LADIES PROFESSIONAL GOLF ASSOCIATION

STEEL IRON SHAFT WEIGHT:

LIGHTER AND MID WEIGHT STEEL IRON SHAFTS VERSUS HEAVIER WEIGHT SHAFTS TO INCREASE DISTANCE FOR MALE AVID GOLFERS

A THESIS SUBMITTED TO

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BY

MICHELLE DUBE

RANCHO SANTA MARGARITA, CALIFORNIA

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I. ABSTRACT

The purpose of this study was to determine if using a lighter steel iron shaft weight (80 grams) would increase the distance the ball would travel as compared to steel iron shafts with a mid weight (107 grams) and heavier weight (125 grams). Thirty male golfers participated in the study. Each golfer hit fifteen shots, five with each weight club. Cleveland Golf supplied the three test 6 irons used for the study. The three 6 irons were identical except for the difference in the weight of each shaft. The Zelocity Pure Contact launch monitor was used to record the carry distance, which was the distance the ball flies in the air before hitting the ground and ball velocity, which was the speed of the ball after impact in miles per hour. The present study proposed that a lighter shaft would increase the distance of iron shots. Hitting the center of the club face would increase the ball speed which would increase distance. Although the current research hypothesized the lighter steel iron shaft weight would increase the club head speed in most golfers, it may cause some golfers to mishit the sweet spot resulting in no increase in distance over a heavier weight steel iron shaft. To account for this, face tape was used on each 6 iron to monitor the centeredness of the contact. This ensured that the Power Transfer Ratio (PTR) was consistent. The results of the study showed that there was not a statistically significant difference among the distances of the three shafts. The data analysis also showed that the lack of any significant difference among the distance of the three shafts was consistent regardless of the age of the participant. These findings suggest that we cannot generalize when it comes to picking the correct shaft weight for a golfer based on their age or ability level, but rather need to consider the individual's swing.

II. INTRODUCTION

The golf industry could do a better job of educating the golfing public with regard to the importance of utilizing properly fit golf clubs. Most golfers tend to think that fitted golf clubs are only for professional golfers, when in reality a novice golfer would see the most benefit from fitted equipment.

In today's age of technology, the use of launch monitors help to determine the optimum club for each individual golfer. Golfers should not wait until they have "mastered the swing" or "break 100, 90, etc" to be deserving of new fitted equipment. Golfers tend to think that they are not "good enough" to have fitted clubs and often arrive to the lesson tee with "hand me down clubs" that are ill fit for them. Typically the shafts are too stiff for their swing speed, or the length is too short or long for their body type. The analogy that seems to make sense and has an impact is asking them if they would wear a pair of shoes two sizes too big for them and learn how to walk around in them for two months and then they can go buy a pair that fits them. The light bulb often comes on, and they are at least willing to consider getting fit for clubs first before learning how to swing. The less skilled you are the more important it is to have the clubs fit you. Golfers would improve their skills faster by using professionally fitted equipment, thus increasing their enjoyment of the game of golf and longevity in the game.

There are many elements of club fitting such as lie angle, club head design, loft, length of club, grip size, shaft flex, shaft weight, and swing weight. One element of club fitting that the industry is moving towards is how lighter steel iron shafts will increase the distance a golfer can hit the

ball. This study explored steel shaft weights in irons. Specifically, the purpose of this study was to answer the question, "Do lighter weight steel iron shafts help increase the distance the ball will travel versus heavier weight steel iron shafts"?

"The shaft in a golf club allows the energy that is created by the golfer to be transferred from the golfer to the end of the club, the club head. In the early 1800's golf club shafts were made out of a stick of hickory that was turned in a lathe, shaved and sanded down by hand."[1] "The nature of the flex in hickory shafts required that golfers use a slow, smooth swing to properly time the acceleration of the club head through the ball. Hickory shafts were generally durable, but also prone to breakage especially over time. Thomas Horsburg, a blacksmith began experimenting with steel golf shafts in the late 1890's. Steel shafted-clubs made for a more durable golf club and allowed golfers to hit the ball greater distances by increasing club head speed. In 1924, the USGA approved the use of steel shafts. The Royal and Ancient Golf Club of Scotland only approved the use of steel shafts after the Prince of Wales used them at St. Andrews in 1929 on the Old Course. The added durability and increased consistency of steel spelled the end of hickory shafts by the mid 1930's."[2] "At the 1931 US Open, Billy Burke was the first to win a major tournament with steel shafted clubs. When Spalding introduced the Bobby Jones signature set of irons in 1930, the clubs featured steel shafts that were painted tan to give the impression of

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[1] Frank Thomas, "Shafts: The engine of the golf club", Franklygolf.com, 2011, http://www.franklygolf.com/golf-shafts-engine-of-the-golf-club.aspx (accessed April 21, 2011)

[2] Kevin Bliss, "History of Hickory Shaft Golf Clubs", Livestrong.com, June 2011, http://www.livestrong.com/article/346480-history-of-hickory-shaft-golf-clubs (accessed April 21, 2011)

hickory."[3] In the early 1960's Shakespeare Sporting Goods Company was the first to introduce a complete fiber glass shaft. These shafts tended to be really strong, but too heavy, and they didn't have good torsional properties. Along came aluminum shafts that were much lighter but only lasted a few years. It wasn't until 1970 that the first graphite shafts were debuted at the PGA Merchandise show. These shafts were much lighter than steel, approximately just over two ounces, which is about half the weight of a steel shaft. The lighter weight shaft makes it possible to swing the club a little faster with the same energy, which could translate into about a five yard gain in distance on average. Golf club manufacturers have long been using lighter graphite shafts in Drivers in an effort to increase the distance of their drives. Today's golfers don't think twice about using a light weight 65 gram graphite driver shaft, but when it comes to irons they never consider that the weight of the shaft would make a difference. Golf club manufacturers are now using this philosophy in creating lighter weight iron shafts in both steel and graphite materials. The general rule of thumb is finding the lightest weight shaft that when you swing it you are still able to maintain control of the club head at impact.

[3] David Green, "The History of Steel Shaft Golf Clubs", Golflink.com, http://www.golflink.com/facts_11073_history-steel-shaft-golf-clubs.html (accessed April 21, 2011)

III. REVIEW OF LITERATURE

Rene Cleaver, PCS Clubmaker of the year states, "Many golfers don't realize the range of possible weights both with steel and graphite shafts." She says. "Golfers sacrifice accuracy when shafts are too light; distance suffers with too heavy a shaft."[4] The industry is now just starting to apply the use of different weight shafts in irons as they have done already for years in driver shafts. The goal is to give each golfer a shaft weight option that suits the individual and will maximize distance in their iron shots as it has done for their drives.

Many golf club manufactures today are using ultra light weight shafts in their iron sets to help reduce the overall weight of the golf club thus increasing the golfer's club head speed and distance they hit their irons. This increase in distance would mean a golfer would possibly be using a short iron into a green instead of a mid iron; your percentages of greens hit in regulation should increase, which in turn should lower your score.

"KZG, Inc. started in 1994 by Jennifer King and Bruce McKinnon as a technology based equipment company selling patented and new technologies to the major golf companies believes that the lightweight shaft will increase club head speed slightly, but it is more important to hit the ball on the center of the face than to increase club head speed. The goal of all fitters is to

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[4] Andy Brumer, "The only shaft story you need to read: six big questions about shafts and the answers to help fly it farther", Golf Digest, Sept. 2005, http://www.findarticles.com/p/articles/mi_m0HFI/is_9_56/ai_n27864932/pg_2 (accessed November 4, 2010)

maximize ball speed and increase distance while still maintaining control. If a player has a quick transition at the top, it is very likely they will not make solid contact at impact using the lightweight shaft."[5]

"Tom Wishon of Tom Wishon Golf Technology explains there are 5 key elements of a golf shaft: Shaft Weight, Shaft Overall Flex, Shaft Bend Profile, Shaft Torsional Stiffness, and Shaft Balance Point. The shaft weight more than any other element in the golf club, controls the total weight of the golf club. The shaft weight has to be matched with the golfer's strength, swing technique, and tempo. More of a hitter style player would need a heavier shaft weight to match their natural tempo. On the other hand, the smoother a player swings, the more passive they look in terms of their swing technique and swing tempo, the lighter the shaft needs to be to match the golfer. The shaft weight is a critical fitting element for all golfers."[6]

D'Lance Golf Performance Center located in Englewood, Colorado determines, "Shaft flex, shaft weight, swing weight and stiffness, by each individual's own shaft loading profile as determined by testing on the True Temper Shaft Lab. A well-fit club has you hitting longer and straighter shots (less dispersion). Distance comes from longer swing arc (which creates club head speed), hitting the sweet spot of the club (which increase ball speed), a club head that has the capacity to create higher ball speed, and the correct shaft profile (weight, butt and tip flex). Every mph increase in ball speed should result in 2.6 additional yards in carry distance. The optimum launch angle for a 6 iron is 22 degrees with a ball speed of 100 and optimum back spin RPM's at

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[5] Tech Talk, KZG, "The Truth Behind Light Weight Shafts", http://www.kzgolf.com/sites/courses/layout9.asp?id=588&page=55272 (accessed February 13, 2011)

[6] Tom Wishon, "The Basic Elements of Professional Shaft Fitting", wishongolf.com, 2009, http://www.wishongolf.com/video_wishongolf.php (accessed February 13, 2011)

5100-5300. The lower your ball speed, the higher you need to launch the ball to obtain maximum carry distance."[7]

Launch monitors are used to track the flight of a golf ball off the clubface. Measurements obtained through the use of a launch monitor are club speed, ball speed, back spin, side spin, carry distance, attack angle, launch angle, and club path. There are various launch monitor brands to pick from such as Trackman, Zelocity, Foresight, and FlightScope. These launch monitors use Doppler radar to track the flight of the ball, while others like the Vector Pro use photographic extrapolation of ball flight by taking a couple of pictures of the ball right after impact and then extrapolates the data based on ball position at each point in time. The cost of a launch monitor can range from a few hundred dollars to thousands of dollars depending on their tracking capabilities and features. Most golf club manufactures have multiple launch monitors that they use to product test. Some have even developed their own proprietary system for tracking the golf ball in flight, as well as the golfer's body movements.

Pure Impact Custom Golf Company states, "Typically, low handicap players have set ideas about what clubs should be in their bags. Playing irons with shafts other than Project X or Dynamic Golds may be unthinkable. Heavy, high bend shafts are the traditional way to go. Mid to high handicappers may have been steered into playing shafts like True Temper Dynalite, TT Lite XL, or even Callaway Memphis 10, none of which are very light by today's standards.

[7] D'Lance Golf, "Custom Clubs", http://www.dlancegolf.com/custom-clubs-step4.htm (accessed February 13,2011)

I'm finding that there are countless new iron shaft designs that go largely unexplored by the majority of golfers. If you've been playing more traditional shafts in your irons and feel you're simply not getting everything you can out of your iron game, try going with light weight shafts for better distance and accuracy."[8]

[8] Pure Impact Custom Golf, "Iron Game Need a Lift? Try These Shaft Fitting Tips", http://www.pureimpactgolf.com/golf/default.asp (accessed November 2010)

The tables below list light, mid, and heavier weight steel shafts that are manufactured today.

Table 1: Heavy weight steel shafts- True Temper

Shaft Weight: Heavy **Brand: True Temper**		
SHAFT NAME	FLEX	WEIGHT
Dynamic Gold	S300	130 grams
TT Lite XL	Stiff	128 grams
Dynamic Gold HL (High Launch)	Stiff	122 grams
Dynalite	Stiff	120 grams
Project X	6.0	120 grams

Table 2: Mid weight steel shafts- True Temper

Shaft Weight: Mid **Brand: True Temper**		
SHAFT NAME	FLEX	WEIGHT
Dynamic Gold SL	S300	106 grams
Dynalite Gold SL	S300	105 grams

Table 3: Mid weight steel shafts- Nippon

Shaft Weight: Mid **Shaft Brand: Nippon**		
SHAFT NAME	FLEX	WEIGHT
NS Pro 1050 GH	Stiff	107 grams

Table 4: Light weight steel shafts- True Temper

Shaft Weight: Light **Brand: True Temper**		
SHAFT NAME	FLEX	WEIGHT
GS75 (Gold Series)	S200	88 grams

"The GS75 is the lightest steel alloy golf shaft in the world. At less than 80 grams trimmed weight,* the GS75 is more than 15% lighter than the lightest steel shafts made today. Building on the proprietary S3 super strength steel technology platform, the GS75 super lightweight steel iron shaft's responsive tip section maximizes peak trajectory, distance, power, and feel.

*Represents average trimmed weight. A trimmed six iron is approximately **78 grams.**

Table 5: Light weight steel shaft- Nippon

Shaft Weight: Light **Shaft Brand: Nippon**		
SHAFT NAME	FLEX	WEIGHT
N.S. Pro 750GH	Stiff	83 grams

The N.S. PRO 750GH steel shafts for irons (ultra-lightweight) the shaft that takes "light" to the next level. The carry distance of graphite, the control of steel. Weighing in at only **75 grams** (R flex), it's packed with the latest technology to capture golfers' imaginations and mark it as the leader of the light generation.

Table 6: Light weight steel shaft- Apollo

Shaft Weight: Light **Shaft Brand: Apollo**		
SHAFT NAME	FLEX	WEIGHT
Acculite 85	Stiff	91 grams

"This new shaft from Apollo features the very latest in ultra-light steel shaft technology. The Acculite has a weight 20-50 grams lighter than most other steel shafts which provides feel and distance that players normally find in a graphite offering. The key is keeping the stability of a steel shaft."

IV. METHOD AND DESIGN OF STUDY

A. Participants

Participants included thirty right-handed avid male golfers between the ages of 40-75 with a handicap of 5-25. The average age was 55, and the average handicap was 10.5. These avid golfers play typically 2 times per week. The golfers are of the lower handicap range to ensure the dispersion pattern on the clubface would be as tight as possible to make data collecting more accurate. These thirty male golfers regularly play at Tijeras Creek Golf Club where the study took place.

B. Study Location

The study took place on the driving range of Tijeras Creek Golf Club located in Rancho Santa Margarita, California. The study was conducted over 4 days. The weather conditions for the 4 days were similar with temperatures between 70-75 degrees, sunny, and no wind. The participants arrived at the driving range in fifteen minute intervals to ensure the participants hit their fifteen shots all at the same time, and data was collected in a timely manner so there was no down time in-between shots.

C. Study Golf Club Specifications- 6 IRON STEEL

Cleveland Golf supplied three test 6 irons for the study. Each 6 iron was the same length, loft, club head design, grip type and size, swing weight, shaft material and flex. The only difference was the weight of the steel iron shaft, 27 grams difference between light to mid, and 18 grams

difference between mid to heavy weight shaft. The test clubs are steel and have a stiff shaft flex. Brent Newsome, Manager, Tour Operations for Cleveland Golf pointed out that the job of the

shaft is to stabilize the club head at impact, it is for this reason tour players tend to play a very stiff shaft flex. Since the primary goal in this study was to determine if the weight of the steel iron shafts have an effect on distance, steel shafts were used instead of graphite shafts. Steel is more consistent than graphite, although the engineering of graphite shafts have greatly improved over the years making them more consistent than in years past. By using a stiff flex this will help to ensure the club head will be more stable at impact resulting in better control of the club head at impact. Also, by choosing a stiff flex and steel shaft as the test 6 irons it gave the best chance of insuring the orientation of the club head at impact was square. A regular flex graphite shafted iron may be too whippy for some of the test golfers thus skewing the data.

Table 7- Study 6 iron specifications

HEAD	SHAFT MODEL	WGT.	FLEX	LENGTH	LIE	SWG WGT.	LOFT
CG16	Dynamic Gold	125	S	37.50”	61.75°	D1.50	29.50
CG16	NS Pro 1050 GH	107	S	37.50”	61.50°	D1.25	29.50
CG16	NS Pro 750 GH	80	S	37.50”	61.50°	D1.25	29.50

D. Study Method

To determine if using a lighter steel iron shaft weight would increase the distance the ball will travel as compared to heavy weight iron steel shaft, two dependent variables were used. Using

the Zelocity Pure Contact launch Monitor, which uses reliable patented radar technology, data for carry distance and ball velocity were collected. **Carry distance** is the distance the ball flies in the air before hitting the ground. **Ball velocity** is the speed of the ball after impact in miles per hour. Dick Roesgen, Product Test manager for Cleveland Golf has conducted several product

tests where he collected data from golfers hitting various clubs. He had determined his data is more accurate the fewer number swings you ask a golfer to perform. He stated "if the golfer has hit too many shots they tend to get tired and the quality of the test is compromised." Furthermore, in the article "What shaft is right for you article", Aaron Baddeley stated, "I wouldn't try anything more than four swings. If it takes any longer than that, you've already started to adjust to the shaft. You've got to get that desired flight right from the start." Consequently in the present study each golfer hit a total of only fifteen shots, five with each shaft weight club.

The golfers did not hit any golf balls prior to the study, they were allowed to warm up by stretching and/or making practice swings with their golf clubs. Statistical software was used to compare the averages of the five shots for the three different shaft weights for all 30 golfers, thus determining if there is a significant difference in using the various weighted shafts. Brand new Pinnacle range balls were used for each iron shot by the participants. To counter balance the order of hitting different weight shafts, the first 15 golfers hit first with the lightest shaft weight, then mid, ending with the heaviest shaft. The next 15 golfers hit the weighted shafts in the opposite order, starting with the heaviest first, mid, and ending with lightest. Golfers were chosen from the primary investigator's student pool based on their ball striker capabilities.

V. RESULTS

Table 8- Mean and Standard Deviation of carry distance and ball velocity.

SHAFT TYPE	**CARRY DISTANCE MEAN±SD**	**BALL VELOCITY MEAN±SD**
Lightest weight shaft- Nippon NS Pro 750 GH (80 grams)	146.96±19.83	104.22±10.26
Mid weight shaft- Nippon NS Pro 1050 GH (107 grams)	147.00±19.77	104.26±10.13
Heaviest weight shaft- True Temper Dynamic Gold (125 grams)	145.60±20.63	103.42±10.73

Table 8 shows the means and standard deviations of the carry distance and ball velocity for each of the three shafts used in the present study. The data suggests only a minimal difference in carry distance or ball velocity between the light, mid, and heavy weight shafts. A one-way ANOVA comparing the difference of the carry distances of the 3 shafts failed to achieve significance, $F(2,87) = .055$, $p = .946$. A one-way ANOVA comparing the difference of the ball velocity of the 3 shafts also failed to achieve significance, $F(2,87) = .093$, $p = .910$.

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Table 9- Age category interaction between the 3 shafts.

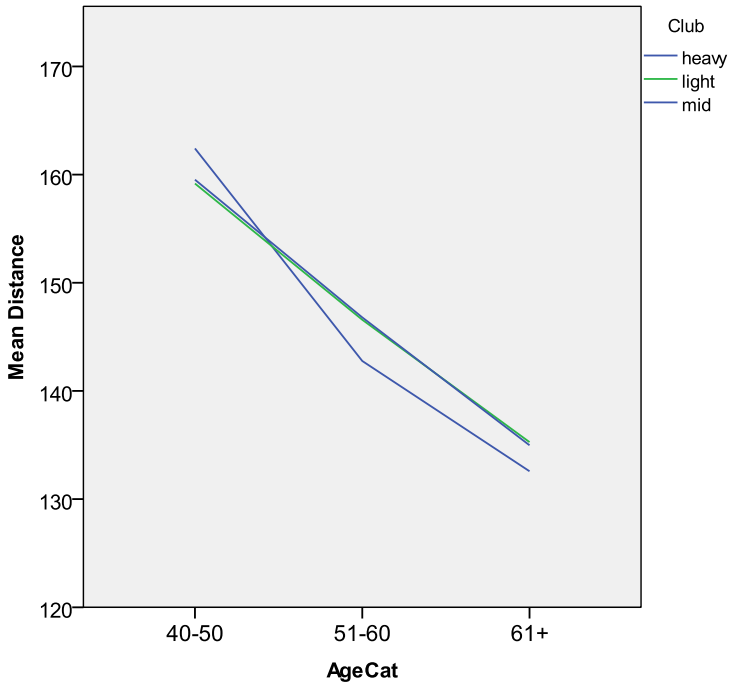

Table 9 shows the mean distance between the 3 various weight shafts, for 3 different age categories: 40-50, 51-60, and 61+. The data suggests on average the participants over 61 years of age didn't hit the ball as far, and that there wasn't an interaction between the age of the golfer and the different shaft weights. To test this effect an interaction term was run on the data. The output shows that there is no interaction between club and age category (p-value = .956). This means that the effect of shaft does not depend on age category. However, age category is significant by itself (p-value =.000). This means that older people tend to not hit the ball as far as seen in Table 9 above with 61+ age category hitting the least distance of all age categories.

VI. SUMMARY AND CONCLUSIONS

The purpose of this study was to determine if lighter weight steel iron shafts increase the carry distance and ball velocity over heavier weight steel iron shafts in the avid male golfer. The results of the study show that there was not any real benefit from light to mid weight shafts and only a slight benefit compared to the heaviest shaft. The data analysis also showed that the effect of the shaft does not depend on age. The age of the study participant wasn't a factor like most would think. The lightest weight shaft didn't necessarily perform better for the study participants who were older than 61.

The results show that we cannot generalize when it comes to picking the correct shaft weight for a golfer based on their age or ability level but on their swing. There are many more companies that fit golfers for clubs with the use of high tech computerized systems. The cost is minimal for a club fitting and will be well worth it in the long run. The golfer will play better and perhaps develop a lasting enthusiasm for the game.

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