

Biomechanics and Skill Analysis of Scrum-Half Passing Skills – Part 2

by
Mark Calverley.

The author is a 'Pom' in New Zealand and he is currently completing the highest coaching paper (Certificate in Rugby) with the NZRFU and Massey University.

He played for Nuneaton, Warwickshire, Nottingham, Harlequins, England U18, Great Britain Students and England Students Rugby League. He is now Head of Physical Education and 1st XV coach at Wanganui Collegiate School in New Zealand.

Acceleration Distance

The previous section (See last week's technical Journal) makes reference to a rifle being more effective in producing an accurate shot when compared to a hand gun. The bullet from the rifle also has greater release velocity and shot length as it is in the barrel longer and under more pressure than the hand gun's bullet.

We can simply apply this principle to the accuracy required in the scrum-half pass. This means, the longer the scrum-half can stay in contact with the ball (accelerating it), the greater the final speed of pass. If we combine this with the other principles (i.e. rotational movement and passing on a flat arc) the result will be a fast, straight and accurate pass. Staying in contact with the ball for a long time means staying balanced (wide BOS, low COG) channelling the energy of the pass down a desired flight path for as fast and long as possible.

Fig 24

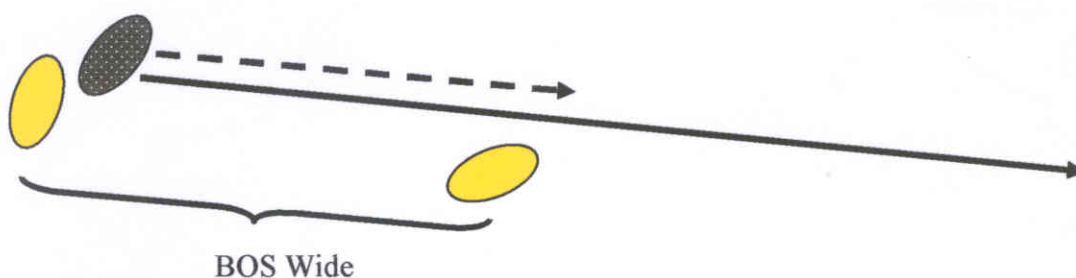
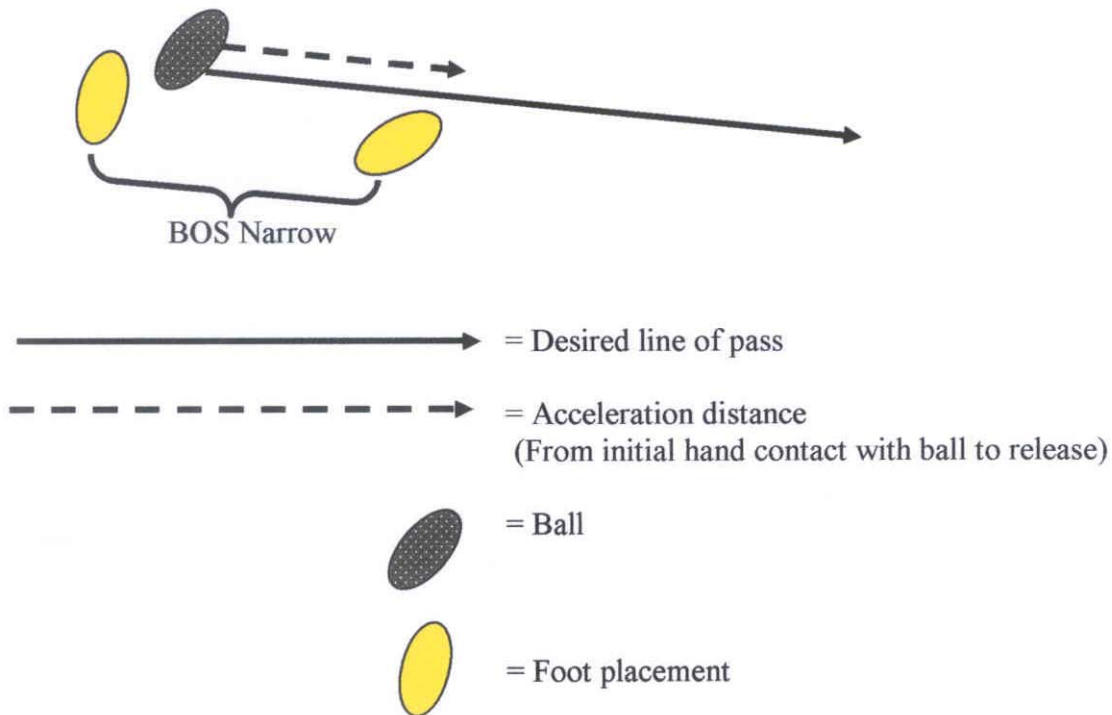


Fig 25



Useful comparisons can be made with feet placement for tackling, scrummage and also for line out throws and many aspects of kicking.

APPLICATION OF PRINCIPLES & SKILLS

FOOTWORK, APPROACH & ROTATION:

Probably the most common root cause of problems in the scrum-half pass is inefficient footwork.

The scrum-half needs to weigh up where he is going to (to get the ball) and where it is going to (the pass direction.) Very often the focus is only towards where to go to get the ball. Once there they then think about where the ball is going and how to get it there.

There are various tell-tale signs of poor initial footwork and inefficient running lines to the ball.

The base of support (BOS) is too square on to the ball

Resultant problems:

- The desired line of pass is blocked by the 'lead' leg.
- Balance is lost as the COG goes outside the BOS when he bends over to pick up the ball (weight goes on to the toes).
- Extra steps are required to correct the problem.
- More time taken to complete the pass.
- More chance of being 'sacked'.
- Other less efficient techniques are adopted to compensate. (Rotation, ball lifting etc.)

Fig 26

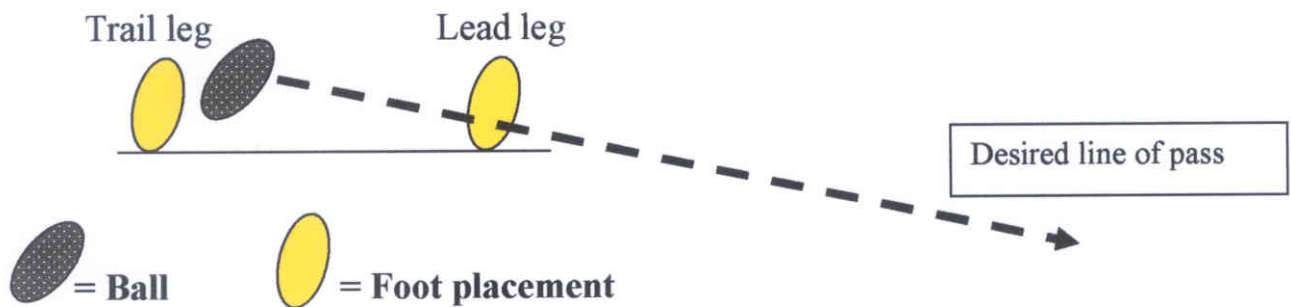


Fig 27

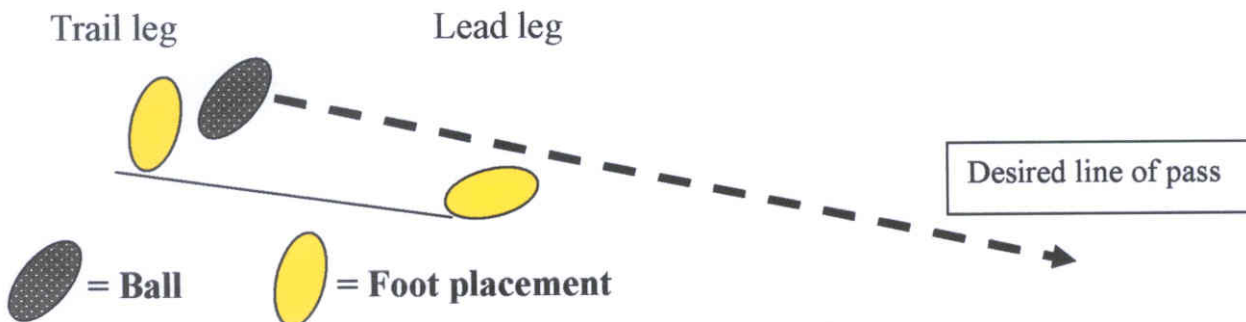


Fig 28

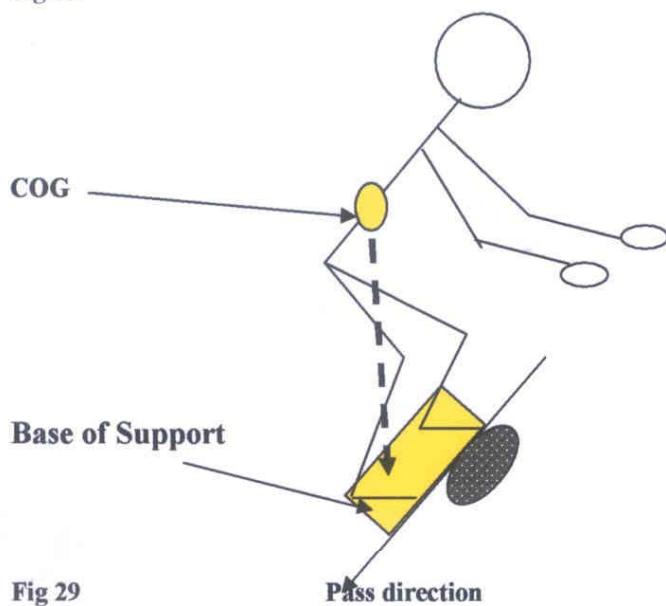


Fig 28 shows the half back with a square on feet and base of support. At this stage he is in balance as the vertical line from the centre of gravity COG is inside the base of support meaning he is in balance.

Fig 29

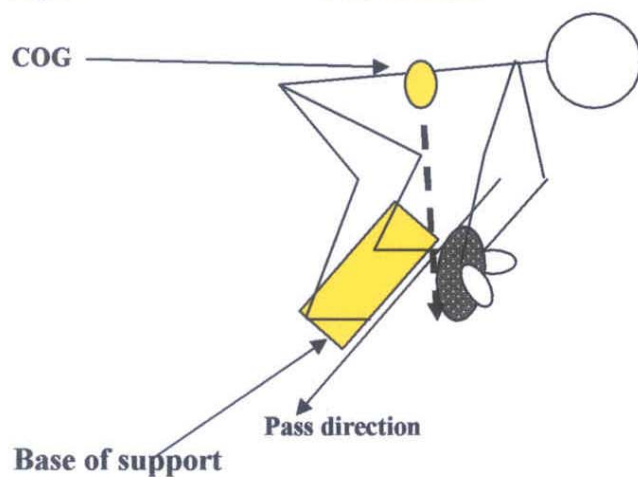


Fig 29 shows that he is too square on initially. In order to pass the ball he bends down and forward, meaning his COG shifts forward. The vertical line from the COG now extends outside the base of support meaning he is losing balance and falling forward.

He will fall over unless he moves his feet and corrects his balance.

Fig 30

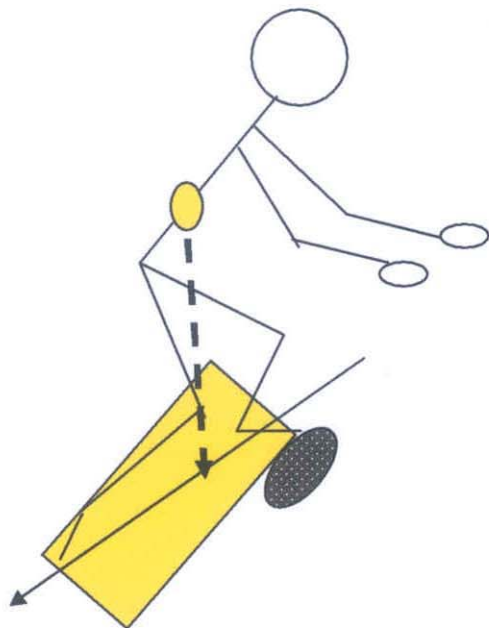


Fig 30 shows the half back with angled feet – one pointing roughly at the ball (trail leg) and one roughly towards the target (lead leg). His COG is over his base of support and he is balanced.

Fig 31

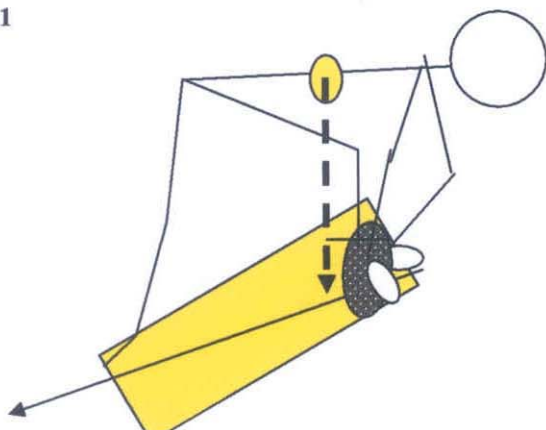


Fig 31 shows that in order to pass the ball he bends down and forward, meaning his COG shifts forward. The vertical line from the COG remains inside the base of support meaning he is maintaining balance and not falling forward.

He is free to pass towards the target whilst maintaining efficient technique and does not need to correct any problems..

Corrections:

- Encourage scrum-halves to **think ahead** to where the pass is likely to go (sometimes a quick switch in direction of play, or an unforeseen problem i.e. a player gets in the way will require unforeseen changes.).
- Encourage the scrum-half to **run a banana shape line to the ball.**
- Adopt a **trail foot that points down field and a lead foot that is angled towards the target.** This allows forwards flexion towards the ball on initial pick-up (when most of the weight is on the trail leg/foot) and more (lateral) flexion (towards the target) when the weight shifts to the lead leg/foot.
- Encourage **no unnecessary footwork movement/correction** during the time the ball is in contact with the hands.
- Encourage a **push and flick technique** with the pass rather than a rotational twist. Pass down the line, not across it.

- **Low COG** to the ball that is maintained and held throughout the phases of the pass.
- **Perfect practice makes perfect.**
- **Regular practice and analysis (use video and/or designated spotters).**

The centre of gravity starts too high, the base of support is too narrow and needs correcting and the centre of gravity raises too much and/or too early.

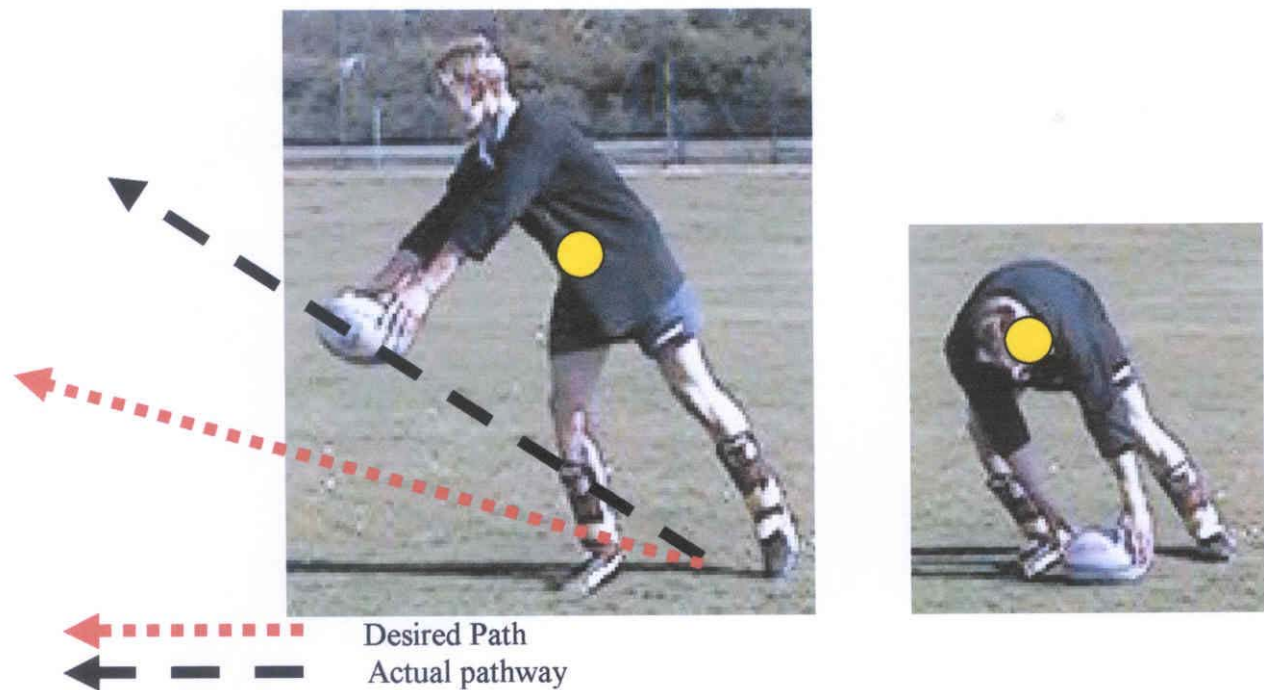
Standing too upright inevitably leads to the COG being higher. The worst case means that the scrum-half cannot reach the ball initially.

If the COG rises during the pass, the result is that the pass goes up (i.e. too high) as the vertical rotation increases.

Problems:

- Liable to be sacked as the pass is slow (effort is not channelled directly at the desired target).
- Pass is less accurate (usually too high as the vertical plane of pass is too pronounced).
- Balance can be compromised as the BOS is too narrow and the COG too high.
- Straight arms leads to a stiff, less ‘whippy’ pass.
- Extra power may be needed in the form of steps or upper body twisting. This is inefficient and slows down the pass.
- For the picture below, the passer starts with the ball too far away from the trail leg (i.e. too central) and this cuts down the potential acceleration distance of the pass. Standing up with the ball may be compensatory to keep in contact with the ball longer and add acceleration distance.

Fig 32



Corrections:

- Encourage the scrum-half to **approach low** (still in a banana shape).
- **Maintain the COG** throughout the passing phases.
- **Practise 'freezing'** for a second or two after the pass, especially when practising, in order to analyse final position.
- Plant and maintain a **wide base of support**.
- **Efficient shift of weight** from back foot to front foot.

The ball is lifted off the ground (unnecessarily) before the swing starts (usually as the passer is trying to avoid his 'lead' leg), which is blocking the line of pass.

Problems:

- More prone to being 'sacked' by the opposition.
- Evasive steps may be needed to get away from a pressurising opposition, meaning potential balance lost, receiver's timing is affected and still more time is required to make the pass.
- Slower total delivery time to receiver (puts them under pressure).
- COG is raised and a more powerful passing position is lost.

- Lead leg blocks the desired line of pass.
- Lack of communication and/or vision relating to where the ball is going once the hands are on the ball.

Corrections:

- **Talk through the issue with scrum-half** and get him to understand and accept the problem as well as formulating corrective measures.
- **Maintain a low COG throughout** the approach, swing and delivery phases of the pass.
- Maintain an **efficient, wide base of support**.
- **Ensure the lead leg is not blocking the line of pass.**
- **Ensure the trail leg is planted first and correctly.**
- Encourage a **sweep pass** from the moment the hands touch the ball. i.e. **NO LIFTING THE BALL.**
- Ensure the **scrum-half runs a 'banana' line to the ball**, to open up his field of vision to the receiver and encourage more efficient foot placement.
- Encourage **visual and verbal communication between passer and receiver** before the scrum-half reaches the ball.

The rotation in the trunk is very elliptical, or horizontal (for the same reason as above.).

Problems:

- Lack of pass accuracy (see Fig 22 & Fig 23).
- Lack of vision at desired target.
- More likely to be 'sacked' by the opposition.
- Possible lack of confidence or co-ordination in the wrists to produce a powerful spin pass.
- BOS may be too narrow, resulting in a short acceleration distance if the sweep pass is used. Upper body twist is used to add power to pass.
- Possible poor foot placement blocking an efficient sweep pass.

Corrections:

- **Talk through the issue with scrum-half** and get him to understand and accept the problem as well as formulating corrective measures.
- Work on **sweeping the ball away on a flat vertical plane.**
- **Maintain a low COG throughout** the approach, swing and delivery phases of the pass.
- Maintain an **efficient, wide base of support**.
- **Ensure the lead leg is not blocking the line of pass.**
- **Ensure the trail leg is planted first and correctly.**
- Encourage a **sweep pass** from the moment the hands touch the ball. (i.e. **NO HORIZONTAL OR ELLIPTICAL ROTATION.**)
- Ensure the **halfback runs a 'banana' line to the ball** to open up his field of vision to the receiver and encourages more efficient foot placement.

- Encourage **visual and verbal communication between passer and receiver** before the scrum-half reaches the ball.

HAND PLACEMENT & ROTATION

Hand placement is a vital aspect of the pass. No matter how good the scrum-half is technically with his feet, COG, BOS etc., poor hand placement will inevitably result in a less efficient pass and have a profound effect on the spinning effect on the ball.

(All technical information will assume the pass is going from right to left)

Problems:

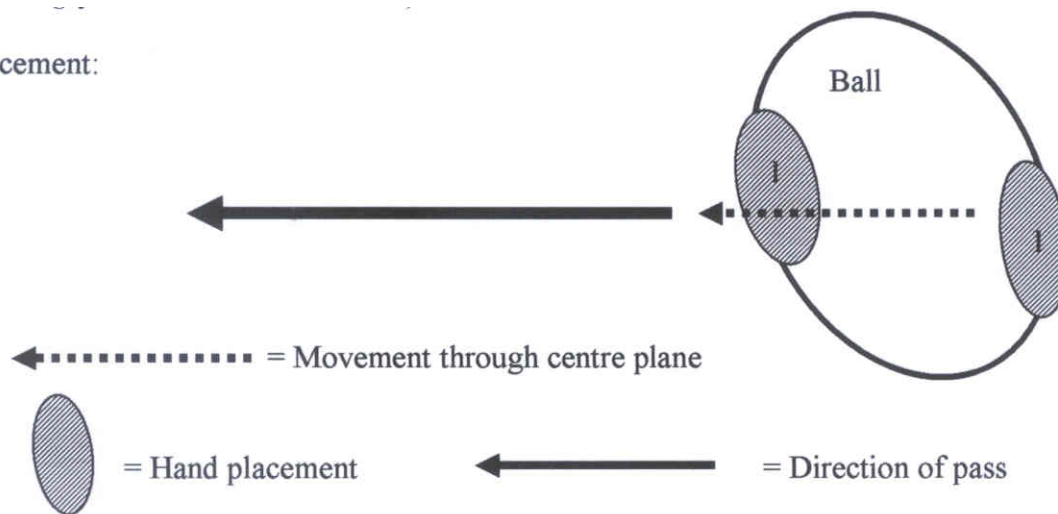
- Poor hand placement results in less 'feel' or control of the ball.
- Inefficient spin imparted to the ball.
- Inefficient hand placement may require re-adjustment, thus slowing the passing process down.

Corrections:

- "Determine the **desired line of flight**.
- All of the **energy and direction is transmitted through the hand behind the ball**, i.e. the right hand on a pass to the left.
- The **longer the hand is in contact with the ball on the desired line of flight, the more accurate the flight** will be. (See Figs 22, 23.)
- Any deviation **from the desired line of flight...can be traced back to the movement of the hand** relative to the ball and the desired line of flight.
- The **length of flight is governed by the speed of the hand in contact with the ball**, and the quality of that contact.
- The **speed of hand is largely a product of bodily forces**, notably weight shift and rotation.
- The **quality of contact depends on how near the force is applied to a plane through the centre of the ball**.

(From 'Total Rugby' by Jim Greenwood. 5th Edition 2003.)

Hand placement:



Notice that the ball is angled (with the nose pointing at 10 or 11 o'clock – when passing to the left). This means that whilst it is not initially pointing at the desired target, the force imparted by the hands and arms can be done through the central plane of the ball (i.e. the COG). As the wrists and fingers impart the spin, the ball turns anti-clockwise so that it spins about its central axis and the nose points at the target.

- Ensure hands are spread to ensure wide and multiple contact points on the ball. (i.e. a wide base of support on the ball, with many contact points for added stability and 'feel'.)
- The fingers extend around the ball, cradling it underneath and at the sides.
- The fingertips should be the last thing to leave contact with the ball - they are responsible for the fine tuning and discreet skills associated with accuracy. Using the fingertips to add the spin also lengthens the length of lever (in the arm and hand) and results in greater (faster) torque (spin).
- The sweep or push from the arms initiates the pass directly down the desired line of flight.
- The spin comes 'fast and last.' Initiating the spin too early will result in the potential acceleration distance being minimised (similar to the example used for a rifle and a hand gun on page 16 – Summation of Forces.).

ROTATION

- Scrum-halves are generally expected to be able to pass with equal force and accuracy to the left *and* to the right.
- The guiding hand (at the back of the ball) should aim to rotate quickly over the ball and impart spin.
- The leading hand (at the front of the ball) is simply to steady the pass and support the swing by keeping it on line.
- The guiding hand would be responsible for the vast majority of the pass success, speed and spin.
- The 'under pass' with the hand going under the ball and in the opposite direction (i.e. clockwise when passing to the left) can be used if under pressure of, say, having the normal guiding hand 'scragged'. Here the lead hand becomes the guiding hand. It minimises the force and distance of the pass (acceleration distance) and can result in the ball being lifted, but it can be a useful 'problem solver' to have in your 'armoury' of available passes. (It was a pass much favoured by Scottish scrum-half, Roy Laidlaw, in the 1980s, who was very much right-handed but did not want to resort to the dive or pivot pass all of the time.).

- A spinning projectile (ball) will travel further and faster than a non-spinning projectile. For example, a bullet from a rifle travels faster and further than a musket ball, due largely to the spinning effect of the bullet being more aerodynamic.

VIDEO ANALYSIS

Video analysis is available to most coaches without the need for expensive software packages. Showing players video shots helps them understand the inefficiencies and allows them to take ‘ownership’ of the improvement of skill. More thought can be given to analysis as the movement can be stopped and analysed piece by piece.

PASSING DRILLS & PRACTICES

Below are a series of drills that can be used. The principles outlined throughout this paper can be applied and explained to the player when doing it. Without baffling the player and overloading them with biomechanical principles, the coach can help the player understand how to make their passing more efficient and successful.

1) SKY CITY PASSING

Key aspects of technique and biomechanics:

Increasing spin speed (torque).

Increasing acceleration distance (levers).

Accuracy.

Effective line of pass (summation of forces).

- Passer stands holding the ball either for a spin pass off the left or right hand. Propel the ball towards the ceiling, aiming to keep the ball spinning perfectly on its vertical axis.
- Try to pass and not have to move.
- Try to make the ball spin as quickly as possible and go as high as possible.
- Feel the ball come off the fingertips ‘fast and last’.
- Keep the movement of the body and arms going vertically and with no body rotation.

2) NAPOLEON PASS

Key aspects of technique and biomechanics:

Effective foot placement (BOS).

Effective body position (COG).

Effective line of pass (summation of forces).

Acceleration speed and distance (levers).

Effective speed of spin (torque).

- Arrange feet in to the final passing position (see Fig 27), ensure a low COG is applied.
- Start with weight on back foot and COG inside the BOS.
- Place left hand behind the ball (for a pass to the right).
- Push and sweep the ball down the line to a target five metres away.

- Keep the right hand behind the back and don't use it to touch the ball.

Progress by:

- Increase the distance of pass.
- Include a spin on the pass.
- Include a 'banana' run to the ball and then the correct foot placement. (rear foot first, weight on the rear then transfer of weight to front foot on completion of the pass.).

3) STICKY FINGERS

Acceleration speed and distance (levers).

Effective speed of spin (torque).

- Using only one hand on the ball, spin the ball from left hand to right and back again as quickly as possible.
- Concentrate on feeling the ball and making it spin off the fingertips 'fast and last'.
- How many can be done without losing control of the ball?
- This is an excellent drill for developing fast spinning ball and 'feel' for the ball.

4) ELASTIC FANTASTIC (2 players)

Key aspects of technique and biomechanics:

Effective foot placement (BOS).

Effective body position (COG).

Effective line of pass (summation of forces).

Acceleration speed and distance (levers).

Effective speed of spin (torque).

- Use a rope or, better still, a piece of long elastic. Anchor the elastic to the ground (with a weight or tent peg etc.) and the other end is tied around player 2's waist.
- Place a ball next to the anchor point.
- Player 1 either starts stationary and passes the ball, or can run towards the ball (banana) and places feet before passing.
- The aim is to get the ball to follow the line of the elastic into the hands of the receiver.
- If the ball does not follow the desired pathway, video analysis and application of the principles can usually easily establish inefficiencies in technique that can easily be seen and understood by the player.

5) CATCHIN' CRABS (2-3players)

Key aspects of technique and biomechanics:

Effective foot placement (BOS).

Effective body position (COG).

Effective line of pass (summation of forces).

Acceleration speed and distance (levers).

Effective speed of spin (torque).

- Player 1 sets himself for a short pass of about five metres to player 3 or a target (i.e. tackle bag). Player 2 adopts a pressurising position as if trying to 'scrag' his opposite number at the scrum.
- Player 1 tries to get the pass away before player 2 can grab his arm and stop the pass.
- Any delay (pick up, backswing, foot movement) in the pass will probably result in a 'scragging' by player 2.
- Player 1 can adapt his technique by actually using foot movement and/or pulling the ball in to the chest before the pass if he can't get the ball away efficiently or quickly enough.
- This is a good, fun competitive game that scrum-halves love to do with other scrum-halves. Whilst it doesn't encourage the full, fluid, technically 'perfect' pass, it does encourage speed of hand movement under pressure and the elimination of visual clues to the opposition i.e. dropping hands to the ball before starting the pass.

6) THE 'SQUIRCLE' (a square circle!)

Banana shaped running lines.

Effective foot placement (BOS).

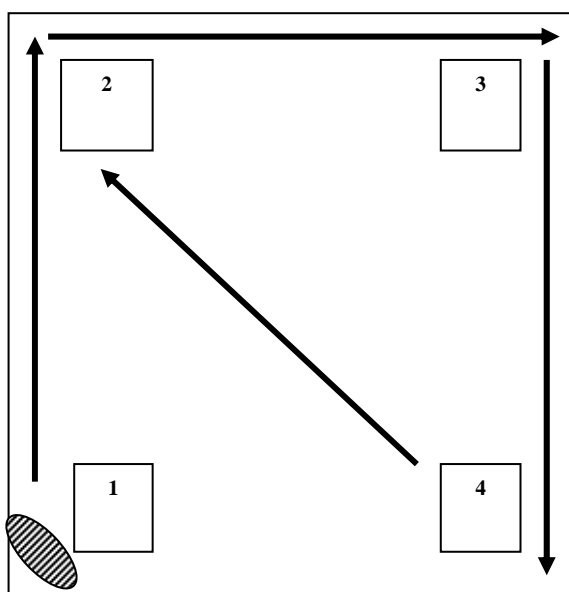
Effective body position (COG).

Effective line of pass (summation of forces).

Acceleration speed and distance (levers).

Effective speed of spin (torque).

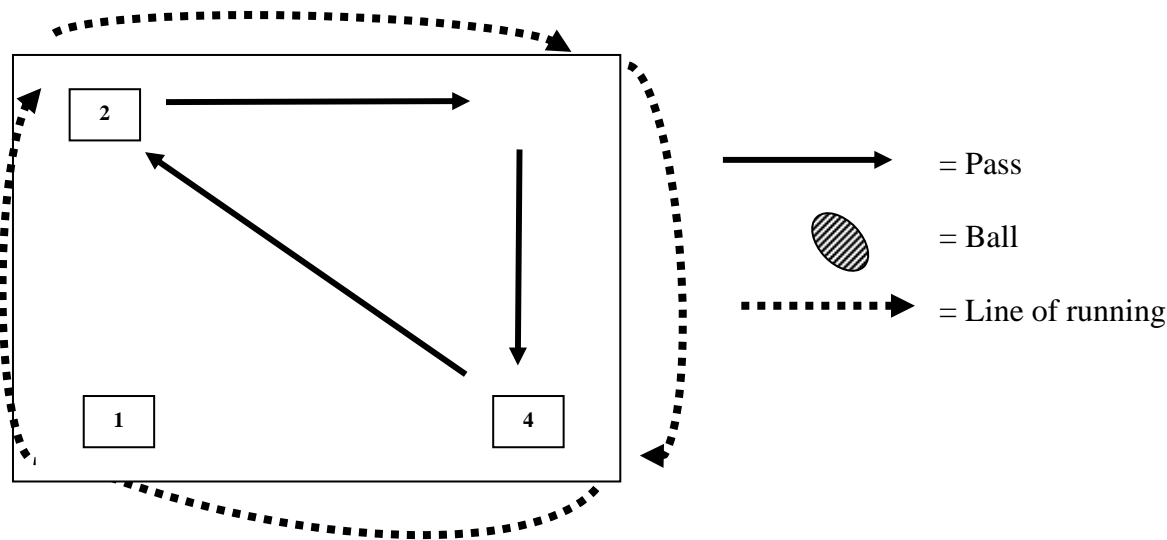
Set out a square about 10m by 10m



= Line of pass
= Ball

- Player 1 passes to P2, then to P3, then to P4 and then across the diagonal to P2 who takes over repeating the sequence. (The drill can be done with fewer people, but it requires the receivers to move in to the next catching position.)

- If the passer runs a direct, straight line to the ball, he will quickly find that his technique becomes less efficient. He will probably find his lead leg blocking his pass and him having to take counter measures to make the pass complete. (i.e. extra foot movement, lifting the ball up or back, rotational/elliptical upper body movement). It is often good to get the scrum-half to do this first then discuss with him how it felt and any problems that were encountered. Again, videoing this can be a really useful analysis and learning tool for the coach and player.
- The drill looks at encouraging a 'banana' run to the ball to help free-up the passing line by improving the BOS foot placement, encouraging a low COG and opening up the passing vision to the receiver. Therefore, although the pass goes straight around the square, the supporting running line is more circular in shape.
- This is a drill that many players have done in practice but, in my experience, very few have been encouraged to (or worked out) the benefits of the 'banana' line of run.



7) ZIGGY-ZAG (2 to unlimited passers.)

Banana shaped running lines (for the first passer).

Effective foot placement (BOS).

Effective body position (COG).

Effective line of pass (summation of forces).

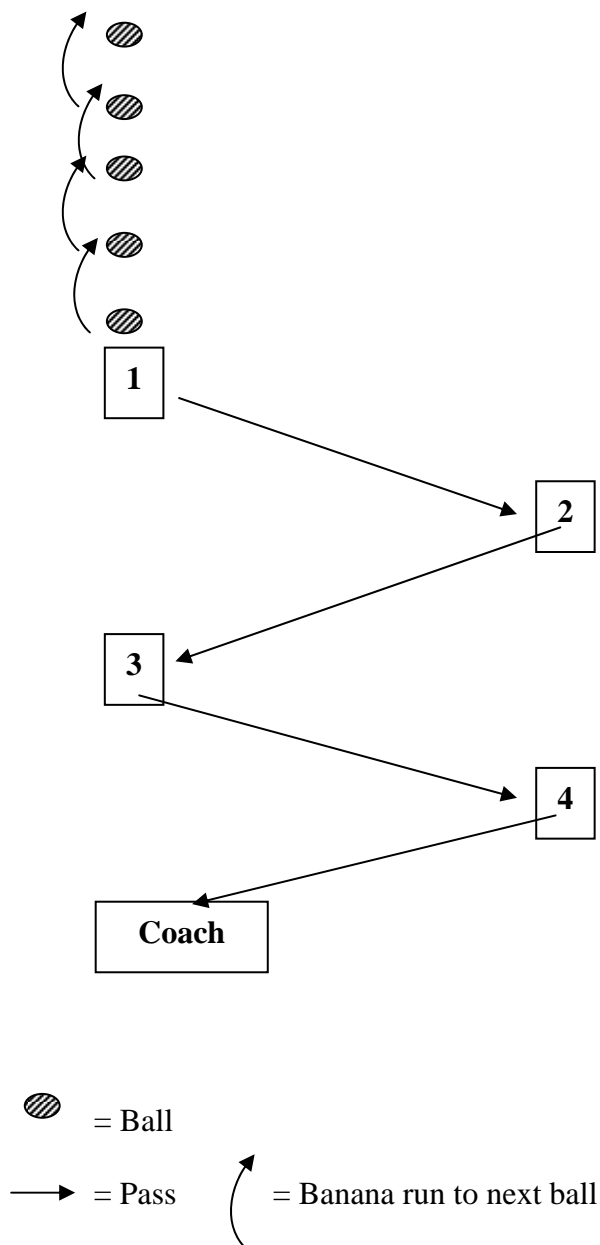
Acceleration speed and distance (levers).

Effective speed of spin (torque).

Accuracy.

Minimising horizontal and elliptical rotation.

This drill is slightly different in that it deals with ball received at waist height (hopefully). The delivery of the ball is slightly unrealistic in some respects but it is an excellent advanced drill to encourage very fast footwork and efficiency and accuracy of pass.



- Player 1 runs 'banana' shapes to each of the 5 balls in order.
- 1 passes off the ground to 2.
- 2 passes to 3
- 3 passes to 4
- 4 passes to the coach
- Passer 1 tries to pass as accurately and efficiently as possible to 2
- Passers 2-4 receive the ball at the height and position that it comes to them. All effort should be made to move the feet and hands in to an efficient position to move the ball on to the next man with no unnecessary foot/hand/body movement.
- Passers 2-Coach move forwards proportionately to the next ball that passer 1 is moving towards. (Balls should be 3-5m apart.)
- Dropped passes or un-catchable passes are ignored and the next pass concentrated on.
- The coach can time the total time for passes and/or give marks for overall quality of passing etc.
- The drill can be developed by the receiver alternating positions. This requires the passer to look where the pass is going prior to passing and the receiver to communicate effectively.

CONCLUSION

The article has looked almost exclusively at the scrum-half pass off the ground and has not sought to analyse other aspects such as the pivot pass, dive pass, reverse pass etc. Hopefully you will gain an insight into biomechanics and skill analysis that can be adapted to other skills and other positions as an introduction only.

Some key factors to take in to account would be:

- Try to stress **EFFICIENCY OF SKILL** rather than good skill and bad skill. The nature of the game is such that passing is an open skill which is externally influenced by others (placement of ball, bodies in the way, other players etc.).

- The scrum-half must have a huge armoury of passing skills and techniques to cope with the unexpected. The 'perfect' situation and the 'perfect pass' happen comparatively rarely. It is far better to think about the **MOST EFFICIENT**. This also takes away the negative re-enforcement to players and encourages them, in my experience, to be less defensive about their skills and more receptive to taking ownership and understanding.
- Be wary of lecturing the players on the detailed principles of biomechanics, but introduce them as aspects of common sense and technique.
- Use the principles outlined to help analyse and evaluate other skills. They work especially well with scrummaging, place kicking, line-out throw and contact skills.

REFERENCES:

- Smart Training For Rugby. McKenzie, Hodge & Sleivert. 2000.
Total Rugby. Greenwood, Jim. 2003 (5th Ed.).
NCEA Level 3.3 Biomechanics Booklet (Golf). Calverley, Mark. 2004.