A Biomechanical Investigation into Weight Distribution and Kinematic Parameters During the Putting Stroke

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ABSTRACT

This study examined the set-up position of 30 elite PGA professional golfers (2007 Season), in comparison with 30 amateur golfers (Handicap +3 to 9) while attempting the same putt of 25ft on a flat surface with a stimpmeter reading of 12. Video analysis at 50 frames per second was used to record kinematic parameters of the golfers' set-up and posture. All golfers performed their typical putting action while standing on an RSscan International 1.0 m x 0.4 m pressure platform. The RSscan Footscan® and Quintic Biomechanics 9.03 v14 software were synchronised to enable key positions of the putting stroke to be identified. Each golfer used their own personal putter. The main difference between the amateur and professional golfers was in set-up. This was found to be significant with amateurs' weight distribution 59.60% Right and 40.40% Left while the Professional Group was 48.34% Left and 51.66% Right, much closer to a balanced set-up. Students' t-test was used to compare the group means for each parameter with a level of significance set at $p < 0.05$. There is a trend to suggest that the wider the stance, the smaller the centre of pressure movement during the putting stroke. Although there was no significant difference in stance width, there was a significant difference in the total amount of centre of pressure movement ($p < 0.05$) between the two groups of golfers.

Key words: Centre of Pressure, Golf Putting, Weight Distribution

Reviewers: Jon Karlsen (Norwegian School of Sport Sciences, Norway)
T.J. Tomasi (PGA Center for Golf Learning and Performance, USA)

INTRODUCTION

Putting has been described as a game within a game on numerous occasions or even a 'black art'. It has caused much heartache in the search for the perfect stroke. Putting represents close to half the strokes most golfers would use in a full round of golf and is in many ways a miniature version of the full golf swing, yet perplexingly it remains the area of the game least taught.

The majority of coaching magazines, manuals, textbooks suggest 'feel' as the key to success, along with a 'good technique'. However the emphasis should be the other way – a good technique is required to create the confidence (feel) necessary to hole putts [1]. Pelz [2] describes the putting stroke as only one of several different types of golf swing and also iterates that that it accounts for nearly half of all swings made – it is easy to draw the inference that putting does not account for half of all tuition. However, what kinematic parameters constitute a good technique? The author believes putting is a strength exercise, the ability to create a stable posture and pivot point is essential if the putter is to be returned consistently from address to impact. It is often stated by golf professionals that it is best to stand comfortably at address and relaxed over the ball prior to hitting the putt. This creates a very individual style of putting. The two questions the author would like to pose are firstly, what constitutes a comfortable set-up? and secondly, is comfortable (for the individual) the optimal position to execute the putting stroke?

Cochran and Stobbs [3] state that the putter head, while actually in contact with the ball, behaves almost as though it were disconnected from the shaft. Research conducted at the Quintic laboratory with high-speed cameras filming at a frame rate of 15,000 fps has shown that the contact time for a medium putt (18 ft) is approximately half a millisecond. Half a millisecond is a miniscule period of time. If the putter head is opening and closing during the impact zone "2 inches before contact and 2 inches after impact" then the chances of finding the clubface square to the target line at impact is significantly reduced [2]. Therefore, it increases the need for the golfer to create a stable, balanced and solid base, along with a fixed pivot point in which to execute the stroke consistently. Successful putting is all about repeating the stroke mechanics under pressure and starting the ball on your intended line; without this ability, the ability to read the green becomes of secondary importance [1]. It is the opinion of the author that the address position is the first stage in developing a consistent and repeatable technique. In order to create a stable base and fixed pivot point for the shoulders to rotate around, static equilibrium is required. This is when the system of forces acting on a body produces no motion, the body is said to be in static equilibrium.

Putting is a strength exercise, but it does not require the body to produce explosive power, such as a weightlifter performing the clean and jerk. It requires stability and balance. The main focus of such balance within the body is as a result of proprioreceptors. These are receptors, which respond to stretch or pressure within the body and are widely distributed within our skin, tendons and skeletal muscles. Because of the abilities of these receptors to sense the amount of stretching our tendons and muscles are withstanding, the human body is able 'to know where its body parts are at any given moment'; subsequently this sensory information is reported to reflex centres of the central nervous system for interpretation and

subsequent motor response.

Our ears are not only organs of hearing. They also help the body maintain balance. The position of your head is important during the putting stroke, not only will it influence distance perception and alignment, it is the first organ for detecting balance. Your inner ear consists of two sacs called the utricle and the saccule. Within these sacs are receptors called maculae. They are made of sensory hair cells covered by a gel-like cap with tiny crystals inside. Whenever you tilt your head, gravity causes the crystals to slide to one side, creating a pull on the gel and the sensory hairs. This triggers the hair cells to fire nerve impulses along the vestibular nerve to your brain. The rotational axis of your head can also influence balance. In addition, your eyes are also delivering important information about your body's position.

As previously stated, the ability to create a repeatable set-up position with the putter is crucial if unwanted manipulation of the putter face is to be limited during the putting stroke. The address position is the first stage in developing a consistent and repeatable technique. This article reports differences in set-up position between professional and amateur golfers attempting the same 25 ft putt on a flat surface. It studies weight distribution and balance, which are two variables that are vital if the golfer is to have a consistent impact position.

Due to the lack of research into the weight distribution and centre of pressure movement in putting, the purpose of the study was to describe these variables along with kinematic parameters of both amateur and professional golfers. Many players and coaches spend a considerable amount of time focusing on these technical areas without first having an understanding of the ranges professional and amateur golfers operate within.

METHODS

SUBJECTS

Thirty male PGA European Tour Golfers performed their typical putting action under the test condition for this study. A total of four out of the 30 professional subjects finished in the top 10 of the European PGA 2007 Order of Merit. Thirty male amateur golfers (handicap +3 to 9) also performed their typical putting action under the test conditions. All subjects were right-handed and given a number of practice putts with their own putter in order to familiarise themselves with the required putt. Each subject putted towards a hole positioned 25 ft away in a straight line with a stimpmeter rating of 12. Subjects wore their personal golf shoes and attire. The trials were all carried out in the Quintic Putting Laboratory over a period of six-month period during the competitive PGA European Tour 2007 season. The distance of 25 ft was chosen as the test distance, because this is the length of a medium to long demanding putt. Each subject used their own putter and used it until they were able to hole the putt. This was deemed to be a successful putt. Every participant holed six successful putts. An average of the six putts was created for each individual. Each golfer was encouraged to go through their normal pre-shot routine prior to each putt.

APPARATUS

A Footscan® pressure plate 1.0 m x 0.4 m, 4 sensors/cm^2 (8192 sensors total) with a sampling rate of 125 Hz was used to collect the data. The foot function was analysed

using RSscan Footscan 7.9 2nd generation software. The range of the Footscan® pressure measurement system was 0.7 N/cm^2 – 155 N/cm^2. The cross in Figure 1, represents the centre of pressure (COP) of the golfer at frame 1 (40 ms before the beginning of the stroke – movement of the clubhead). The COP is the point on a body where the sum total of the pressure fields acts, causing a force and no moment about that point. The COP can move in two directions, medial/lateral and in the anterior/posterior direction. In the example below, during the putting stroke the COP moves towards the heels of the golfer. The cross enables the four quadrants to specify the % weight distribution of the golfer at specific time intervals. For example in Figure 1: Left Heel = 14.72% / Left Toe = 28.37 / Right Heel = 31.41% / Right Toe = 25.50%.

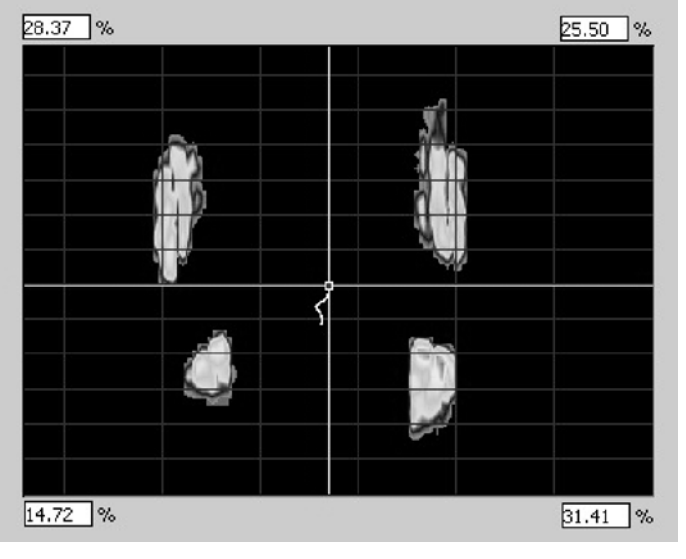


Figure 1. RSscan Pressure Platform Image of the Feet of a Right-Handed Golfer

TEST PROCEDURE

The putting stroke was filmed using a standard digital video Sony TRV 900E camcorder. The camcorder was placed at 90˚ to the path of the golf ball, level with the putting surface. The RSscan Footscan® and Quintic Biomechanics 9.03 v14 software were synchronised using a 'key controller', a software package designed specially to link the two software programs. This enabled the key positions of the putting stroke to be identified and calculate the amount of COP movement for each category.

All golfers used their normal putting stroke and personal putters. Digital video film (50 Hz) was recorded giving the set-up, top of backswing, impact and follow through. After processing, the film was analysed using a personal computer running Quintic Biomechanics v14 video analysis software. Each video was calibrated in the horizontal plane using the pressure platform in the video (1 m scale). All putting

strokes were digitised at a rate of 50 Hz. The putter head of each golfer was digitised and tracked using automatic tracking Quintic Biomechanics v14 and the resulting kinematic data smoothed using a low pass Butterworth filter (10 hz).

The students' t-test was used to compare the group means for each parameter and investigate if any were significantly different. The level of significance was set at $p < 0.05$.

RESULTS

WEIGHT DISTRIBUTION

For each of the 60 golfers, the weight distribution for the Left and Right feet at set-up along with the weight distribution of Heels and Toes were calculated (see Table 1 & 2). The values were obtained for set-up 40 ms prior to the club-head moving. The notion of 40 ms was used, because a number of golfers actually had a body movement away from the ball before the putter head even moved. In addition, the percentage of weight distribution in each quarter (Left Heel / Left Toe / Right Heel / Right Toe) was also calculated 40 ms before club-head movement.

Table 1. Weight Distribution at Set-Up for the 30 Amateur Golfers (S.E. = Standard Error)

					LEFT FOOT		RIGHT FOOT	
	LEFT	RIGHT	HEELS	TOES	HEEL	TOES	HEEL	TOES
Mean	40.40%	59.60%	47.70%	53.43%	19.57%	21.00%	27.17%	32.43%
± S.E.	3	5	4	4	3	3	4	3

Table 2. Weight Distribution at Set-Up for the 30 Professional Golfers (S.E. = Standard Error)

					LEFT FOOT		RIGHT FOOT	
	LEFT	RIGHT	HEELS	TOES	HEEL	TOES	HEEL	TOES
Mean	48.34%	51.66%	45.55%	54.45%	21.37%	26.97%	24.18%	27.48%
± S.E.	3	4	3	3	3	3	3	4

It is interesting to note that amateur golfers show a weight distribution at address of 60% right and 40% left, very similar to PGA recommended weight distribution for a long iron or even a driver at set-up [4]. This would justify the statement made in the introduction that putting in many ways is a miniature version of the full golf swing – with the majority of coaching suggesting feel and standing comfortable as the key to success. What is a comfortable set-up for the majority of golfers? Typically it is what they do the most of, i.e. practice the full swing. Only 5 amateur golfers had a set-up position of more than 50% weight on the left side. Interestingly, one amateur, a former international table tennis player had a set-up of 50% Left and 50% Right. This isn't that surprising given the nature of the game of table tennis, explosive reactions, both left and right, forward and backwards.

For the amateur group, there was a small bias in percentage favouring the toes at address 53%, again possibly reflecting the full-swing set-up posture. However, it

should be noted that there was a considerable variation at set-up ranging from 10% to 90% weight distribution for the toes at address.

The professional golfers showed a more balanced weight distribution at address of 52% right and 48% left (Range 29% – 75% Right Side) to that of the amateur golfers. This was significantly different ($p < 0.05$) to that of the amateur golfers. Ten professionals had a slight bias towards the left side. However, the professional golfers at set-up exhibited an increase in percentage favouring the toes at address, 55% toes, ranging from 32% to 86%.

CENTRE OF PRESSURE MOVEMENT

For each of the sixty golfers, the centre of pressure movement was calculated for the total movement of the putt from start to finish (Mean Total Body COP movement). The putting stroke was broken down into three categories: 1) Start (40 ms before club-head movement), to the Top of Backswing; 2) Top of Backswing – Impact; and 3) Impact – Finish. The amount of COP movement was calculated for each category by synchronising the RSscan pressure platform with the Quintic video software program.

Table 3. Centre of Pressure Movement for the 30 Amateur and 30 Professional Golfers

	Mean Total COP Movement	Start – Top of Backswing	Top of Backswing – Impact	Impact – Finish
Amateur	83.10*	17.61*	12.23	53.26*
± S.E.	6	3	4	5
Professional	64.34	12.24	10.13	41.97
± S.E.	6	2	3	5

Centre of Pressure movement (mm); *Significant difference $p < 0.05$

SE = Standard Error

It is interesting to note that amateur golfers showed a significant increase in total amount of COP movement compared to the professionals. The amateur golfers on average moved 83.10 mm during the putting stroke. This compared to 64.34 mm of movement for the professional golfers. This was significantly different for the two groups of subjects at $p < 0.05$. In each section of the putting stroke, the average amount of movement was greater for the amateur group than for the Professional golfers. It is also interesting to note that the Start – Top of Backswing and Impact – Finish category were also significantly lower for the professional group.

It is the opinion of the author that the lower the amount of centre of pressure movement, the greater the stability and balance of the golfer during the putting stroke. The lowest total amount of COP movement (mm) during the whole stroke was 23 mm, with 18 mm of this movement coming after impact. It is interesting to note that this professional golfer had a 52% left and 48% right weight distribution with also an equal split heels and toes.

The highest amount of movement was recorded post impact to finish. The finish of the stroke was calculated as the moment the putter reached the furthest horizontal position from impact. The majority of this movement is a reaction to the impact as

the head moves backwards (away from the target line). As a result, the putter head can often be seen to rise steeply after impact. A number of amateur golfers had movements of 75 mm during this phase of the stroke.

The professional group has an average stance width of 28.84 cm, 4 cm wider than that of the amateur group. This value may well explain some of the difference in COP movement. However, none of the kinematic parameters presented below in Table 4 were significantly different between the two groups at $p < 0.05$.

By means of comparison, the average amount of body movement for the same time length as performing a putt (2 seconds), when trying to stand still in a normal standing position was 24.28 mm of mean total body movement. Therefore it can be approximated that the notion of swinging a putter causes the Amateur group to increase their COP movement by 58.82 mm and the Professional group a further 40.06 mm.

KINEMATIC PARAMETERS

Table 4. Kinematic Parameters
SE = Standard Error

		Pros		Amateurs	
Parameter	**Units**	**Mean**	**SE**	**Mean**	**SE**
Stance Width	cm	28.84	3.24	24.21	3.45
Height: Sternum – Floor	cm	136	4.10	135	3.39
Stance Width / Sternum Height	%	21.29	3.84	17.98	2.68
Ball Position / Stance Width	%	71.11	5.76	63.24	6.28
Ball Position: Sternum	cm	2.51	2.55	2.63	2.44
Ball Position: Left Eye	cm	-0.57	2.87	0.68	1.90
Ball Position: Bottom of Arc	cm	109	3	88	5

Stance Width

Stance width was measured from inside the left heel to inside the right heel (see horizontal line in Figure 2)

Professional Stance Width (cm)	
Average	28.84
S.E.±	3.24
Range	17 – 43

Amateur Stance Width (cm)	
Average	24.21
S.E.±	3.45
Range	15 – 37

Figure 2. Stance Width

Height: Sternum – Floor

This was the vertical distance measured from the sternum to the floor (see vertical line in Figure 3)

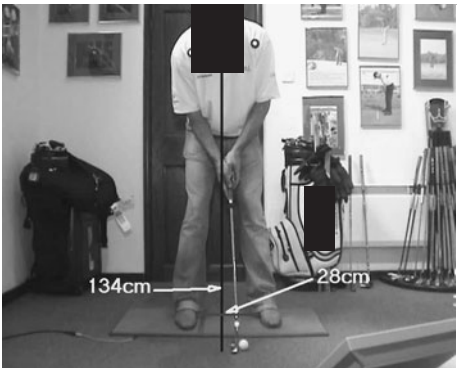
Professional Height: Sternum – Floor (cm)	
Average	136
S.E. ±	4.10
Range	125 – 144

Amateur Height: Sternum – Floor (cm)	
Average	135
S.D.±	3.39
Range	126 – 149

Figure 3. Sternum Height Above Floor

Stance Width/Sternum Height

For this measure, stance width was expressed as a percentage of sternum height. Both stance width and sternum height were measured in the manner above.



Professional Stance Width/Sternum Height (%)	
Average	21.29
S.E. ±	3.84
Range	10.71 – 33.07

Amateur Stance Width/Sternum Height (%)	
Average	17.98
S.E.±	2.68
Range	6.73 – 25.88

Figure 4. Stance Width 28cm / Sternum Height 134cm x 100= 20.90%

Ball Position/Stance Width (%)

Firstly, the horizontal distance between the inside right heel to the back of the ball was measured. See example in the photo below (Figure 5). This was then expressed as a percentage of the stance width (as measured above).

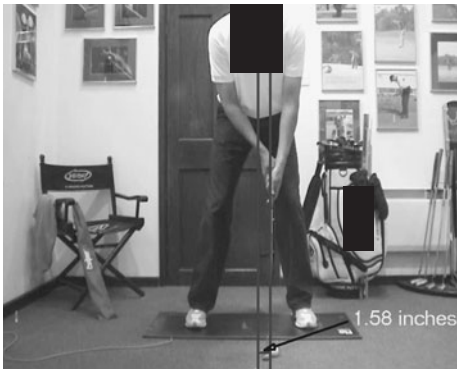
Professional Ball Position/Stance Width (%)	
Average	71.11
S.E. ±	5.76
Range	56 – 95

Amateur Ball Position/Stance Width (%)	
Average	63.24
S.E.±	6.28
Range	45 – 96

Figure 5. 24cm / 43cm x 100 = 55.81%
Note: A value of 100% means ball is positioned opposite left heel.

Ball Position: Sternum-Back of Ball

Figure 6 highlights the ball position in relation to the sternum. This is the horizontal distance between the bottom of the sternum and back of ball. A negative figure indicates that the ball is positioned behind the sternum and a positive figure indicates the ball is positioned in front of the sternum.



Professional Ball Position: Sternum-Back of Ball		
	Inches	cm
Average	0.95	2.51
S.E. ±	1.04	2.55
Range	-0.79 / + 3.54	-1 / + 9

Amateur Ball Position: Sternum-Back of Ball		
	Inches	cm
Average	1.12	2.63
S.E. ±	0.89	2.44
Range	-0.99 / + 3.91	-1 / + 10

Figure 6. Ball Position – Sternum

Ball Position: Left Eye-Back of Ball

Ball position was measured in relation to the left eye. The horizontal distance was measured between the middle of the left eye and the back of the ball. A positive value indicates the ball is positioned ahead of the left eye. A negative value indicates the ball is positioned behind the left eye (see Figure 7).

Professional

Ball Position: Left Eye-Back of Ball	inches	cm
Average	-0.23	-0.57
S.E. ±	1.14	2.87
Range	-2.76 / +1.58	-7.00 / +5.00

Amateur

Ball Position: Left Eye-Back of Ball	Inches	Cm
Average	0.36	0.68
S.E. ±	1.26	1.90
Range	-2.06 / +1.98	-6.35 / +6.78

Figure 7. Ball Position – Left eye

Ball Position:Bottom of Arc-Back of Ball

Finally, ball position was measured in relation to the bottom of the arc of the through-swing to the back of the ball (Figure 8). The bottom of the arc was determined from the digitisation data and subsequently was the lowest vertical point. A negative figure means that the bottom of the arc occurs in front of ball. It is interesting to note that this measure indicates that the bottom of the arc of the putting stroke does not always fall under the sternum, the figure of – 1.58 inches highlights this.

Professional

Ball Position: Bottom Arc-Back of Ball	inches	cm
Average	2.35	5.97
S.E. ±	1.63	4.14
Range	-1.58 / +5.51	-4.00 / +14.00

Amateur

Ball Position: Bottom Arc-Back of Ball	inches	cm
Average	2.05	5.57
S.E. ±	1.43	3.89
Range	-2.08 / +5.34	-4.56 / +13.65

Figure 8. Ball Position – Bottom of Arc

CONCLUSION

This paper has reported various differences in set-up position between 30 elite PGA professionals and 30 amateur golfers while attempting the same putt of 25 ft on a flat surface with a stimpmeter reading of 12. The main difference between the amateur and professional group was in set-up. This was found to be significant with amateurs approximately 60% Right – 40% Left while the professional golfers were much closer to 50% on both sides. There is a trend ($p = 0.11$) to suggest that the wider the

stance width (professional), the smaller the centre of pressure (COP) movement during the putting stroke. Although there was no significant difference in stance width, there was a significant difference in the total amount of COP movement between the two groups. No significant differences were found between the kinematic parameters, most notably ball position and posture, between the amateur and professional golfers. The use of balance and pressure analysis is becoming more popular in the analysis of the golf swing, but there has been very little research into these parameters during the putting stroke. The pressure analysis enables the instructor to look at dynamics and body movement that the naked eye cannot see. Generally the instructor can see positional aspects of the golf swing such as address and top of backswing, but the balance/pressure software allows the instructor to critically review weight distribution and COP movement during the stroke. A good putting technique has the ability to create a stable posture and pivot point to allow the putter to be returned consistently from address to impact without manipulation. Standing comfortably at address and relaxed over the ball creates a very individual style of putting. However, in the author's opinion, "comfortably" and "optimum balance" (50% Toes / 50% Heels / 50% Left / 50% Right) are seldom the same position. None of the sixty golfers exhibited a set-up position with 25% of weight distribution in each of the four quadrants. Each individual had a bias to one or two particular quadrants. It is therefore the opinion of the author that it is possible for all golfers analysed during this study to obtain a more stable and balanced position for the putting stroke. Future research should focus on the effect of COP movement on performance and the importance of balance and weight distribution in reducing body movement during the putting stroke.

REFERENCES

1. Hurrion, P., Putting on Fast Greens, *Golf International*, 2008, March, Issue 78.
2. Pelz, D., *Dave Pelz's Putting Bible: The Complete Guide to Mastering the Green*, Doubleday, New York, 2000.
3. Cochran, A. and Stobbs, J., *The Search for the Perfect Swing*, Heinemann, London, 1968.
4. Professional Golfer Association of Great Britain and Ireland, *PGA Training Manual*, PGA National Training Centre, The Belfry, UK, 2006.

A Biomechanical Investigation into Weight Distribution and Kinematic Parameters During the Putting Stroke:

A Commentary

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INTRODUCTION

Paul Hurrion has done a descriptive analysis of set-up parameters including weight distribution and centre-of-pressure (COP) movement. He has also compared elite professionals with good amateurs. I would like to commend Hurrion for using highly skilled elite players in his study. Quantifying and understanding the kinematics and kinetics of the best players is an important step of gaining knowledge about how to perform putting technique at its best.

I find the study relevant. The set-up is important for making a good and consistent putting stroke, because the biomechanics of the set-up dictates how the body can move during the stroke.

A further and even more important step is to relate kinematic parameters to technique performance, which is how consistent a player can start the ball in the direction the putter face is aimed at address, and how consistent a player can start the ball with the intended speed.

Is it so that a player will start the ball more consistent if the stance is wider, if the weight distribution is 50/50, or if there is less lateral movement? To me it seems likely, and I use these as preferences in my teaching, but we still need more scientific studies to prove it.

DO AMATEURS USE A FULL SWING SET-UP IN PUTTING?

The main difference Hurrion found between the amateurs and professionals was that amateurs had a weight distribution at set up that was closer to what we see in the full swing with about 60% of the weight on the right foot. It corresponds with what I have experienced from teaching elite juniors, especially those who have not received much teaching in basic putting technique. Very often these juniors have more like a full-swing set-up, which is characterized by a ‘full-swing grip’ compared to a ‘putting grip’ which is placed in between the palms of the left hand, a ‘full-swing posture’ compared to a ‘putting posture’ where the cervical spine is close to horizontal, and the

upper body more forward tilted. In addition, I often find straighter elbows in these juniors, compared to a putting set-up where the upper arms are tucked into the body, and the lower arm follows the shaft when viewed in the saggital plane.

What I above call a 'putting set-up' refers to my teaching preferences for technique. Interestingly, they seem to correspond very well with Hurrion's [1]

PUTTING TECHNIQUE IN PERSPECTIVE

On the importance of putting technique for putting performance, I seem to disagree with Hurrion; i.e., "Successful putting is all about repeating the stroke mechanics under pressure and starting the ball on your intended line, without this ability, the ability to read the green becomes of secondary importance" (p. 90). From research we have done, and through practical teaching, I find green reading to be far more important than putting technique for putting performance. In one study of highly skilled players, we found that green reading explained almost twice as much of the distance variability than putting technique (60 vs. 34 %) [2]. In another study, we concluded that the putting stroke only had a minor influence on the direction variability in putting [3]. For example, we found that the stroke of an average European Tour player was consistent enough to hole 95% of all putts from 4 meters. Even though this was calculated from repeated putts, it indicates the minor influence of the technique, and thus the high importance of green reading.

CONCLUSION

In my view, this underlines the importance of not losing perspective of what putting is about when we are discussing technical details. The fact that coaches, players and researchers like to discuss technical details to an extent that does not match its importance in determining performance can be explained by the fact that technique is easier to describe, picture, present and discuss compared to the mental processes related to green reading. However, it will still be important to learn more about the technical details of putting, and I will encourage Paul Hurrion and others to continue their excellent work in this field.

REFERENCES

1. Hurrion, P., How to Putt Like a Tour Pro, *Golf International*, 2007, December, http://www.paulhurrion.com/77_Putt.pdf

2. Karlsen, J. and Nilsson, J., Distance Variability in Golf Putting: The Role of Green Reading, *Annual Review of Golf Coaching*, 2008, 2, 71-80.

3. Karlsen, J., Smith, G. and Nilsson, J., The Stroke has Only Minor Influence on Direction Consistency in Golf Putting Among Elite Players, *Journal of Sports Sciences*, 2008, 3, 243-250.

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A Commentary

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INTRODUCTION

This paper is original in that while there are many studies using force plates and special video software, most target the full golf swing and do not deal with the center of pressure (COP) of putting.

It is clear from the results that the professional golfers set up differently than the amateurs in terms of foot-pressure distribution and that there is less movement of the COP in the professional than the amateur group during the putting motion. What is not clear, since no objective measurement was made of the 60 subjects to determine who were good putters, is what the differences between the groups have to do with good putting.

Since the goal of the study was to compare weight distribution and key kinematic parameters between amateurs and professional to identify any statistically significant differences, I believe the goal was achieved. However, it is all too easy for the reader to make the jump from 'the pros do it this way' to 'and so should you' a jump fueled by the implicit assumption promoted by the author that 'if you are a tour pro, you are a good putter.'

BASE LINE OF PUTTING EXCELLENCE

While it is the author's perogative to limit the scope of the study, this implicit assumption and its ramifications should be noted. I believe the scope of the study would be much expanded had, in addition to the pro/am groups, the author established a base line of putting excellence for the entire field.

One way to do this would be to identify the 30 most successful putters and the 30 least successful putters by recording who holed six 25 footers in the least amount of attempts and, by extension, the 30 least successful putters as the 30 who needed more attempts. Or perhaps the top 20 versus the worst 20, with the middle 20 eliminated from the final comparisons.

Since a record must have been kept of each attempt until the subject made six putts, it would have been very simple to record the total number of attempts (e.g., subject #5 took 45 attempts to make six 25-foot putts, subject #8 took 15 attempts to make six 25-foot putts, etc.) and then to calculate the percentage of successful putts. Armed with this baseline, relationships between weight distribution and COP could be firmed up so that in addition to 'here's what the professionals and amateurs did differently,' you'd have 'here's what the best putters did differently from the worst putters'.

SWAY

The author equates changes in COP with sway with the implication that sway is to be avoided (p. 94). While 'sway', as normally used in golf, should be avoided, should pressure shifts also be avoided? In the normal usage, golf sway is not identical with pressure shifts so to yoke the two concepts, one benign and one detrimental, is to further muddle the issue.

I believe that certain magnitudes of change in pressure that are recorded while putting may not be detrimental to good balance nor directly related to swaying. In fact, they may be part of a sway-prevention mechanism; i.e., part of the body's natural system of balance necessary to effectively perform a motor activity. Perturbations to a body at rest cause palliative counterbalance responses and it may be only when these shifts in COP are unduly restrained that true imbalance occurs. To follow this line of reasoning; the very act of trying to stand stock still – with frozen head, your lower body anchored in cement – increases stress, because natural correctional systems are interfered with. Performance will decline, with the ultimate being the yips where the subject tries to stay so still that they literally 'can't move' until a sudden explosion of imbalance sends the body flailing and the ball flying.

So I would be hesitant, without any research to the contrary, to subscribe to the logic that "the lower the amount of centre of pressure movement, the greater the stability and balance of the golfer during the putting stroke" (p. 94) with the implication that this makes for better putting.

There is no reference in Hurrion's study to foot pressure measurements on the inside or outside rims of the feet (only heel and toe and right and left). Rim pressure would seem to be an important factor in terms of measuring sway and if it is not, then it should be identified as such.

OPTIMUM BALANCE

Hurrion's opinion is that "optimum balance" in the putting set-up is 50% toes/50% heels/50% left /50% right" (p. 99). However, in the absence of any research to the contrary, when 60 golfers (100% of the subjects in Hurrion's study) don't match the "optimum balance" in set-up, it may be that the 50/50/50/50 is not optimum at all since no one does it. Posing it another way: if you did a study to test the hypothesis that there was no optimum balance set-up with a sample size of 60 golfers composed of 30 tour pros and 30 amateurs with handicaps less than ten, and the results were that none of the subjects used the optimum balance set-up, you might conclude that your hypothesis was correct; i.e., there is no optimum balance set-up.

CONCLUSION

Hurrion's study is impressive in that the technology is state of the art, and it involves a large number of high-level players, but it might have been interesting to fill out the amateur field with a few middle and high handicaps.