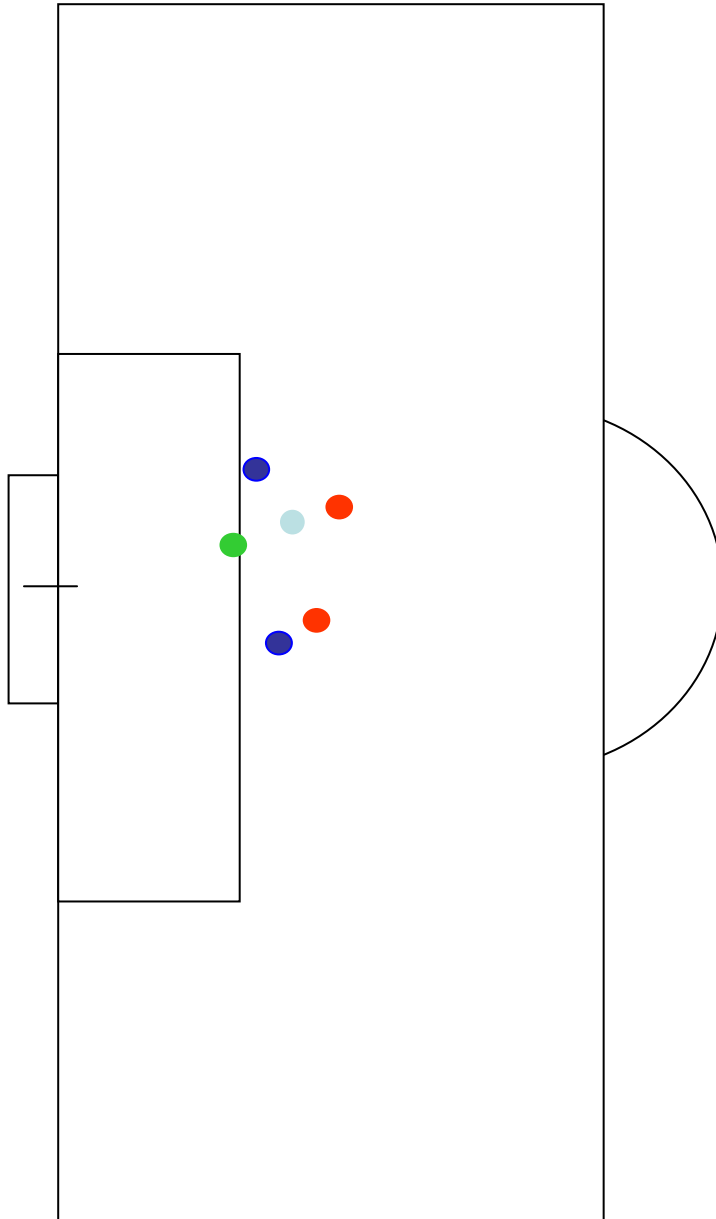
2.A



Ball on the grass and
player low pressed,
break

Ball kicking, stay a bit
more on the base line

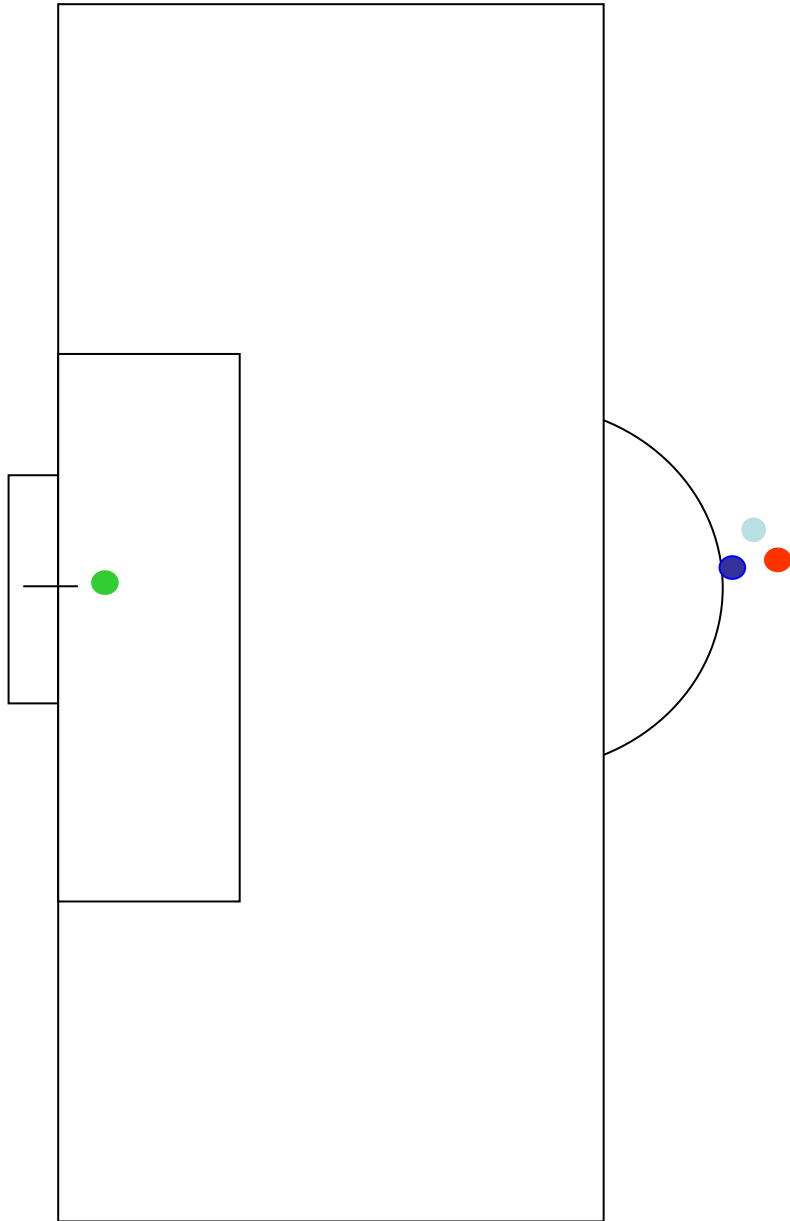
2.B



Ball on the grass and
player low pressed,
break

Ball kicking, stay a bit
more on the base line

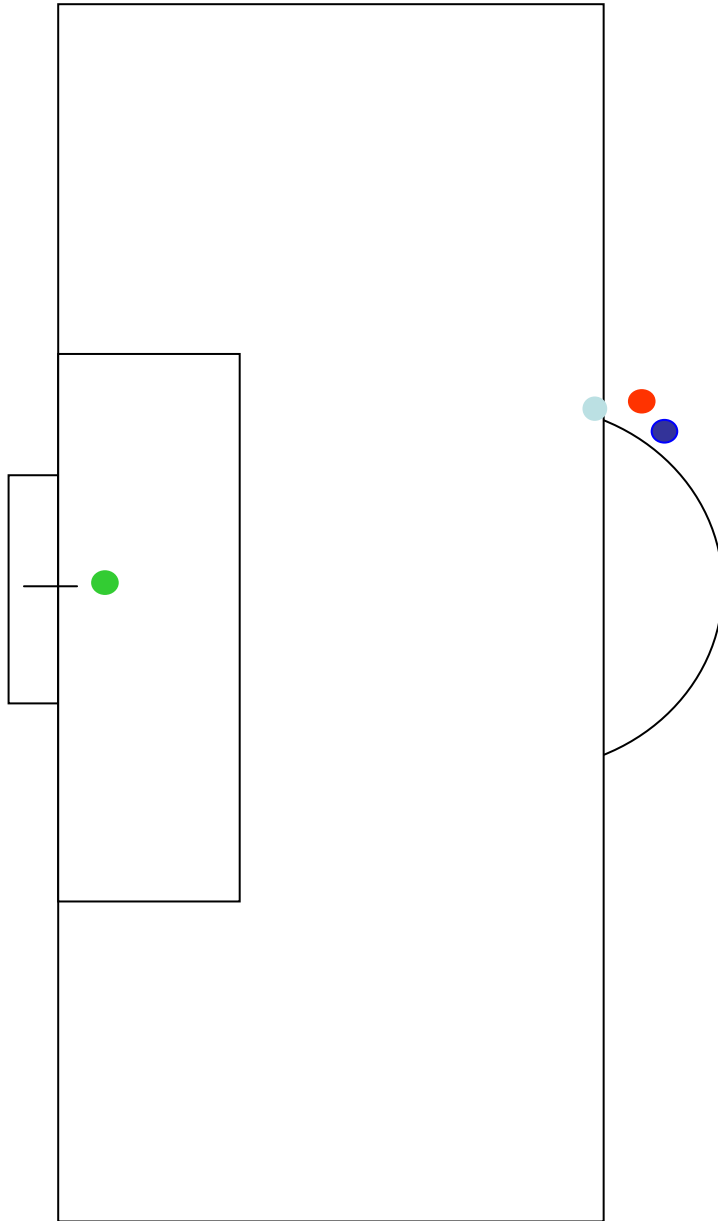
2.C



Defender recovered,
comeback to the base line

Ball kicking, stay on the
base line

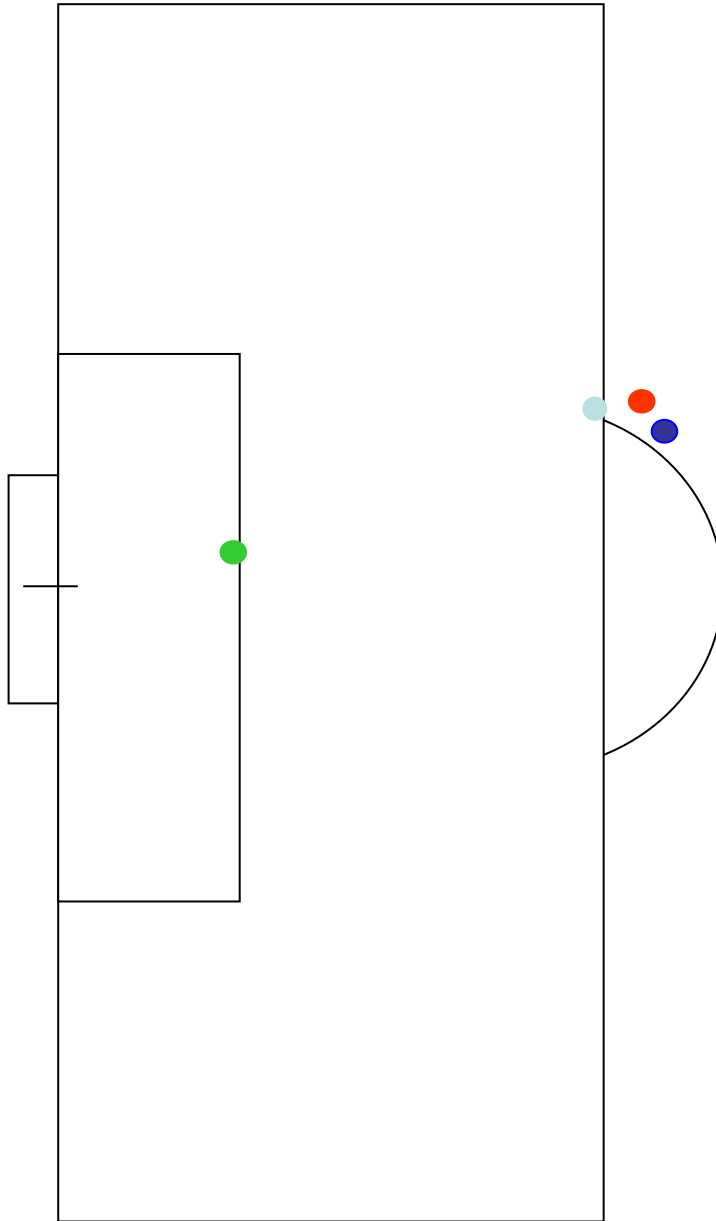
3A



Defender recovered,
comeback to the base line

Ball kicking, stay on the
base line

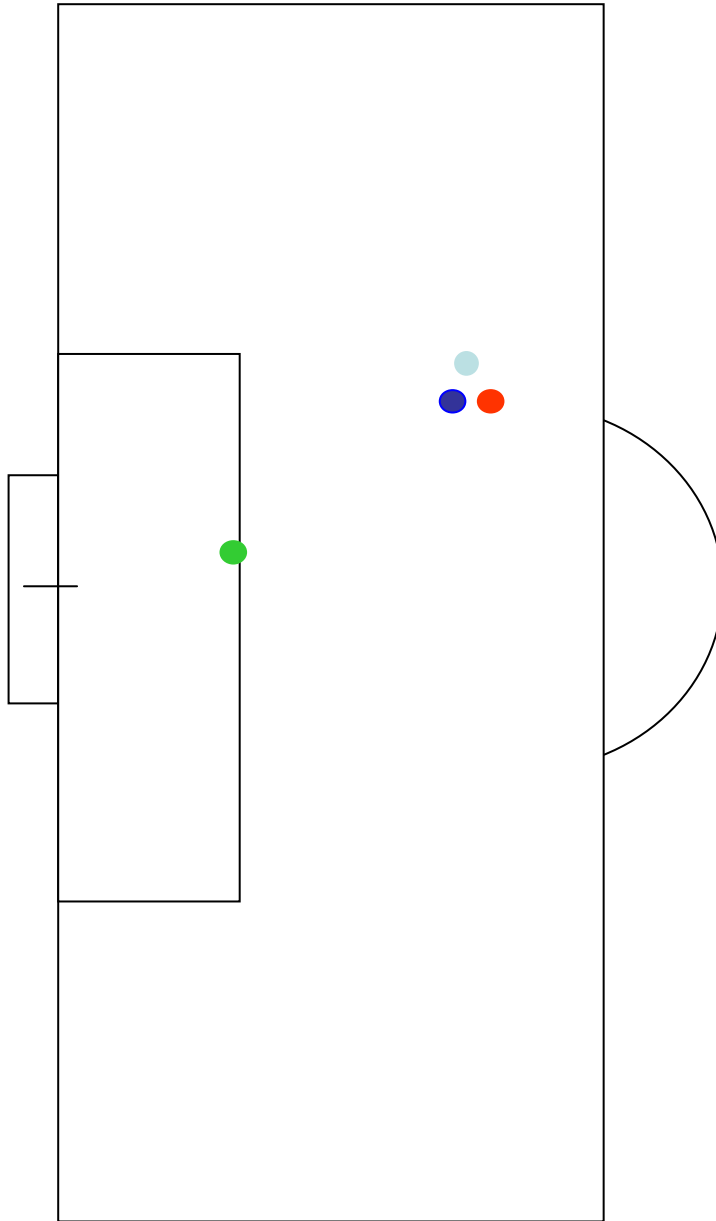
3.B



Defender recovered,
comeback to the base line

Ball kicking, stay on the
base line

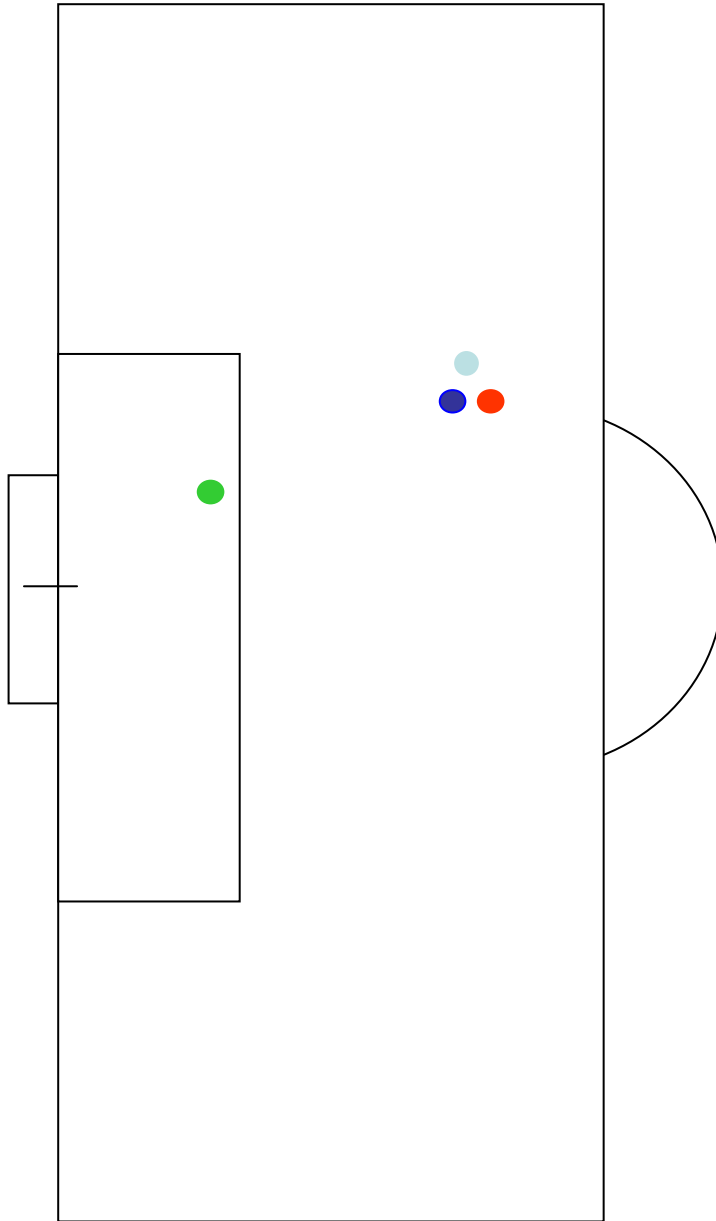
3.C



Defender recovered,
comeback to the base line

Ball kicking, stay on the
base line

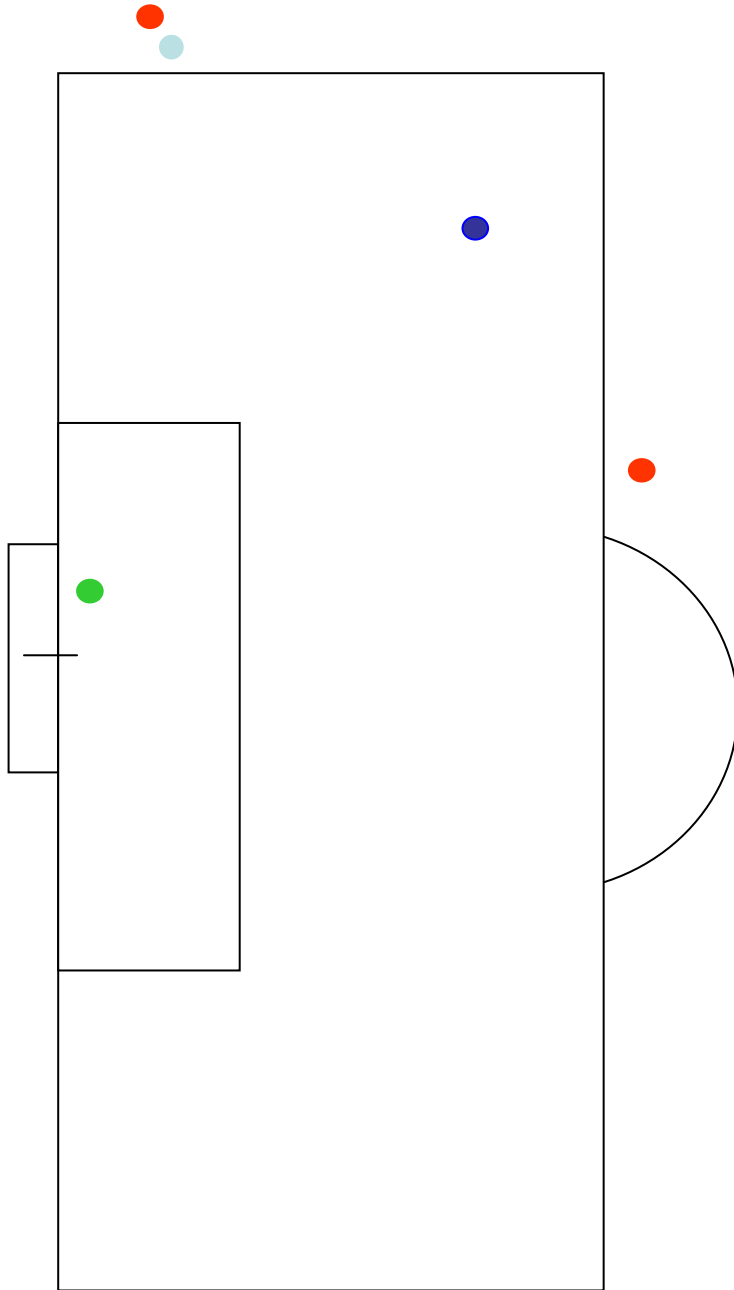
3.D



Defender recovered,
comeback to the base line

Ball kicking, stay on the
base line

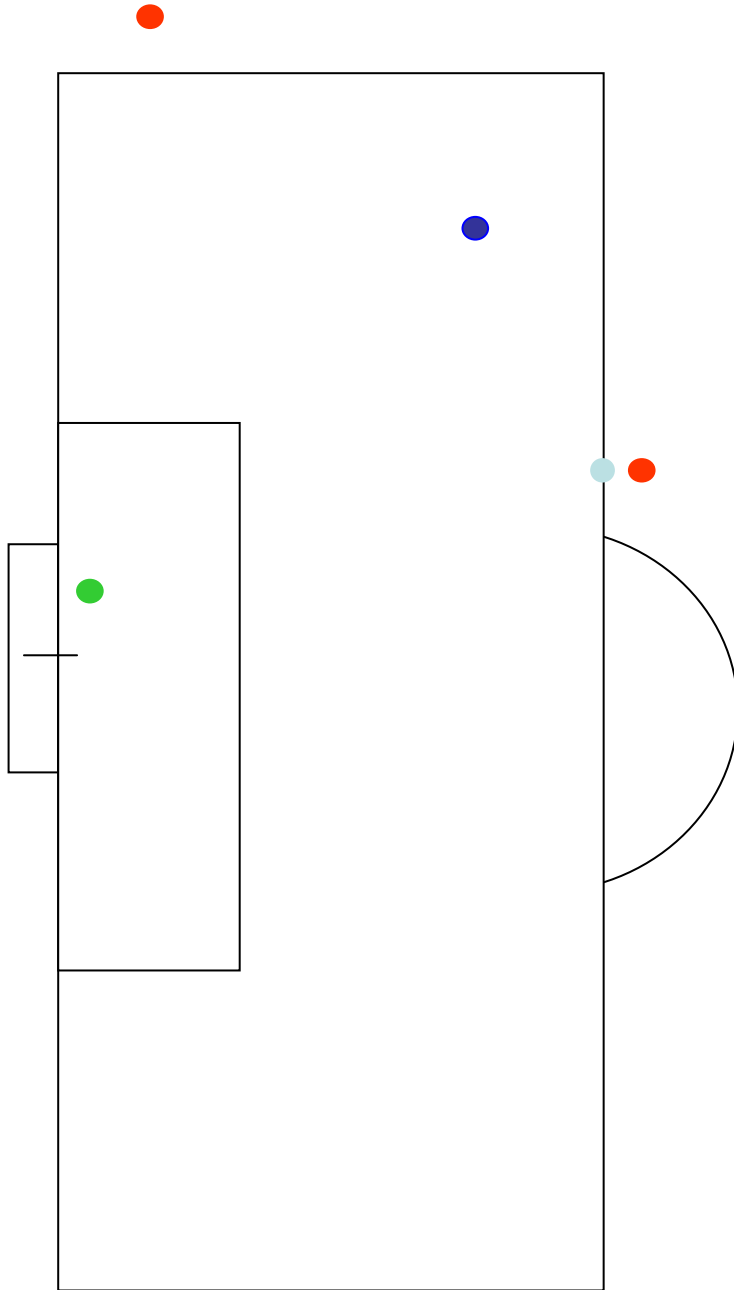
3.E



Ball on the grass and
player not pressed

Ball kicking, stay on the
base line

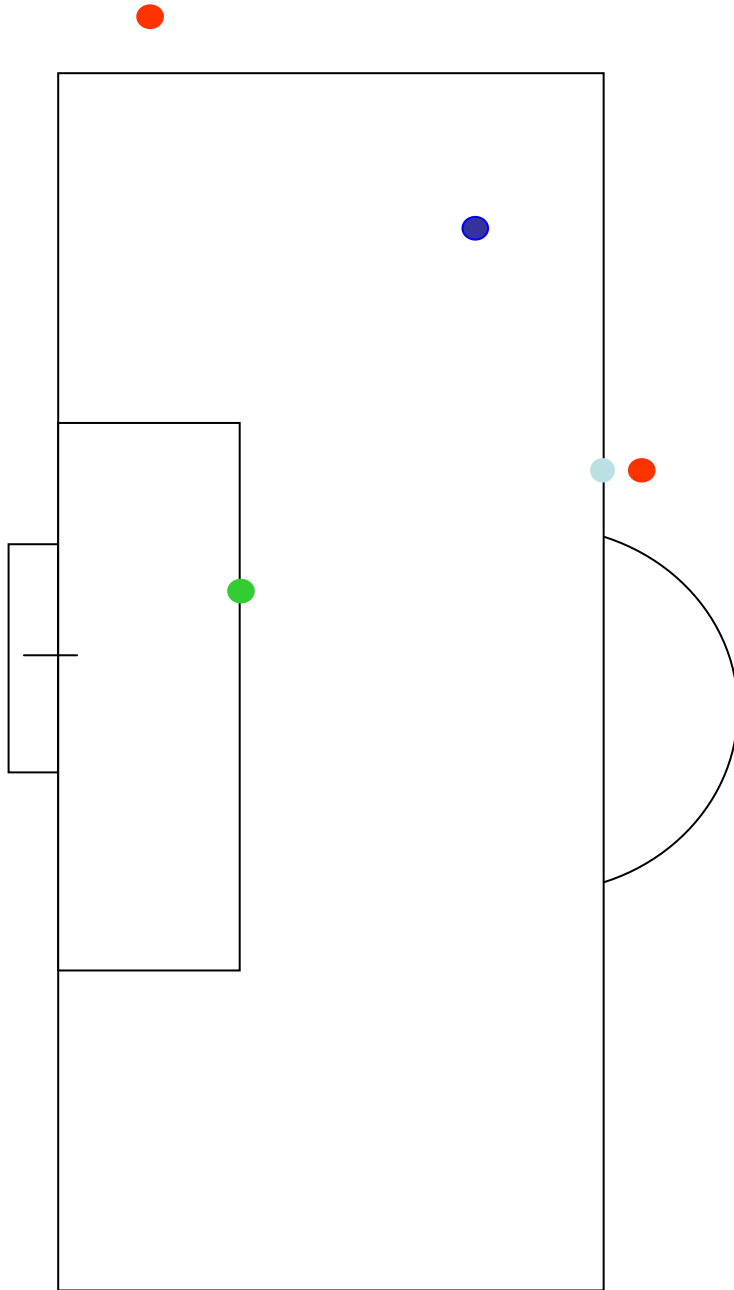
4.A



Ball on the grass and
player not pressed

Ball kicking, stay on the
base line

4.B

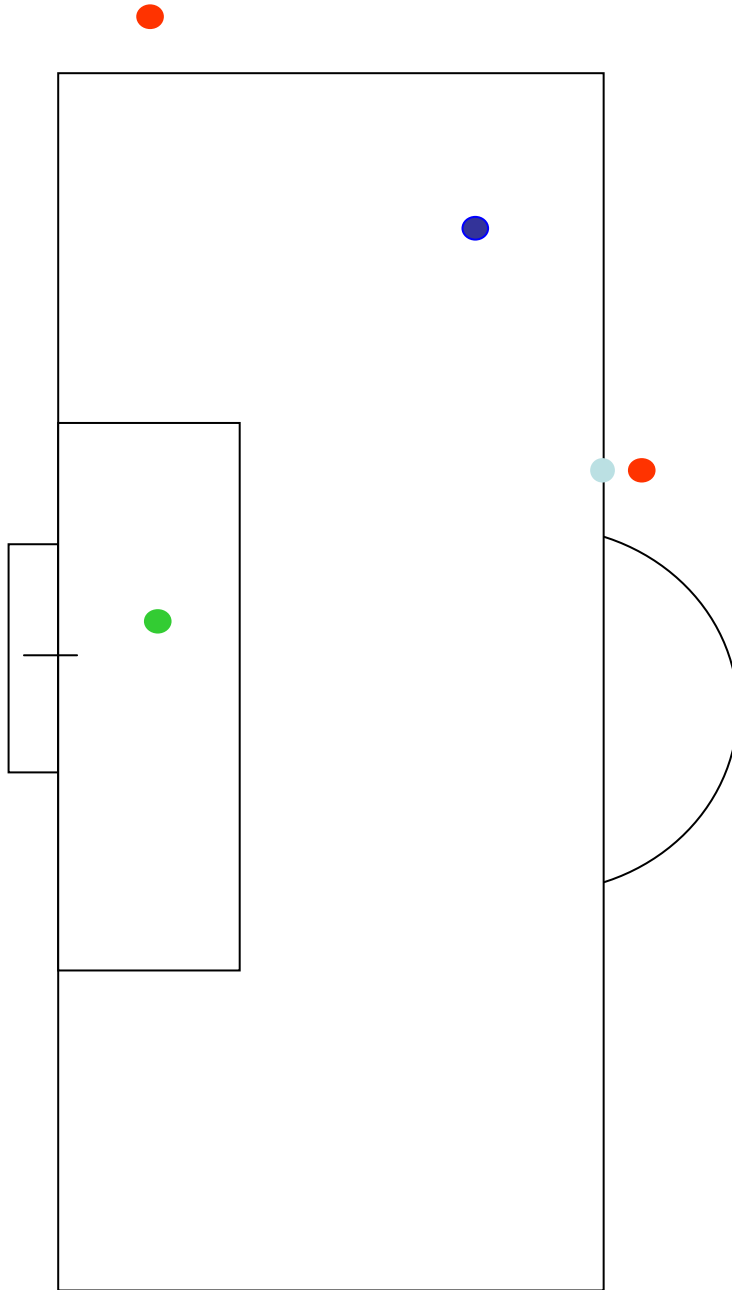


Ball on the grass and
player not pressed

If the player look,
comeback

Ball kicking, stay on the
base line

5 C

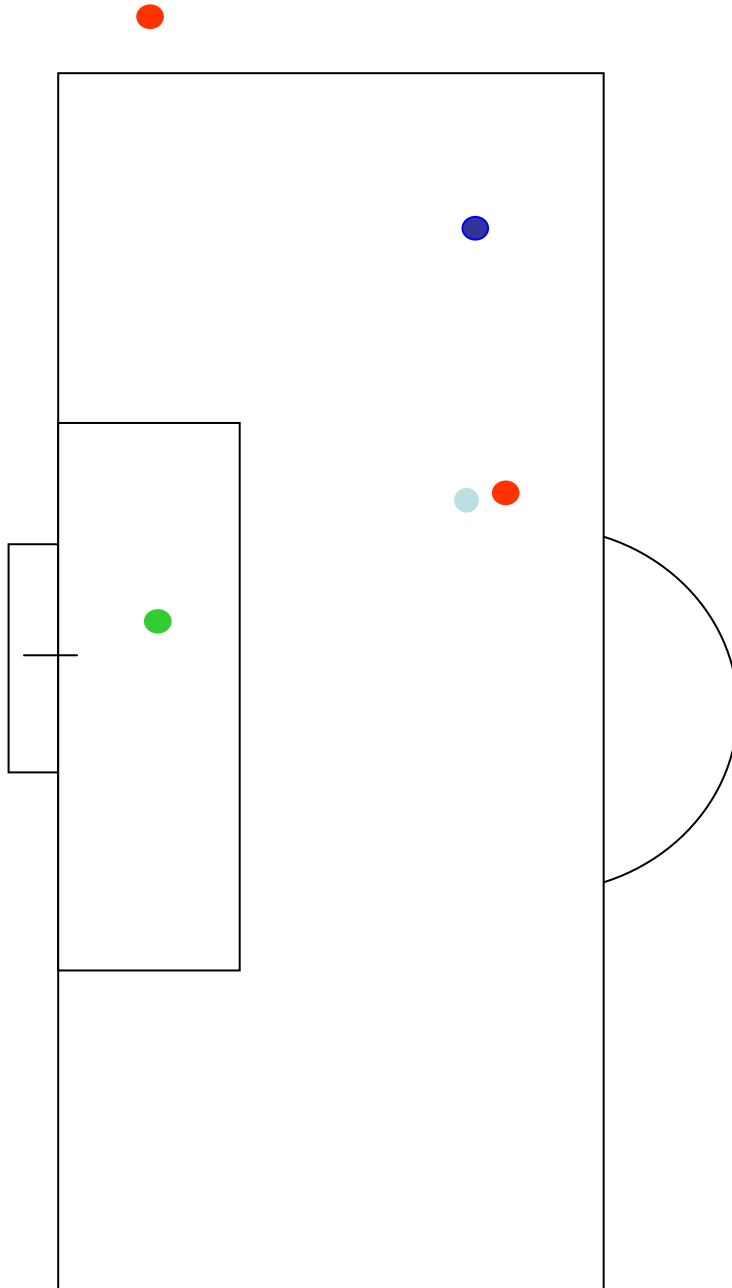


Ball on the grass and
player not pressed

If the player look,
comeback

Ball kicking, stay on the
base line

4.D

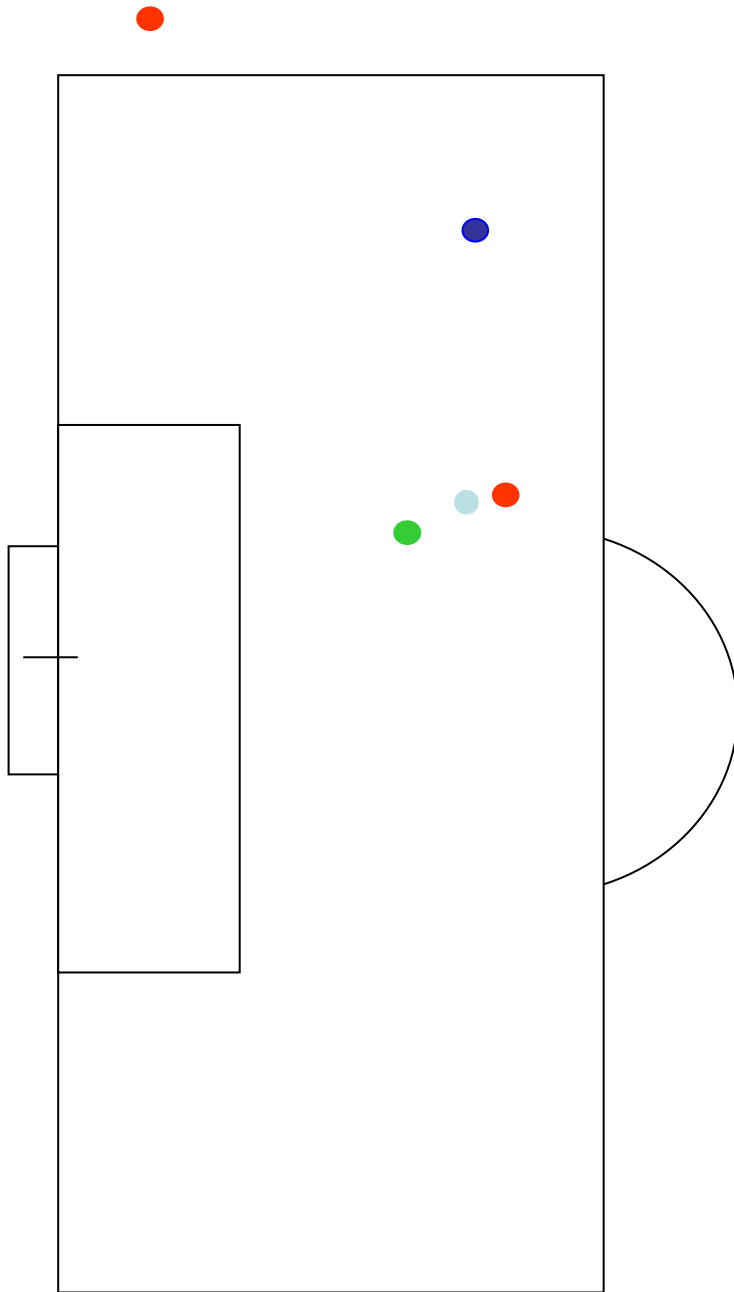


Ball on the grass and
player not pressed

If the player run,
close or break

Ball kicking, stay on the
base line

4.E

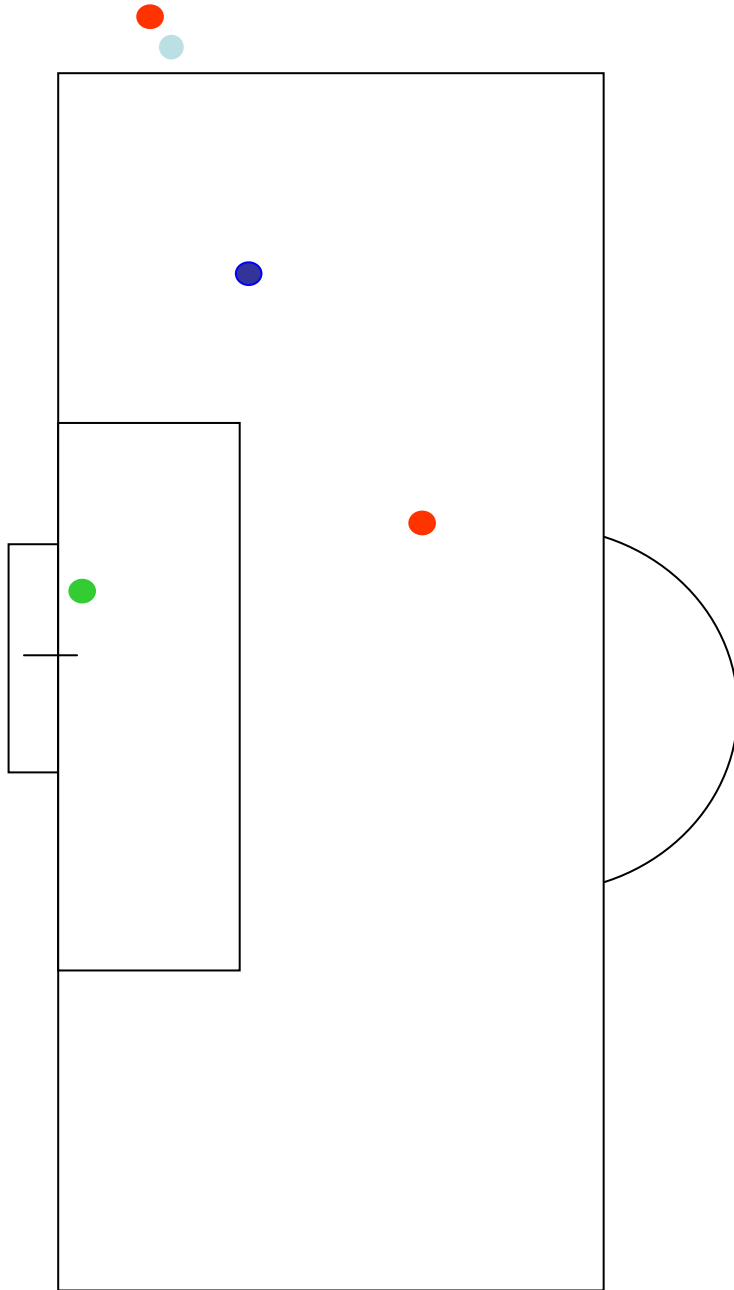


Ball on the grass and
player not pressed

If the player run,
close or break

Ball kicking, stay on the
base line

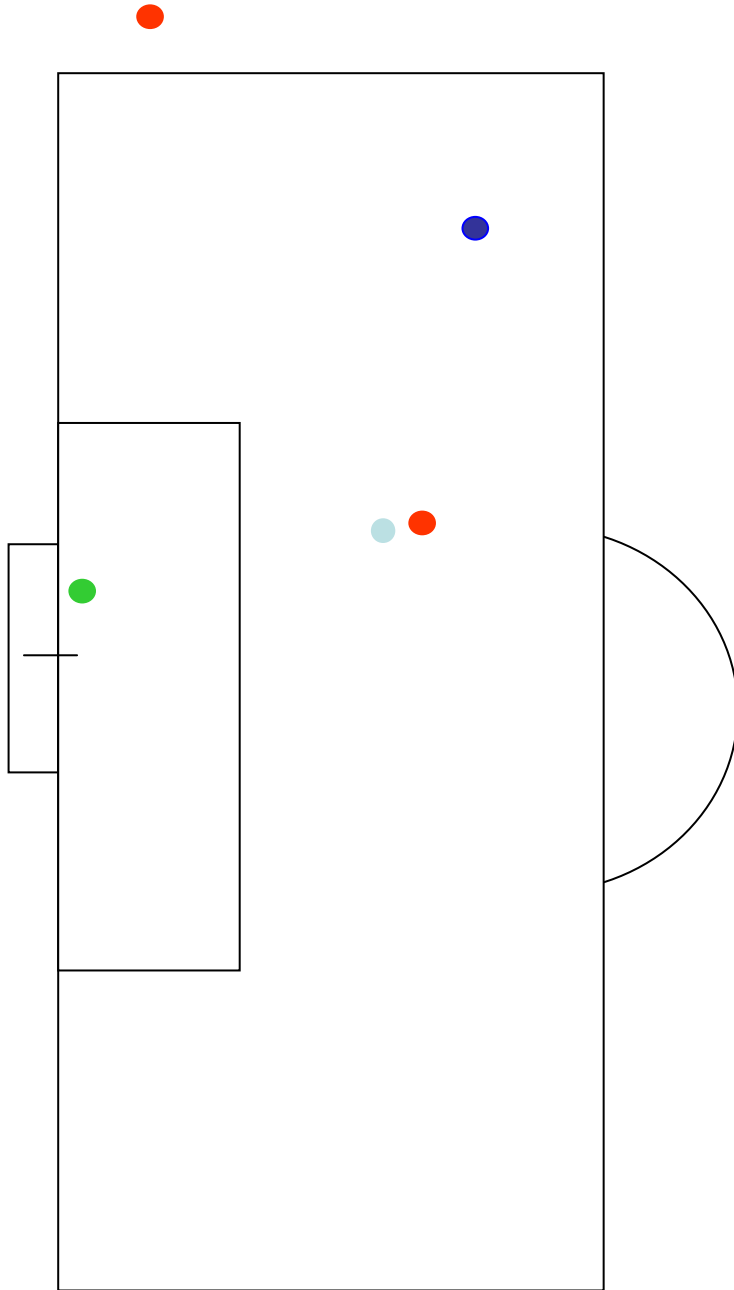
4.F



Ball on the grass and
player not pressed

Ball kicking, stay on the
base line

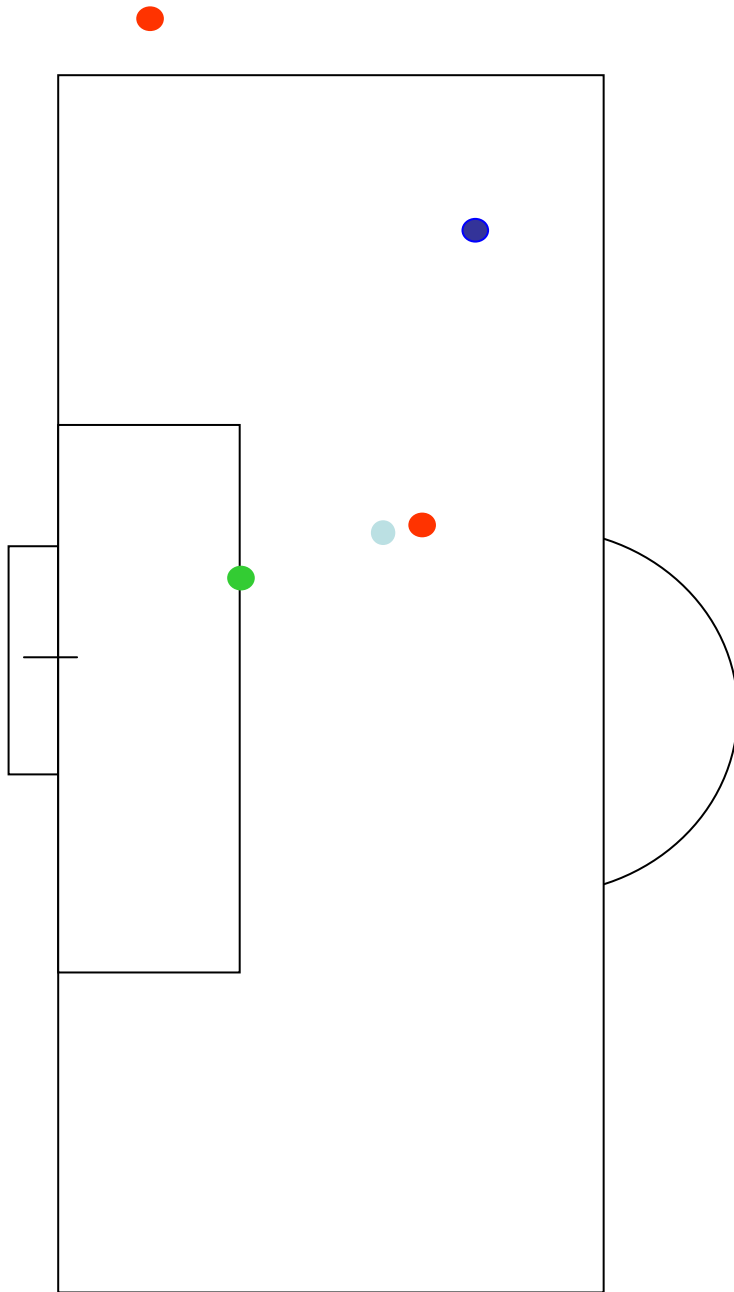
5.A



Ball on the grass and
player not pressed

Ball kicking, stay on the
base line

5 B

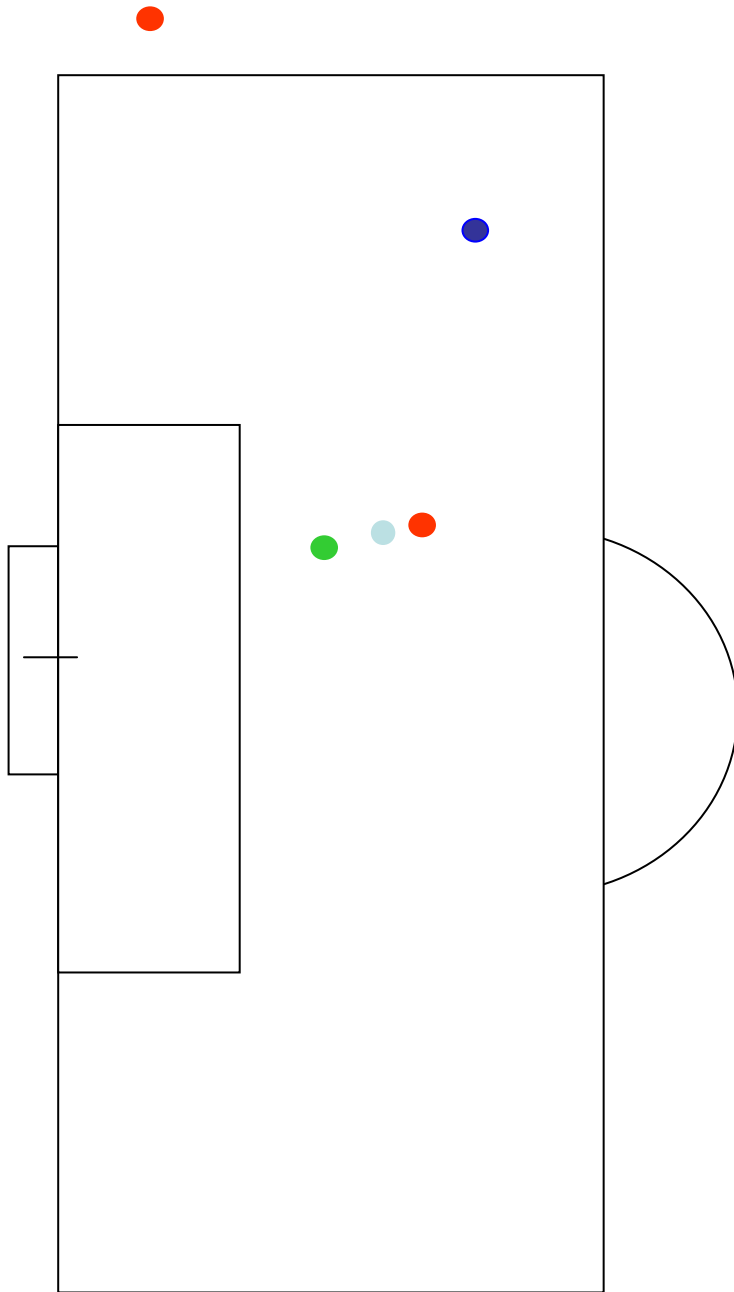


Ball on the grass and
player not pressed

Ball kicking, stay on the
base line

5.C

200



Ball on the grass and
player not pressed

Ball kicking, stay on the
base line

5.D

Layout

- Introduction
- Goal keeper
- Soccer game model
- Example
- Game evaluation and design
- Future works

A sequence of Continuous Stochastic Dynamical Systems

State at t : 3D position of players and ball on the field at time t .

Interruption: referee break.

output: score

After each interruption the score is updated, the initial conditions are reset, and the system may be modified.

System Dynamics

- **Player** is an autonomous system
- **Team** is a set of players
- **Game**: one team plays against other
- **Team objective in a game**: make goals and avoid adversary goals

System characterization

- **Player ability:** dictionary of actions and capability of executing it
- **Player strategy:** prediction of next events and planning of corresponding action sequences

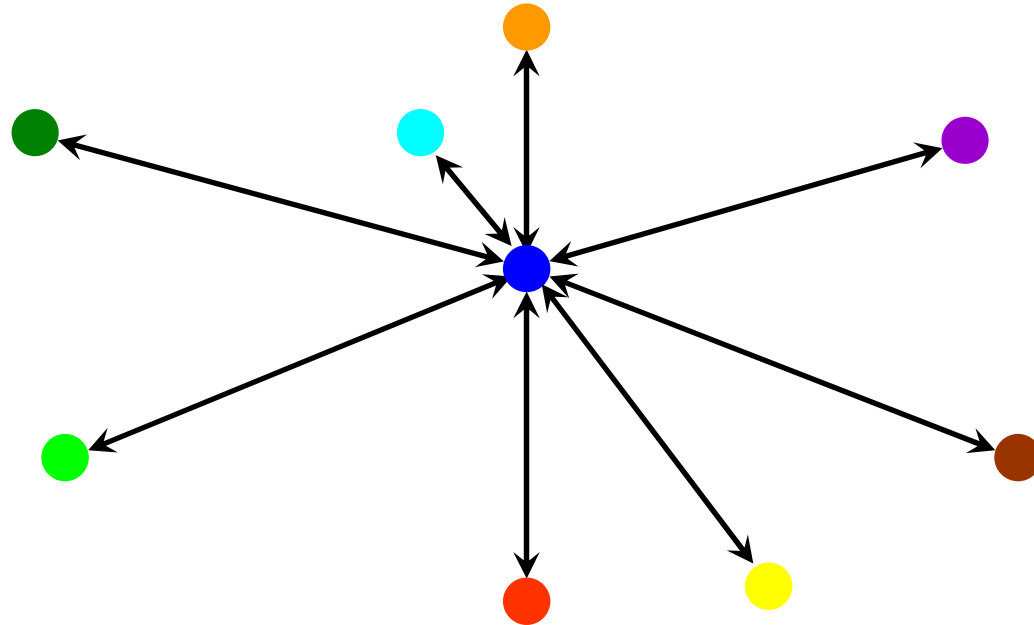
System modeling

- **Dictionary action:** stochastic dynamical systems (Markov chains) – discrete or hybrid
- **Player strategy**
 - **prediction:** conditional distribution, $P(\text{fact} \mid \text{system state})$
 - **planning:** mapping of a fact in a sequence of dictionary actions

Layout

- Introduction
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Goal keeper strategy



● Prediction

● Planning

● Positioning

● Ready

● Catch

● Close

● Break

● Talk









● Ball pass

Goal keeper strategy

Dynamical simulation

Shot defense



- | | | |
|---|---|--|
|  Prediction |  Planning |  Positioning |
|  Ready |  Catch |  Close |
|  Break |  Talk |  Ball pass |

Layout

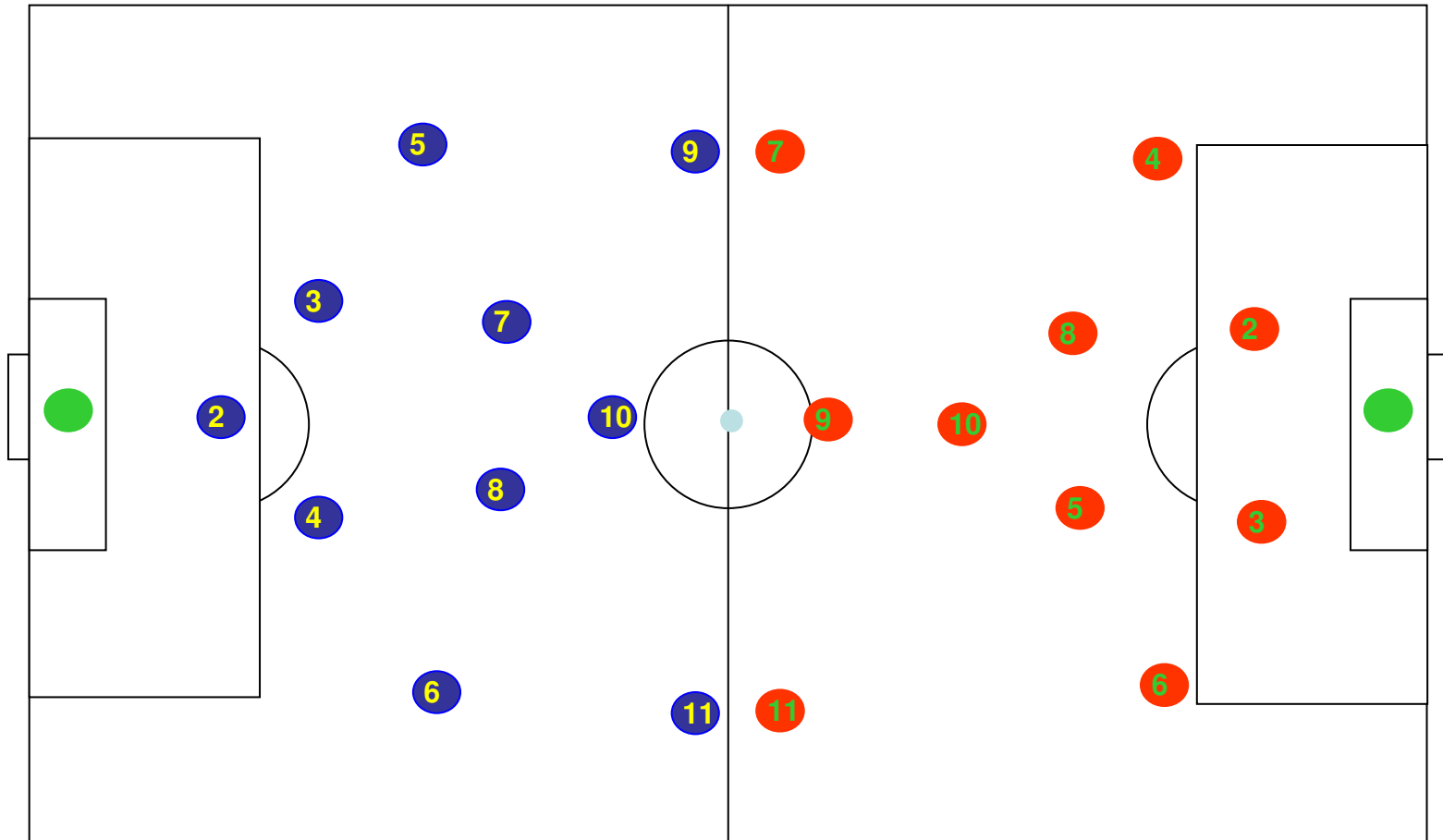
- Introduction
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- **Game tactics** attractors of the stochastic dynamical system that represents the game
- **Team tactics** attractors of the stochastic dynamical subsystem that represents the team

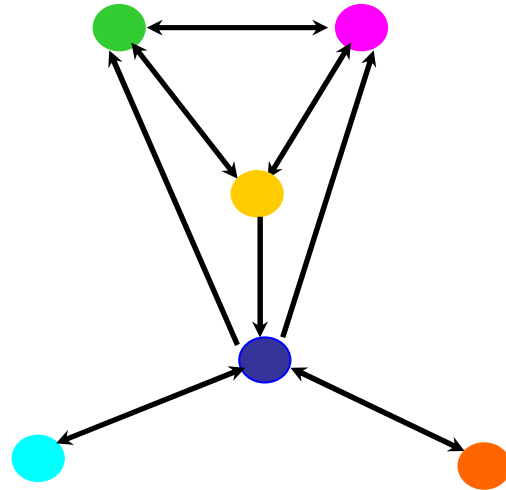
Example

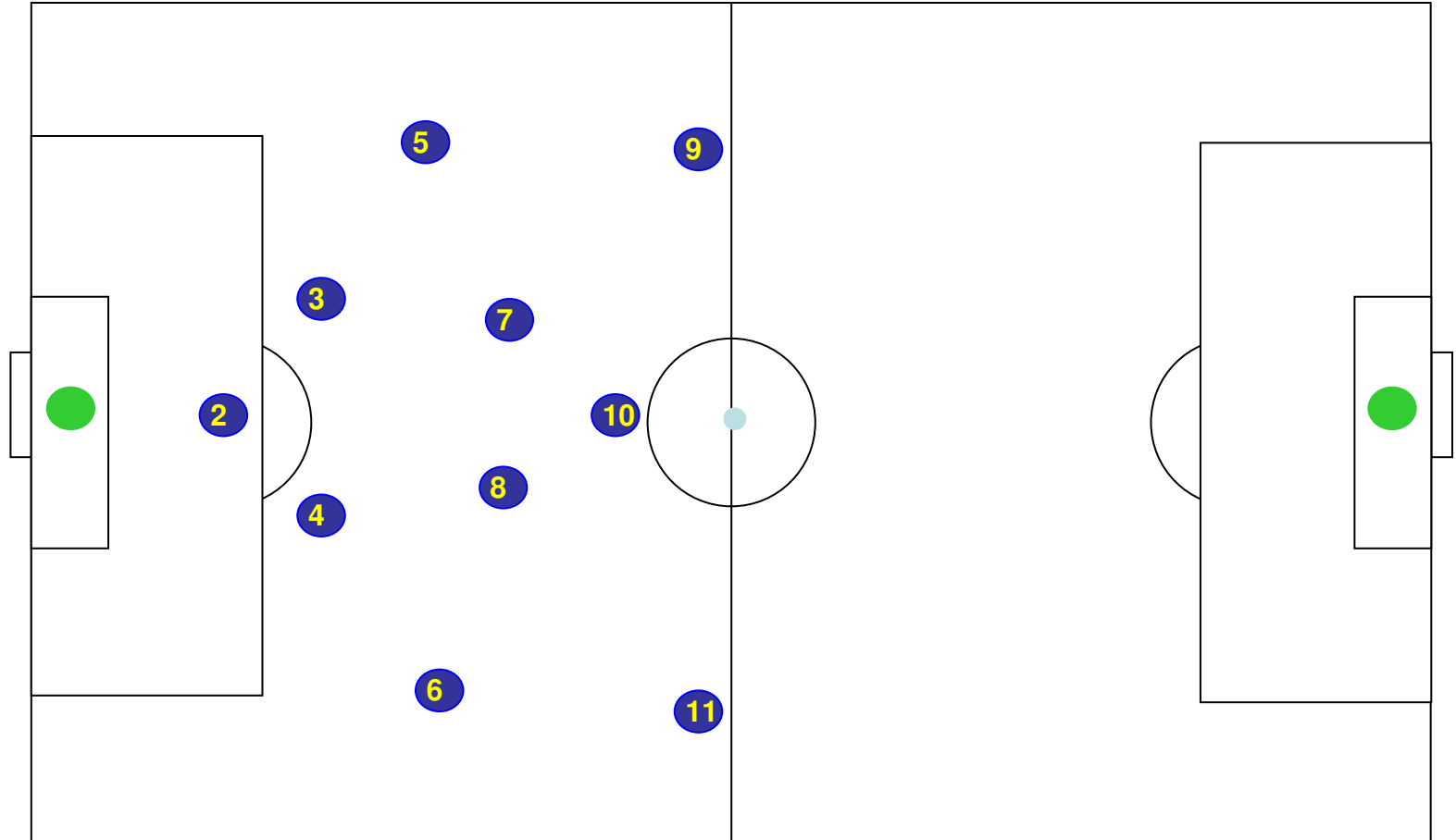
3-5-2

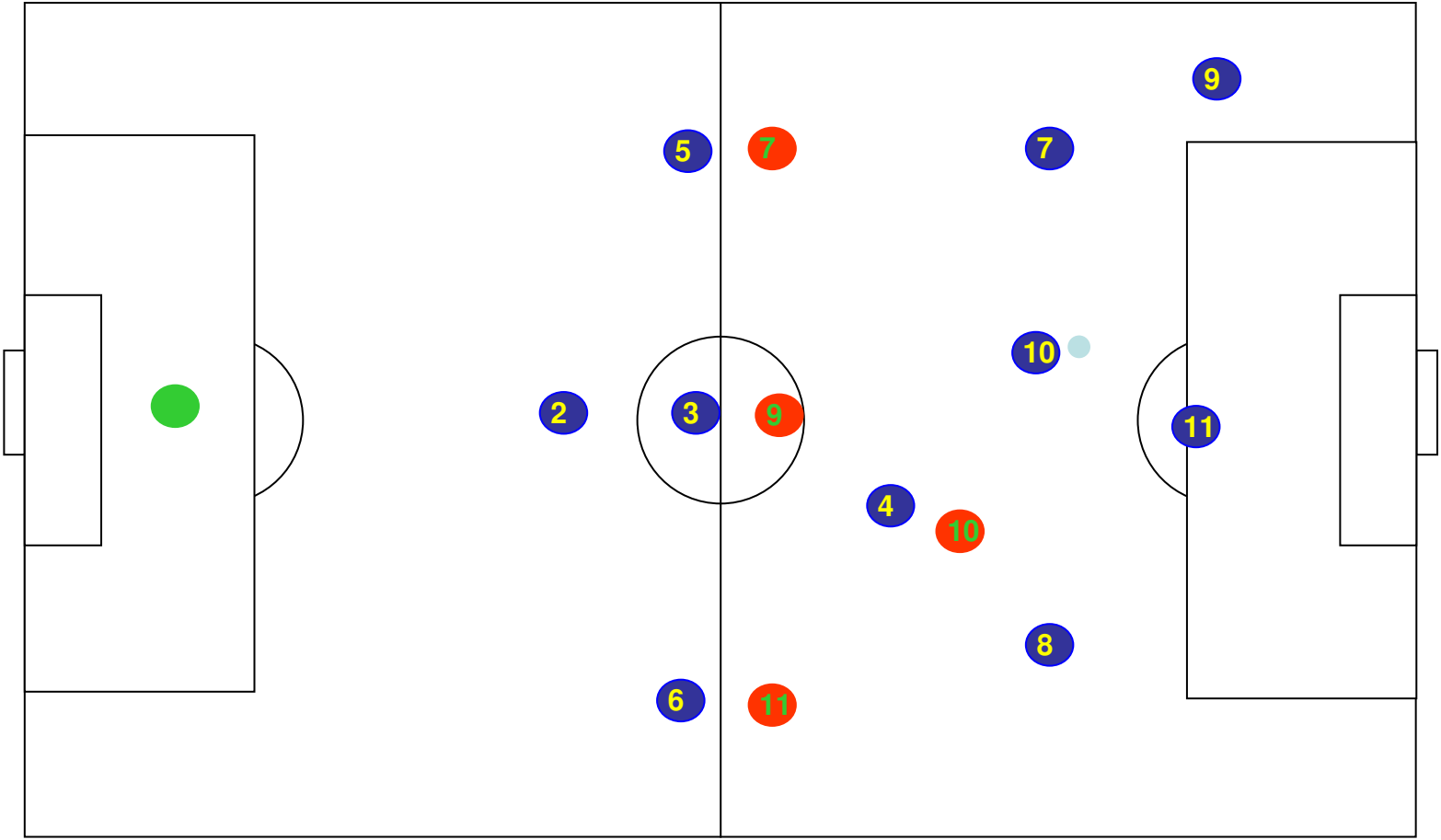
4-3-3

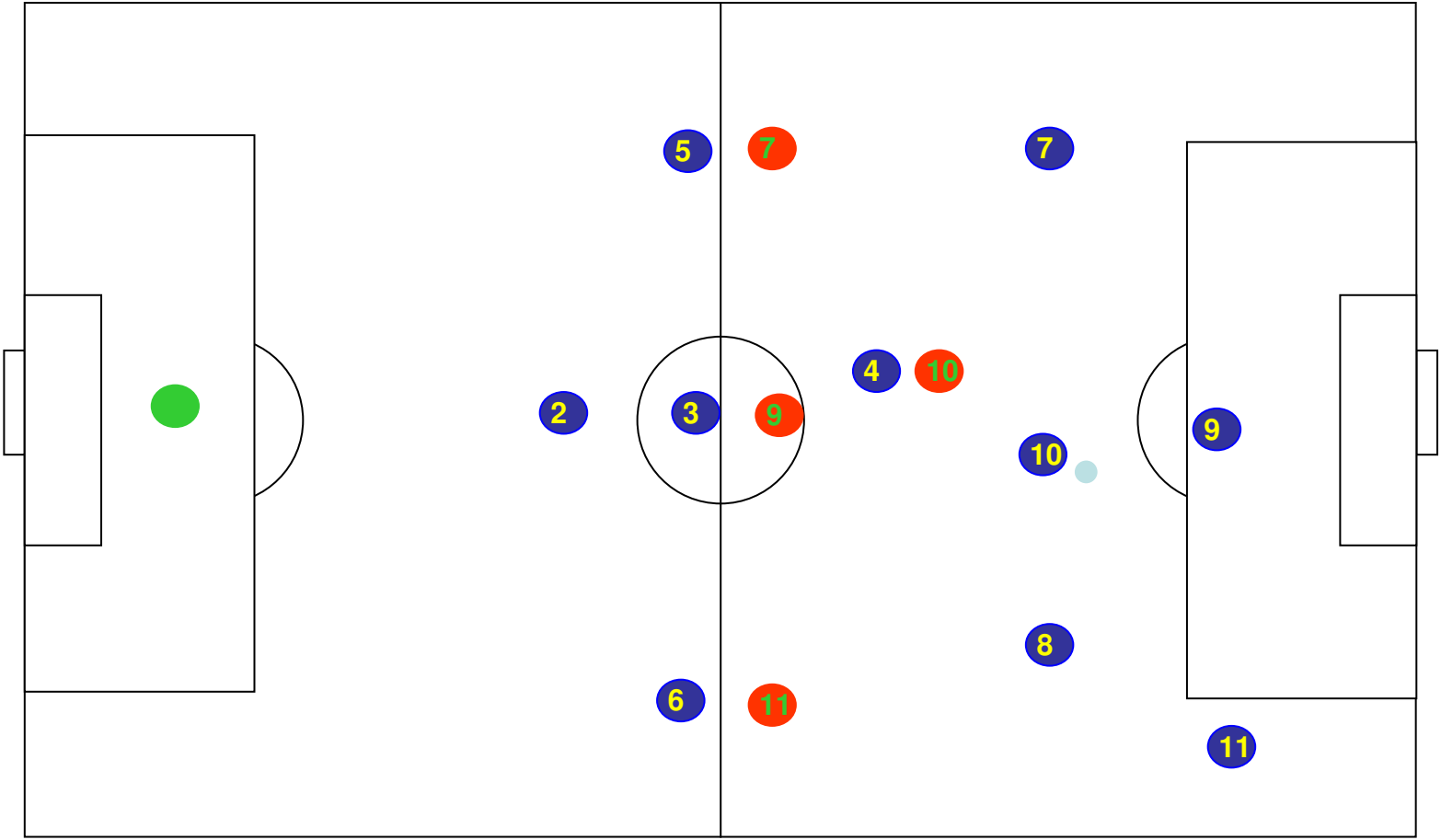


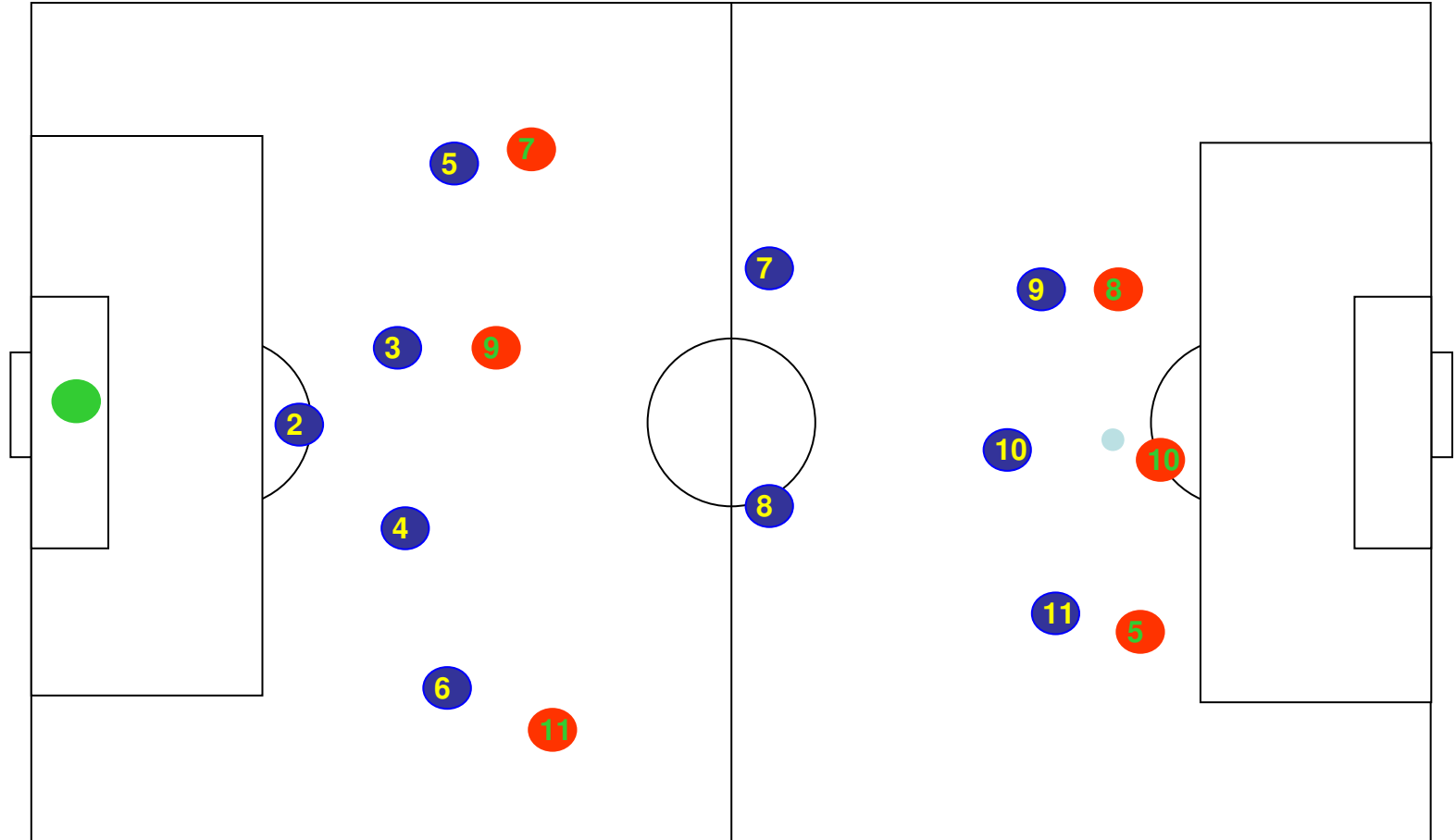
3-5-2 Dynamical Tactics

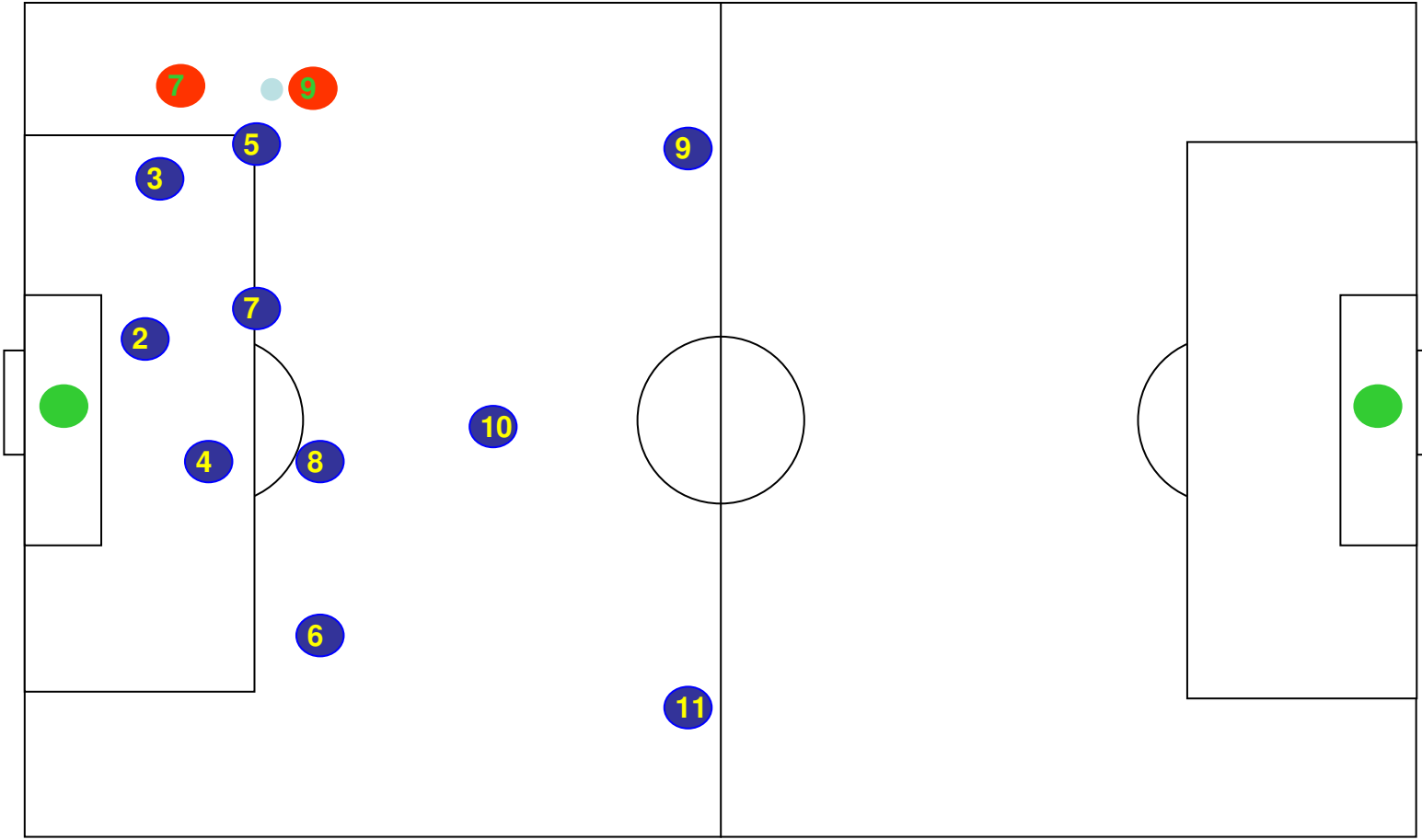


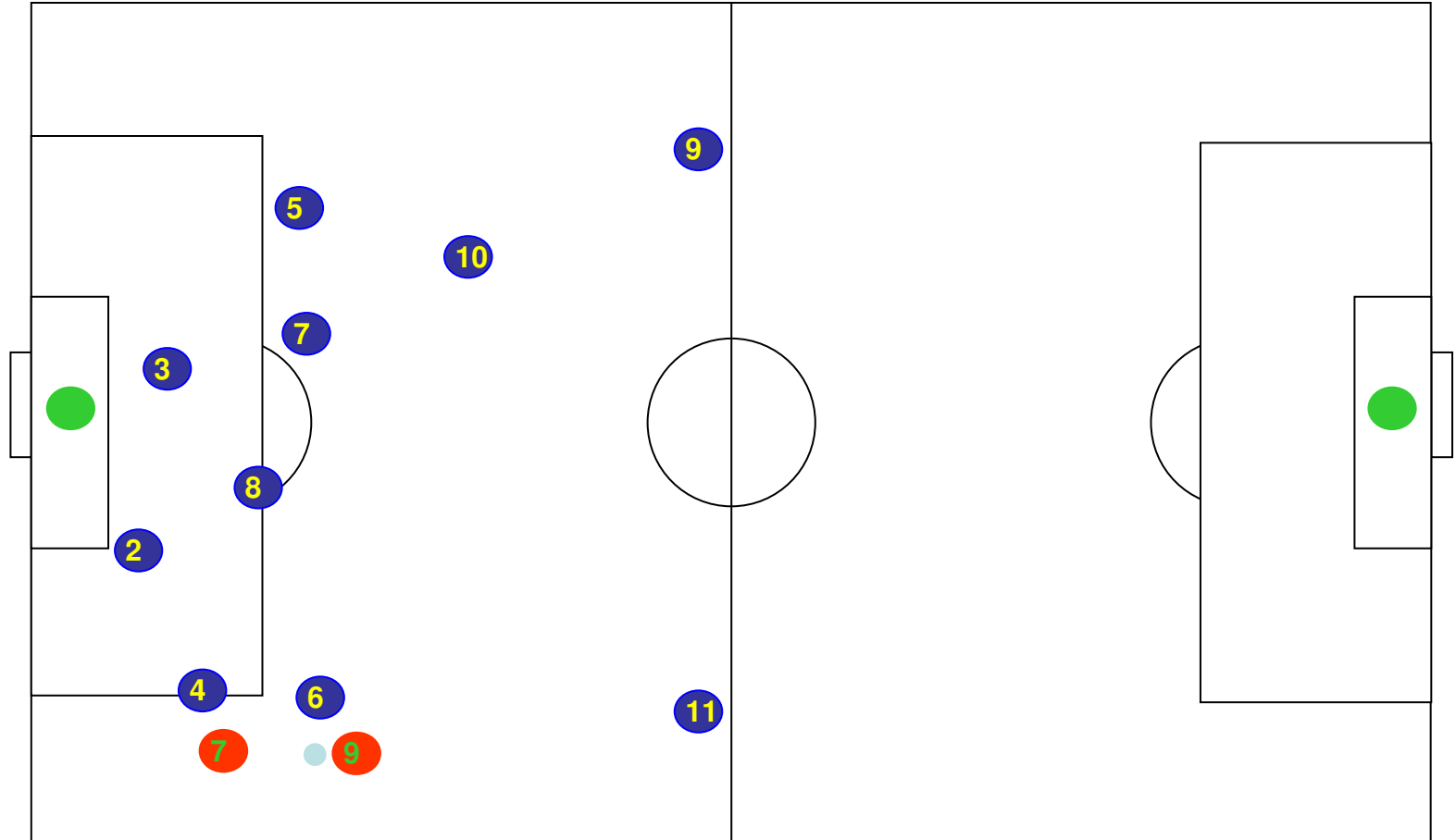












- **Game evaluation** build the dynamical tactics from game observation (real images or simulation)
- **Game design** change team players strategy and build the dynamical tactics iteratively

Layout

- Introduction
- Goal keeper
- Soccer game model
- Example
- Game evaluation and design
- **Future works**

- Estimate the relative impact of **ability and strategy** in goal keeper results
- Formalize a **goal keeper strategy** and validate it statistically
- Develop **methodologies for training** the goal keeper strategy: data base of tapes (keeper actions, adversary players abilities), simulators, field techniques
- Model player **ability and strategies**
- Develop tools **to simulate** soccer games; to **design dynamical tactics**; and to **extract dynamical tactics automatically** from game tapes