A SCIENTIFIC REVIEW OF MXV PUTTER DESIGNED BY MXVGOLF

Dr. Abaz Kryemadhi
Messiah College

October 2011

A SCIENTIFIC REVIEW OF MXV PUTTER DESIGNED BY MXVGOLF

Dr. Abaz Kryemadhi, Messiah College

Introduction:

The **MxV1** putter has been designed with the Newton's cradle principle in mind (see reference [1] for how momentum and energy conservation are applied to the Newton's cradle). The name of the putter is actually inspired from the formula for momentum which says momentum is Mass x Velocity (MxV). The idea behind the putter is to make the thickness of the club head the same as of the golf ball thus making it possible for a head on collision with the ball, hitting at the center of the ball which would result in better precision. Newton's cradle is a single pendulum effect which would guarantee a more accurate hit than a double or triple pendulum. In this paper the MxV1 putter was treated as a scientific experiment. There were three main ideas tested a) how efficient is the putter in energy transfer to the ball b) what are the dwell times, and c) do a statistical analysis test and compare it to an Odyssey two ball putter to extract the precision of the two putters. In addition the moment of inertia of the putter was measured.

Energy Transfer Test

For this test, the ball was allowed to drop from a certain height straight on the club head and the bouncing height was measured. From the measurements the coefficient of restitution was extracted, in the golf lingo called the Newton's rule. It was found to be e =0.7, which is comparable to other clubs. The ratio of mass of the ball (m) over effective mass of club head (M) is called a= m/M. According to reference [2], the percentage of energy transferred to the ball is given by:

Eq. 1 $$\frac{a(1+e)^2}{(1+a)^2}$$

This formula assumes an effective loft of approximately zero. Having an effective loft of zero, ensures that there is very little spin or backspin, so no kinetic energy is lost due to spinning, and ensuring a better putt shot if no initial spin. For the MxV1, the percentage of energy transferred to the ball based on equation 1 is approximately 27% (effective mass M=400 grams). These numbers are comparable to a lot of other good quality putters. What is unique about this design is that an effective loft of approximately zero combined with a head on collision as in Newton's cradle, maintain a consistency of low or zero initial spin thus a more accurate shot.

Moment of Inertia

Moment of inertia was measured using the physical pendulum method. Reference [3] gives a description of the method and the proper equations. The basic idea behind making this measurement is to use the club as a physical pendulum and measure the period of oscillations which is connected to the moment of inertia.

The formula which connects period to moment of inertia is given by:

$$\text{Eq. 2} \qquad T = 2\pi\sqrt{\frac{I}{mgL}}$$

Where I is the moment of inertia, m is the total mass of the head plus the shaft, L is the distance from the tip of the shaft to the center of the mass, and g is the acceleration due to gravity. Several measurements were done for the period which averaged to T=1.888 seconds. The standard deviation on the period was 0.033 seconds. The mass including the shaft was 588.8 grams. The mass of the head was 400 grams. The location of the center of mass was found using simple balancing, which gave the length L=0.7 meters. The moment of Inertia was calculated then using:

$$\text{Eq. 3} \qquad I = mgL\frac{T^2}{4\pi^2}$$

This calculation yielded the moment of inertia including the tolerance to be:

$$I = (0.365 \pm 0.013)\ \text{kg m}^2$$

The moment of inertia is a very important element in determining the amount of energy the club carries and also in the amount of energy transferred to the ball as in Equation 1.

Dwell Time

Dwell time is the time that the ball is in contact with the club head, there is some indications (see reference [4]) that increased dwell time increased accuracy, however given the large variety of putters out there it has not been proven fully to be the case. Typical dwell times are of the order of milliseconds. An experimental measurement was carried where the ball was put in a thin layer of aluminum conductor and then hooked to a digital oscilloscope. When the ball is in contact with the putter then one sees a spike in the voltage. The dwell time is the time when the voltage is above the threshold. Several measurements were done to encapsulate the dwell time. Two of the measurements are shown in the pictures in Figure 1 and 2. The dwell times measured were in the range from 0.6-1.0 milliseconds. These dwell times fit within the typical dwell times for other putters. One interesting feature observed is that the contact of the ball with the club happens very fast (observed by the fast rise on the pulse in oscilloscope) and then ball is let go not as fast (observed by the slower fall of the voltage in the oscilloscope), this is a good feature of the putter since letting go slower improves the accuracy.

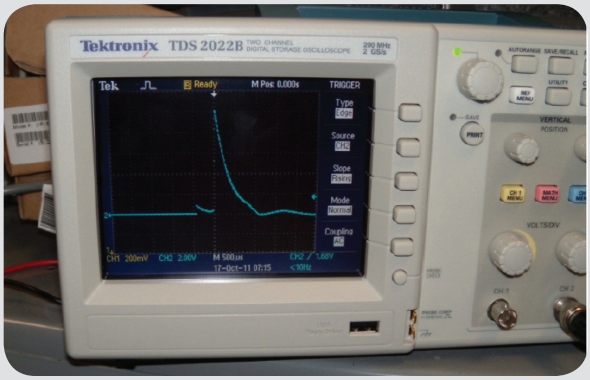

Figure 1.

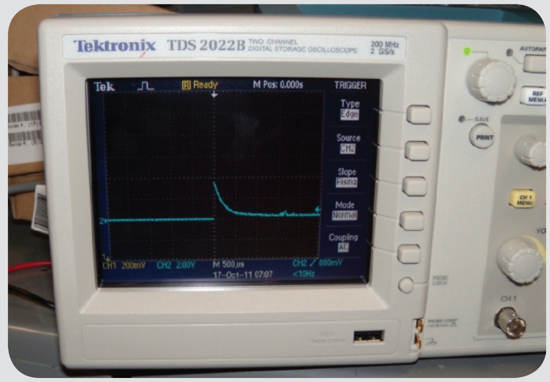

Figure 2.

Figure 1. This oscilloscope picture shows the dwell time for one instance of collision of the ball with the MxV1 putter. The dwell time in this case is two divisions, which is 2x500 microseconds =1millisecond.
Figure 2. In this oscilloscope trigger the dwell time is 0.6 milliseconds.

Statistical Test

In a realistic game there are so many variables to consider, starting from skill of the player, whether the green is flat or not, wind conditions, even whether there is a flag pole inside or outside the pole. Inferring the precision and accuracy of the MxV1 club becomes a very challenging problem. The best one can do in these circumstances is to use statistical tests to infer the accuracy and precision. A statistical test was carried where I putted from a fictitious hole located 12 feet away from the hit spot. The goal of this test was to send 100 putts to the same hole using the same distance from it using the MxV1 putter, an Odyssey two ball putter, and a greater than five year old standard putter, and measure the lateral spread of the putts (meaning how far away the putts from the actual hole are). Using the same conditions for all putts one safeguard the same variables controlling the clubs and the lateral spread would reveal to some degree the precision of both clubs. Care was taken to guarantee similar conditions of three clubs. The results of this test are shown in figure 3, and 4. The red distribution in figure 1 corresponds to the lateral distribution of putts carried with the MxV1 putter, and the blue one corresponds to the distribution of putts carried with the Odyssey two ball club. The red distribution in figure 4 corresponds to the other standard putter. There are two numbers to look at distributions; they are the Mean and root mean square (RMS). The mean values for all the three tests reveal no veering to the left or right for all the three putters, so no design flaws are noticed in all the three putters. The RMS for the MxV1 putter is 5.62 inches; the RMS for the Odyssey flat faced putter is 5.96 inches; and the RMS for the other standard putter is 6.42 inches. The RMS is a measure of precision of the putters, the smaller the RMS the better the precision or consistency of the putts. These tests show that the precision is slightly best for the MXV putter, followed closely by the Odyssey flat faced putter. The MxV1 putter show definite improvement over the standard putter. The MxV1 putter precision is about 6% better than Odyssey flat faced putter and 14% better than the other standard putter.

Summary

The MXV golf putter with a unique design where the thickness of the club is the same as the size of the ball was investigated in a scientific fashion. The goal of a good putter is accuracy and while accuracy is determined by many variables, some beyond the scope of the investigation such as skill of player and feel for the putter. The following paragraphs list some of the tests done which correlate with accuracy.

Energy Transfer

Efficient transfer of energy to the ball from the club could translate in better accuracy. The energy transfer tests were done for the MxV1 putter. In terms of the energy transfer it was found that MxV1 putter transfers energy efficiently to the ball.

General Idea

The uniqueness of the MxV1 putter comes in the fact that as a Newton's cradle idea where the thickness of the putter is the same as the size of the ball, it will maintain a low or zero initial spin consistently thus insuring a more accurate shot.

Moment of Inertia

Moment of inertia was also measured for the MxV1 putter using the physical pendulum method. Moment of inertia contributes to the energy transfer therefore it was an important measurement since as mentioned above energy transfer relates with accuracy.

Dwell Time

Some golf experts suggest that longer dwell times improve the accuracy. Several measurements were done measure the dwell time (contact time of the ball with the club) using a digital oscilloscope and the measured values range from 0.6 – 1.0 milliseconds. These measurements are comparable to other good quality putters. One unique feature noticed for the MxV1 putter was that the ball was let go slower from the head which is expected to improve the accuracy.

Statistical Comparison

The statistical test compared MXV club with the Odyssey two ball putter and another older than five years standard putter. The spread of values from the hole was measured and reported for the three putters. The spread for the MxV1 putter was about 6% better than Odyssey two ball putter and about 14% better than the other standard putter.

References

[1] Gavenda, J. D. & J. R. Edington, Newton's Cradle and Scientific Explanation, TPT, 35, 411-417, 1997.
[2] T. P. Jorgensen, The Physics of Golf, Springer 2nd edition, 1999.
[3] http://hyperphysics.phy-astr.gsu.edu/hbase/pendp.html (Last retrieved on October 17, 2011)
[4] J. Zumerchik, Newton on Tee: A Good Walk through the Science of Golf, Simon & Schuster, 2008.

Distribution of 100 putts

Distribution in inches from the putt hole

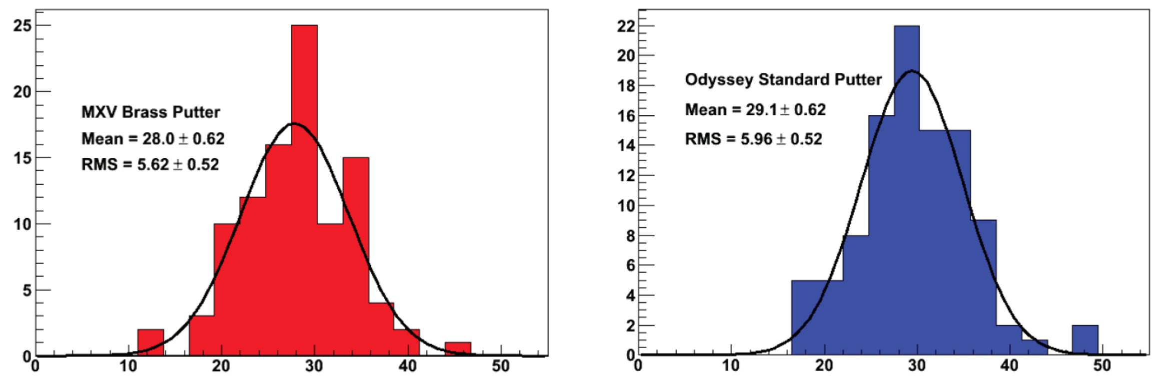

Figure 3. The red histogram shows the lateral distribution of 100 putts from the target for the MXV putter and blue shows the lateral distribution for an Odyssey two ball putter.

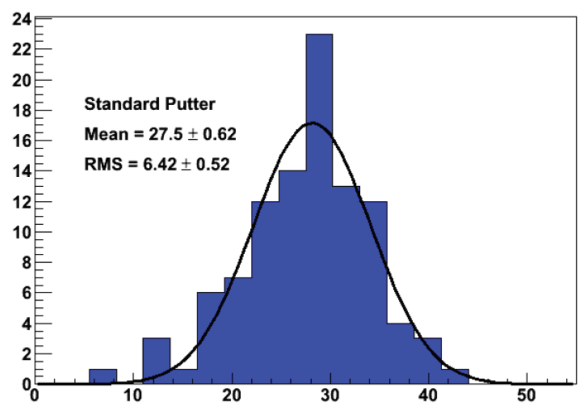

Figure 4. Distribution of putts for another standard putter.

Abaz Kryemadhi is a Professor of Physics at Messiah University in Pennsylvania.