

An Investigation Into the Effect of ‘Miss-Hits’ During the Putting Stroke

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Abstract

This study examines a putter during impact with a golf ball. Video analysis at 1000 frames per second was used to analyse distance, speed and acceleration of the putter head and ball during the initial stages of putting. A standard weighted 34” length putter was used for the experiment, clamped to a ‘Perfectioniser’, which was used to simulate a ‘pure-in-line-square’ putting stroke. The putter struck the ball in three different positions; Toe of the club, Sweet Spot and the Heel of Putter. Each putt was analysed using Quintic (2004) Biomechanics 9.03v9 video analysis software.

Keywords: Golf Putting; Speed, Impact, Performance.

Introduction

“The putting stroke is only one of several different types of golf swings, yet it accounts for nearly half of all swings made” 43% (Pelz, 2000) 45% (Swash, 2001)

Putting has been described as a game within a game on numerous occasions. The majority of coaching magazines, manuals, textbooks suggest ‘feel’ as the key to success, along with a ‘good technique’. A good technique is required in order to create the confidence necessary to hole putts. There is no recovery opportunity from bad putting or bad luck. Controlling the speed and energy transfer of the putter at impact is vital for distance control and good green reading.

‘Every putt is a straight putt – it just depends on how hard you hit the putt as to whether the ball takes the break or not’ (Swash, 2001)

Because putting is such a significant part of golf, the ability to strike the putter consistently out of the ‘sweet spot’ is crucial.

The ‘sweet spot’ is the point on the clubface where contact is the most solid, eliminating the rotation and wobble of the putter during impact (Pelz, 2000).

By striking the ball out of the 'sweet spot' the maximum energy possible from the club will be transferred into the ball. It is possible for a player to miss the 'sweet spot' in both the vertical plane (bottom or top of the putter face) along with the horizontal plane (Heel or Toe of the putter face). If the golfer misses the 'sweet spot' by even a fraction, this will result in a miss-hit and a reduction in energy transfer to the golf ball. The more consistent a player can be in transferring energy to the golf ball, the greater control they will have on the speed of the golf ball. The distance a golf ball travels is determined by speed. The speed of the ball, dictates how much the ball will break and therefore the line of the putt. Consistently striking the ball out of the 'sweet spot', will greatly improve a player's 'touch and feel'.

"Most three putts aren't caused by bad green reading, but by bad judgement of speed"
(Crenshaw, 1981).

A 'sweet spot' putt involves two variables;

- putts struck on the same area of the face as well as;
- ensuring that the striking surface is 100% square to the target line during impact (non-glancing blow);

This paper analyses the performance of a putter and ball, using a 'pure-in-line-square' putting stroke when a putt is hit out of the 'Toe', 'Sweet Spot' and 'Heel'.

Method

Test Condition : Standard weight 34" Face balanced putter

During each putt, the putter was clamped to the 'Perfectioniser' (Figure 1a). Data analysis was performed in the Quintic Putting Laboratory (12-13 Stimpmeter). The putter head was pulled back to a set position each time and released to simulate a 15ft putt. Every effort was made to ensure the putter blade was released from the same position – in order to standardise the impact speed of the clubhead.



Figure 1a: ‘Perfectioniser’ – Designed by Harold Swash (1998)

Figure 1b: Grip of putter attached to the ‘Perfectioniser’

The club and ball impact position were filmed under three different conditions: (i) Sweet Spot, (ii) Toe of the Club and (iii) Heel of the Club. Six trials were carried out for each of these conditions.

Data Acquisition and Analysis

Each trial was filmed using a Redlake PCI 2000S High Speed camera. The camera was placed at 90 degrees to the path of the golf ball, level with the putting surface. Figure 2 shows a typical set-up for the experiments.



Figure 2. Experimental Design

Digitisation results were obtained for each of the three impact positions. Digital video film (1000Hz) was recorded giving 40ms prior to ball contact and 200ms after ball contact. After processing, the film was analysed using a Sony VAIO PCG-Z1XSP personal computer running Quintic (2004) Biomechanics 9.03v9 video analysis software. Two-dimensional scaling, prior to digitisation was carried out using two-dimensional calibration. All putting strokes were digitised at a rate of 500Hz.

On average 10 frames were digitised prior to ball contact and twenty-five frames post ball contact. A four-point model was created for the purpose of the analysis (2 points on the club face and 2 points on the ball). For each frame, the horizontal distance travelled (mm), horizontal velocity (m/s) and the horizontal acceleration (m/s/s) were recorded for both the clubhead and ball.

Note: The digitised values for the clubhead and ball were both averaged to reduce experimental error. Figure 3 shows a typical example of the digitisation process.

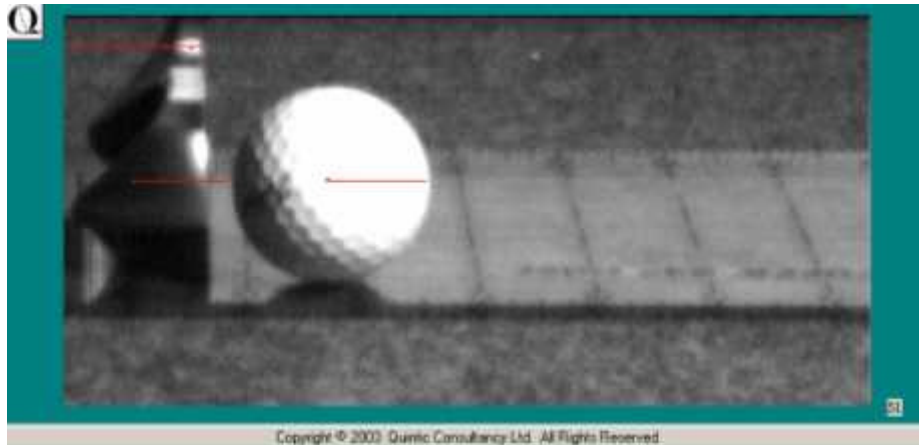


Figure 3. Digitisation Process: 2 points on the club / 2 points on the ball

Statistical Analysis

Descriptive statistics were calculated for the average distance travelled (mm), velocity (ms/s) and the acceleration (ms/s/s) for both the clubhead and ball.

Results and Discussion

Figure 4 gives an example of how the video images are presented within the Quintic (2004) Biomechanics 9.03v9 video analysis software.

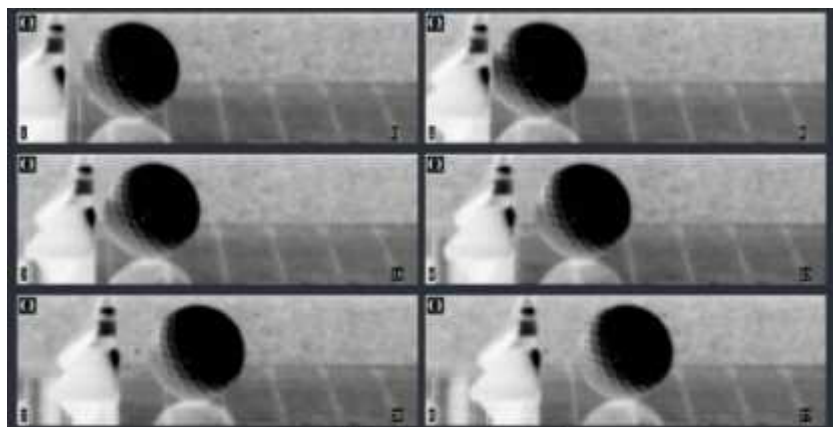


Figure 4: Typical Video Images obtained from Quintic (2004) Biomechanics 9.03v9 video analysis Software. 'Sweet Spot'

Due to the slight variation in the impact velocity of the clubhead throughout the testing phase, it was necessary to compare the impact velocity of the club for each of the three impact positions. Table 1 shows the average impact velocity of the clubhead.

Table 1: Averages (n=6): Mean Impact Velocity (m/s)

	Heel	Sweet Spot	Toe	Average
Putter 1	1.045	1.012	1.104	1.054

The highest impact speed was 1.104 ms⁻¹ during the ‘Toe’ condition, compared with the ‘Sweet Spot’ 1.012 ms⁻¹. A ratio was therefore calculated by dividing the ‘Peak Ball Velocity’ (ms⁻¹) by the ‘Impact Speed’ of the club (ms⁻¹) to give an ‘Impact Ratio’ (IR). The ‘Impact Ratio’ can be seen for each of the three impact positions in Table 2. The mean, standard deviation and standard error figures are also presented.

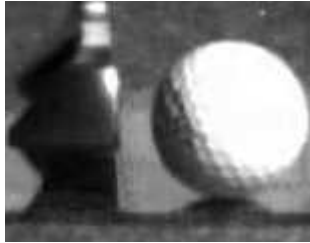
Table 2: Impact Speed, Peak Ball Speed and Impact Ratio.

	HEEL			SWEET SPOT			TOE		
	Impact Speed (m/s)	Peak Ball Speed (m/s)	Impact Ratio	Impact Speed (m/s)	Peak Ball Speed (m/s)	Impact Ratio	Impact Speed (m/s)	Peak Ball Speed (m/s)	Impact Ratio
1	1.091	1.594	1.46	0.931	1.927	2.07	1.198	1.610	1.34
2	1.054	1.499	1.42	1.075	2.001	1.86	1.103	1.503	1.36
3	1.009	1.524	1.51	0.984	1.952	1.98	1.062	1.511	1.42
4	0.984	1.404	1.43	1.046	1.993	1.91	1.095	1.577	1.44
5	0.922	1.425	1.54	1.050	1.911	1.82	1.029	1.519	1.48
6	1.207	1.779	1.47	0.984	1.828	1.86	1.132	1.577	1.39
Mean	1.045	1.537	1.47	1.012	1.935	1.92	1.104	1.550	1.41
SD	0.090	0.125	0.04	0.050	0.058	0.09	0.053	0.040	0.05
SE	0.037	0.051	0.02	0.020	0.024	0.04	0.022	0.016	0.02

Table 3: Averages: Impact Velocity (m/s) / Distance (m) / Peak Ball Speed (m/s)

	Impact Velocity (m/s)	Distance (m) after 0.4s	Peak Ball Speed (m/s)	Impact Ratio $\pm$ S.E.
Heel	1.045	0.0549	1.532	1.47 ± 0.02
Sweet Spot	1.012	0.0733	1.928	1.92 ± 0.04
Toe	1.104	0.0495	1.546	1.41 ± 0.04

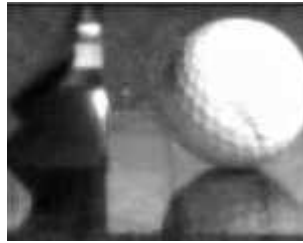
The IR for the 'Toe' condition (1.41) is considerably lower than that of the sweet spot (1.92). It has been commonly suggested by 'Teaching Professionals' that by striking a putt out of the 'Toe' deadens the putt and the ball has a much lower resultant velocity. This fact is substantiated by the data, as it is the 'Toe' condition that has the lowest impact ratio. The ball on average had only travelled 0.0495m compared with 0.0733m when struck out of the 'Sweet Spot', this despite the 'Toe' condition having the higher impact speed (1.104 ms⁻¹) compared to 1.012 ms⁻¹ (Sweet Spot).



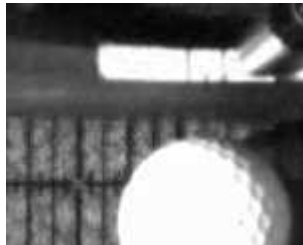
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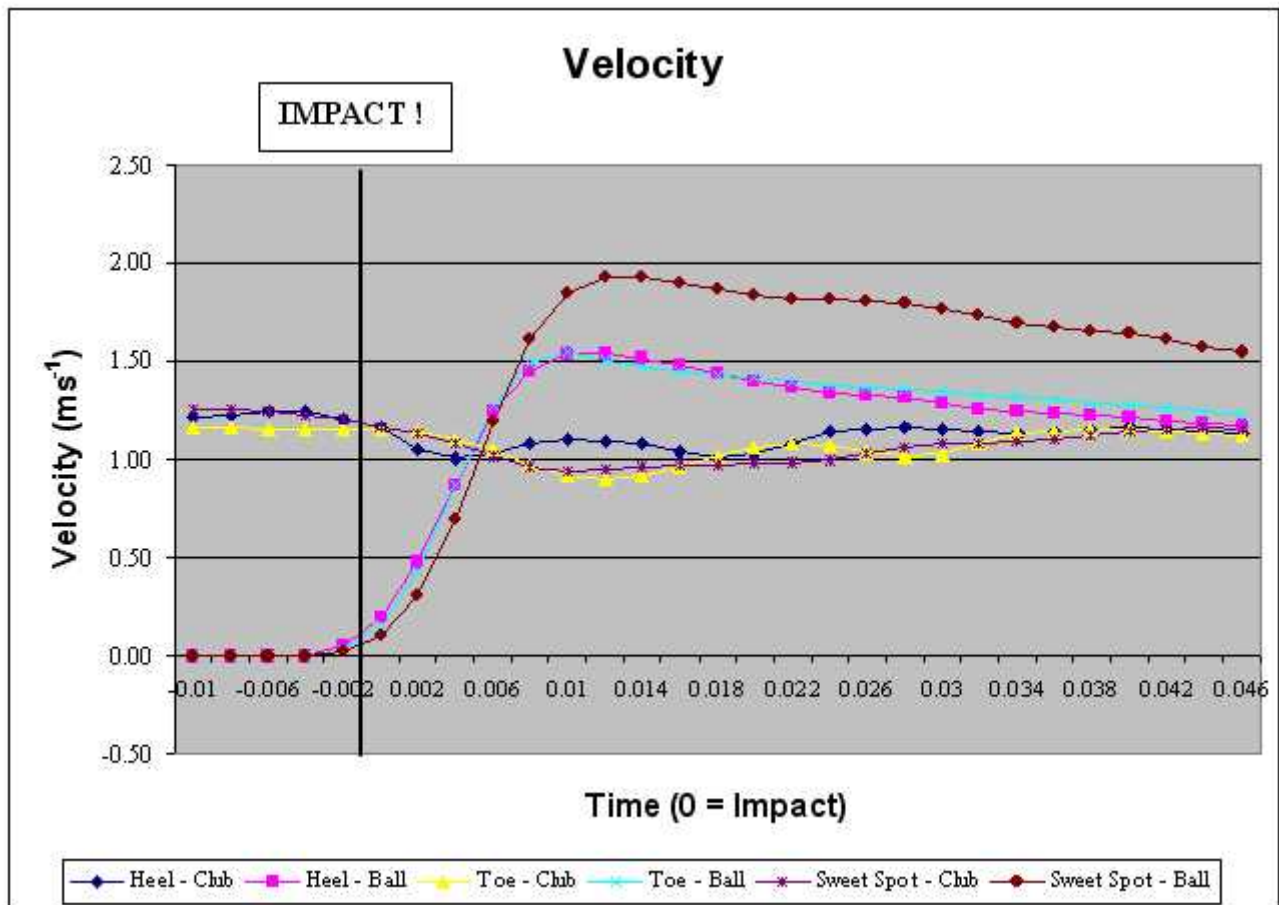
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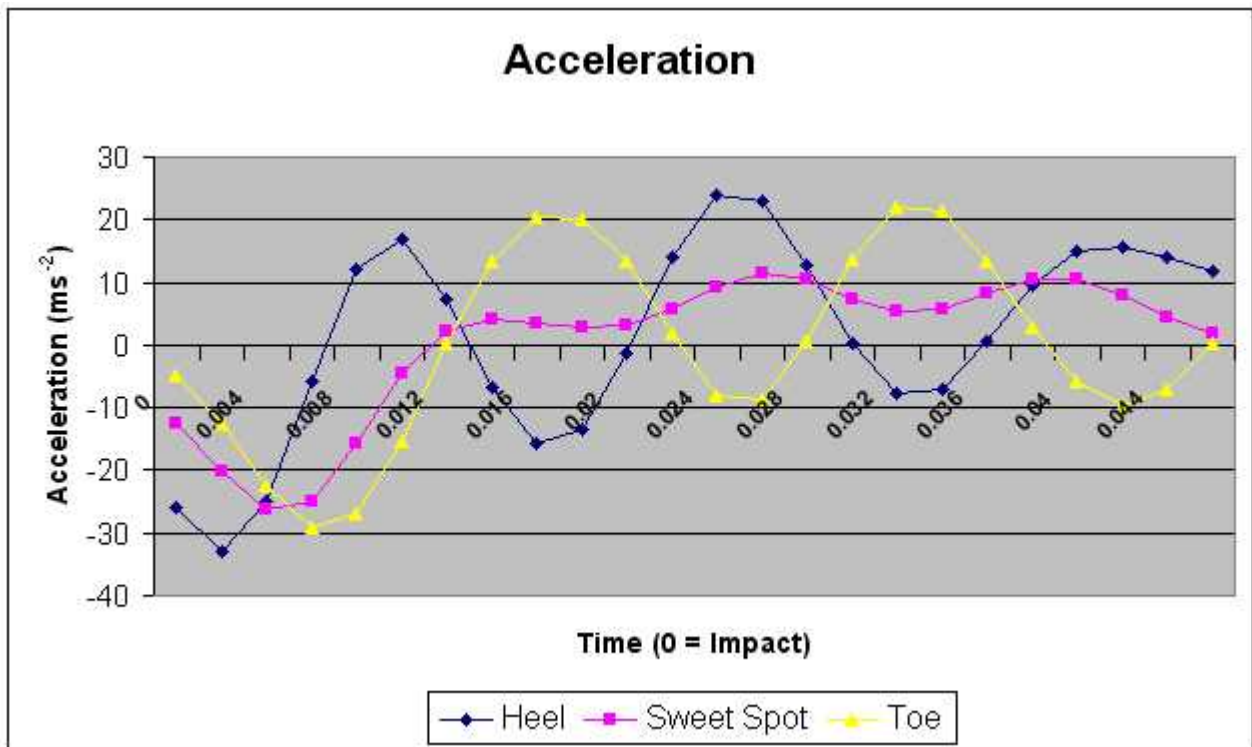
Graph 1 highlights the difference in velocities between the club and ball during the three different test conditions.



Graph 1: Velocity of Clubhead and Ball

It is not until you analyse the velocity and acceleration graphs of the putter head during the 'Toe' impact that it is clear to see why this type of stroke wouldn't be recommended. When viewing the clubhead during impact using 1000Hz video footage, it is clear to see the putter head 'open' during impact with the golf ball (Video 1: Frame 34 – 40 & Video 4: Frame 40 - 45). The same explanation can be given as to why you shouldn't strike a putt out of the 'Heel' of the putter. When viewing the clubhead it is clear to see the putter head 'close' during impact with the golf ball (Video 3: Frame 15-20 & Video 6: Frame 26-31). When compared with the 'sweet spot' 'Video 2 & Video 5', during impact there is no change in the clubhead position.

There are a series of accelerations and decelerations of the putter head after impact due to vibration through the shaft. These oscillations can be clearly seen in Graph 2. The velocity of the club changes as much as 35% during this phase when the ball is struck out of the 'Heel' and 'Toe'. There are even slight oscillations in the shaft when the ball is struck from the 'Sweet Spot'.



Graph 2 – Acceleration / Deceleration of the Clubhead AFTER impact with the golf ball

Conclusion

The results of this experiment would suggest that the range of the impact ratio when striking the golf ball from the sweet spot compared to the 'Toe' or 'Heel' varies up to 75%. The range of the 'Impact Ratio' for the three conditions is 0.51 ('Sweet Spot' 1.92 – 'Toe' 1.41). The greater this range, the greater the range in the peak ball velocity and therefore distance travelled. This wouldn't be a problem for a golfer, if they struck the putt out of the same point of the putter each time...

By reducing the range of the impact ratio, or simply increasing the size of the 'sweet spot' of the putter, this would allow for more 'misshits'. The impact speed of the putter controls the distance the ball travels AND more importantly the line the golfer needs to start the putt to be successful. Controlling the speed of the putter at impact is vital for distance control and good green reading.

'Every putt is a straight putt – it just depends on how hard you hit the putt as to whether the ball takes the break or not' Swash (2001)

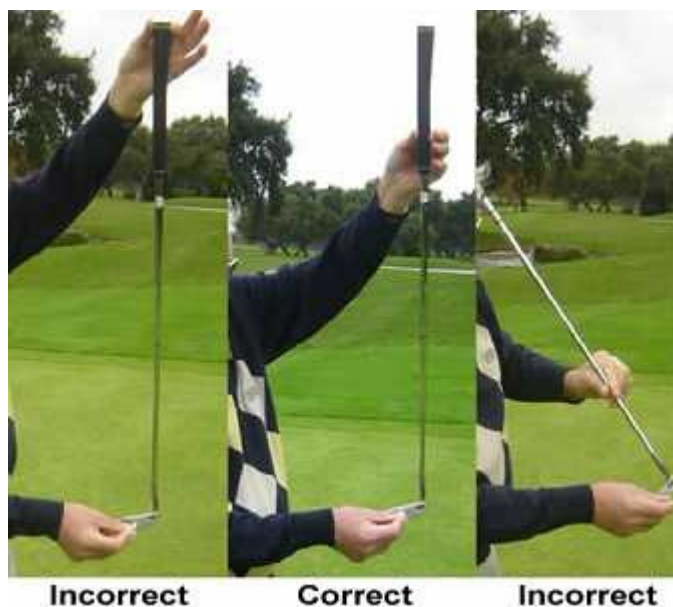
A very simple drill, involving 'lipstick' can be used to see if the ball is being struck on the centre of the clubface. Simply smear lipstick on the face of the club. Hit a putt and see where the ball is being struck by the mark that is left. (Figure 5)



Figure 5: Lipstick Drill

How to find the ‘sweet spot’ on your putter... (Adapted from Swash 2003)

Until you find the ‘sweet spot’ on your putter head, you will not know where to strike the ball on it’s face. EVERY time you miss the ‘sweet spot’, the putter will twist slightly on impact... This will mean miss hits, poor strikes and misdirected putts.



There is a simple way to enable you to find the ‘sweet spot’:

- Hold the putter with your weakest hand (left-handed if you are naturally right handed) between thumb and fore or middle finger at the point where your lowest hand normally holds the grip.
- With a tee peg between thumb and finger (Strongest Hand) tap along the face until the putter moves straight back and does not twist.
- Do not be tempted to hold the club at the top of the handle or the middle of the shaft unless you have a face balanced putter.
- When you find the spot, mark it on the putter – opposite to where it falls on the clubface so that you can see it at address. This may not be the same position as indicated by the manufacturers.



Finally, ‘feel’ is vitally important during the putting stroke. By striking the golf ball out of the ‘sweet spot’ you will increase the ‘feel’ and ‘touch’ for the golfer. Controlling the speed and energy transfer of the putter at impact is vital for distance control and good green reading.

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