

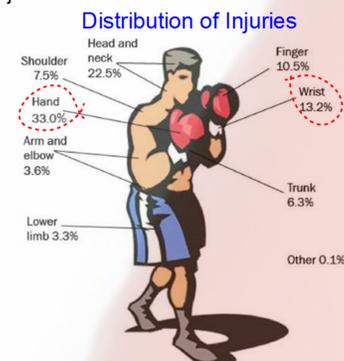
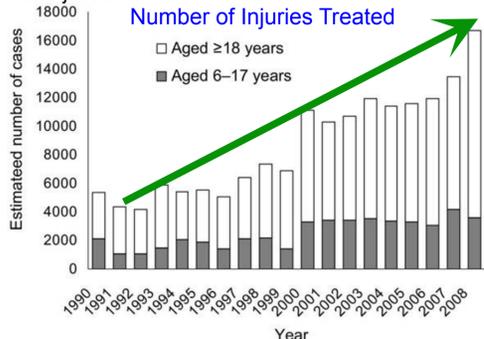


# Road to Rio - Protecting our Olympic Boxing Future



## Introduction

- Boxing is Ireland's most successful Olympic Sport accounting for 57% of all medals ever won by Ireland. In the new millenia it has accounted for 78% of the medals won by Ireland (Source: Olympic Council of Ireland www.olympics.ie).
- Since the 2012 Olympics three out of four of Ireland's Boxing Olympians withdrew from important championships due to hand/wrist injury (Source: Irish Amateur Boxing Association www.IABA.ie).
- In 2007 the AIBA, which is the worldwide governing body for amateur boxing, commissioned a report 'INJURIES OF THE HAND AND WRIST' which found that wrist/hand injuries are among the more frequently seen problems in boxing. The majority of these are soft-tissue injuries, sprains and strains but occasional fractures of the hand are also seen though infrequent. The injuries are caused when the hand and wrist are not aligned when the punch makes contact with the target.
- A new large scale American study, 'Boxing Injuries Presenting to U.S. Emergency Departments, 1990-2008', published in 2011 in the American Journal of Preventive Medicine, examined boxing injuries among participants 6 years of age and older, and found that the number of reported injuries has risen dramatically between 1990 and 2008. Combined Hand and Wrist injuries accounted for 46.2% of all recorded injuries.

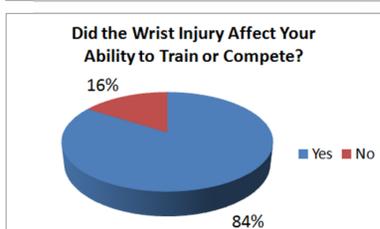
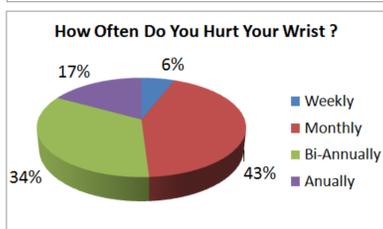
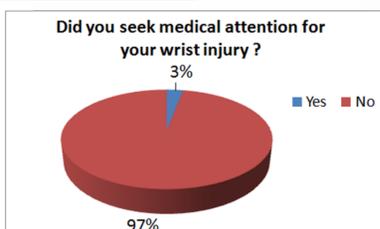
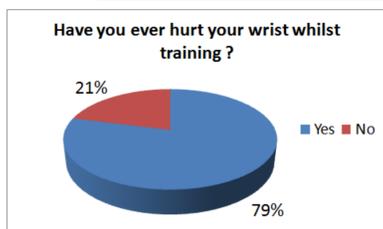


- Cloth handwraps to prevent hand and wrist injury when punching were introduced in 1865 and became commonplace in the 1920's and have remained largely unchanged since then.
- In order to address the problem of hand and wrist injury in advance of the 2016 Olympic Games in Rio De Janerio a new device called 'The Brap' was designed by a member of this team to improve hand and wrist alignment and therefore reduce the likelihood of injury.
- A survey of the Irish experience regarding hand/wrist injuries was conducted in conjunction with experiments to assess the Braps performance, no pre-existing Irish survey could be located.
- A detailed search of the available scientific literature reveals that this scientific study, which measures hand and wrist alignment when punching, is the first such scientific study of its kind in the world.

## Survey (Sample Size 227)

- The survey was designed after completing a pilot survey in our local boxing club and was designed to extract the respondents experience of wrist injuries and their frequency.
- The survey was completed in hardcopy format and administered in person.
- The population of licensed boxers in Ireland at amateur level is approx. 7,500+ (Source: IABA).
- 227 respondents representing licensed boxers in clubs in North Leinster and South Ulster were surveyed.
- The Margin of error for a sample size of 227 from a population of 7,500 was calculated using the confidence interval calculator at the web address www.surveysystem.com/sscalc.htm.

Responses = 227	Percentage	Number
Gender: Male	98.2%	222
Gender: Female	1.8%	5
Mean Age		18.4
Mean Years Experience		3.1
Survey Margin of Error	6.4%	



## Objective

To measure and statistically compare hand and wrist alignment when using the 'Brap' and traditional Hand-wraps in order to determine if the 'Brap' improves hand and wrist alignment when boxing.

## Experimental Design

- Repeatability:** A lack of pure repeatability is inherent in human activities therefore each test subject was required to punch 30 punches with each protective method in order to reduce random error.
- Statistical Validity:** A cohort sample size of 30 test subjects was used for each experiment to allow for a reasonable accuracy of the standard deviation estimation. A sample size of 30 test subjects is a commonly accepted rule of thumb to allow statistically valid inferences and conclusions to be made. Punches were sequenced in alternate batches of ten for each protective method to ensure any changes in the test environment affected both protective methods equally.
- Researcher Bias:** The test results from the experiments were independently coded to facilitate a form of blind analysis.
- Omission/Inclusion Bias:** Test Subjects were drawn from different clubs and included males and females aged 10 to 46.
- Measurement Bias:** All equipment was calibrated and traceable to national standards. The accelerometer has an accuracy error of max 0.06%. The measurement sensitivity (resolution) of the accelerometer is .037 m/s<sup>2</sup> giving a maximum absolute reading error of .0185 m/s<sup>2</sup> (contributes 0.05% error when compared to the mean acceleration).

## Experiments

### Angle of Flexion/Extension (Degrees) (Sample: 1800 punches with 30 test subjects)

- The experiment required the test subject to punch a Punch-Bag with maximum effort in alternate batches of 10 punches i.e. 10 punches wearing the traditional hand-wrap followed by 10 punches wearing the 'Brap', and the sequence was repeated until 30 punches for each protective method for each test subject was measured.
- The punches were recorded using a 240 frame per second High Definition camera and the angle of flexion/extension in degrees was measured for each punch using video motion analysis software.
- 1800 punches were analysed in total ( 30 punches using the traditional hand-wrap plus 30 punches using the 'Brap' for each test subject for a cohort of 30 test subjects).
- The maximum value for the absolute angle of flexion/extension for each test subject was used for a statistical comparison analysis.

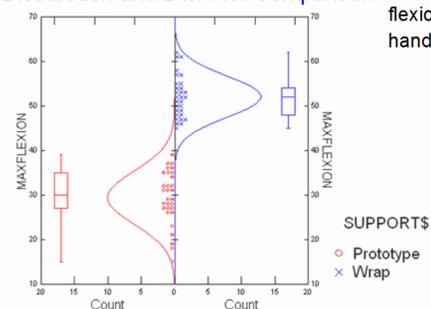


### Descriptive Statistics

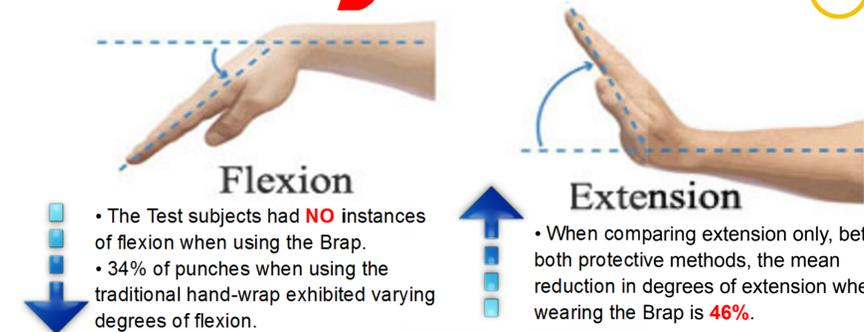
	BRAP	HANDWRAPS
N of Cases	30	30
Minimum	21.000	45.000
Maximum	39.000	62.000
Arithmetic Mean	29.900	52.100
Standard Deviation	5.054	4.641

- A difference between the Mean angle of flexion/extension of 42% (95% CI=38%, 47%) is of practical significance.
- Shapiro-Wilks p-value for the difference between the protective methods is .054 (> .05) indicating the difference between the protective methods is normally distributed and therefore the Paired t-Test is a suitable hypothesis test.

### Distribution and Box Plot Comparison



- Clear difference in the Brap(Prototype) data distribution of degrees of flexion/extension compared to the traditional Hand-wrap (Wrap).



### Punch Force (Newtons) (Sample: 1800 punches with 30 test subjects)

- As a control measure whilst the previous experiment was being conducted, punch force was simultaneously measured for each punch in order to gauge whether test subject effort was a source of bias in the results.
- Instantaneous Punch Force was measured using a 3 axis accelerometer and a punchbag. The unit of measurement was Newtons (N).
- The punch force for each test subject corresponding to the punch which produced the maximum absolute angle of flexion/extension was used for statistical analysis.

### Descriptive Statistics

	HANDWRAP	BRAP
N of Cases	30	30
Minimum	1,561.140	1,620.780
Maximum	2,393.057	2,483.700
Arithmetic Mean	1,905.650	1,983.289
Standard Deviation	225.317	229.770
Shapiro-Wilk Statistic	0.950	0.950
Shapiro-Wilk p-Value	0.171	0.174

### Paired t-Test

Variable	Mean Difference	95.00% Confidence Interval		Standard Deviation of Difference	t	df	p-Value
		Lower Limit	Upper Limit				
HANDWRAP	-77.638	-82.318	-72.959	12.532	-33.933	29.000	0.000
BRAP							

- The Paired t-Test p value is <0.05, the 95% confidence intervals do not include zero, and the t-value is significantly larger than 2.045 for 29 degrees of freedom, thus implying the difference is statistically significant and not due to chance.
- Difference of 4% in Mean Punch Force in favour of the Brap.
- Shapiro-Wilks p-Value for the difference in punch force using either protective method was 0.09 (>0.05) implying the distribution is normal and the Paired t-Test is a suitable hypothesis test.
- The results of the force test show a slightly greater force (4%) when punching with the Brap indicating that the 42% reduction in angle of flexion/extension observed in favour of the Brap was not due to a reduced punch force, and therefore by extension the difference is not due to test subject effort.
- Because the punch force when wearing the Brap was 4% greater it could be opined that the difference in angle of flexion/extension between the protective methods would be larger than 42% if the punch force was equal.
- Test subjects reported feeling more confident of not injuring themselves when wearing the Brap and this possibly accounts for the greater punching force, or alternatively it may be due to the enhanced wrist/hand alignment provided by the Brap.

## Conclusions

1) According to our survey, Injury of the wrist/hand occurs frequently in Irish Boxing and this reflects the general picture observed in International studies of reported injuries.

Our survey reveals;

- 79% of Boxers have hurt their wrists during training,
- of those that hurt their wrists 97% did not seek medical attention even though it affected their ability to train or compete, and
- of those that hurt their wrists, 49% hurt their wrists at least once a month.

2) The 'Brap' device is superior to the traditional Hand-Wraps for maintaining hand and wrist alignment when punching, it can be concluded the Brap reduces the maximum angle of wrist flexion by an average of 42%, thereby reducing the likelihood of injury.

## Next Steps

- Longitudinal Study:** The Brap device was assessed by Ms. Katie Taylor who competes at international level and is a five times World Champion boxer and Olympic Gold medalist and who suffers regularly from wrist/hand injuries. She has tried many other solutions to try and improve her hand and wrist alignment and has found the Brap device to be "amazing", and when compared to other solutions it is "the best by far". She has requested a pair of Braps for her own use, and the feedback from her use over the next 12 months will be used to further evaluate the device. Other boxers will be approached with a view to recruiting them to participate in this longitudinal study where incidence of injury and user experience will be logged and subsequently analysed.
- Increased Sample Size:** Over the next twelve months further test subjects will be added to the empirical data set in order to further narrow the confidence interval and improve the statistical validity of the results. A further survey will also be conducted in the second quarter of this year at the National Boxing Championships, which draws participants from across Ireland, in order to ensure the survey results are more nationally representative.

