SHARC

Stopping **H**aemorrhage by **A**pplication of **R**ope Tourniquet or Inguinal **C**ompression

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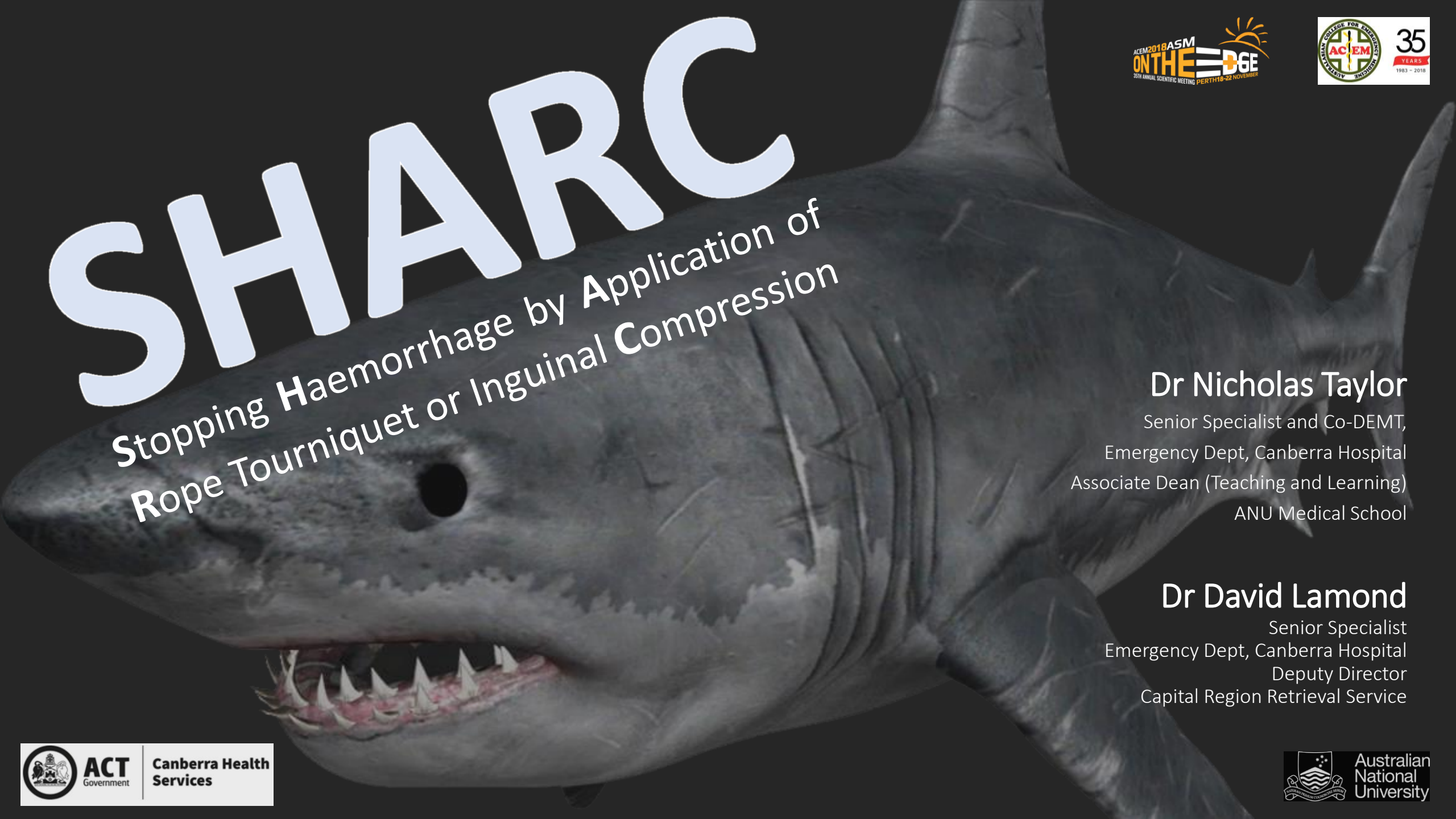
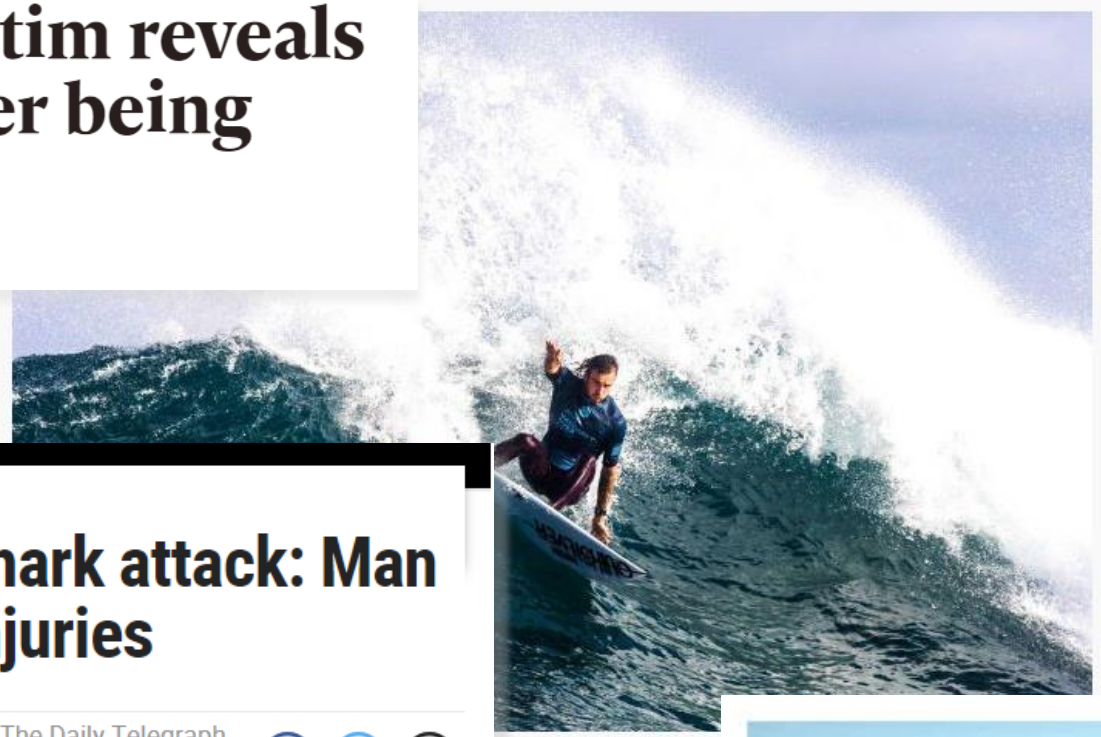


"I didn't examine the wound, but from what I could estimate it occupied most of the back of her thigh … a massive wound."
Dr Hadok described
minor" and said he c
rescue

Margaret River Pro surfing event cancelled after shark attacks near Gracetown

Updated 19 Apr 2018, 6:38am



Australia shark attack victim reveals gruesome leg injuries after being bitten by great white

Young surfer escapes after huge fish becomes entangled in leg rope

Shark attack in Whitsundays leaves woman with critical leg injury

By Rebecca Hyam, Tara Cassidy and staff

Updated 20 Sep 2018, 12:32pm

NSW

Black Head Beach shark attack: Man suffers severe leg injuries

Linda Silmalis, Richard Noone and Laura Banks, The Daily Telegraph
September 5, 2015 5:46pm

The shark caused deep puncture wounds to his torso and leg, Truto harbormaster Gary Sharpless told the Times. The man is conscious and ta according to Truro Fire Chief Tim Collins.

Australia shark attack: mauled surfer swims to shore despite leg injuries

A Melbourne schoolgirl attacked by a shark while swimming in the Whitsunday

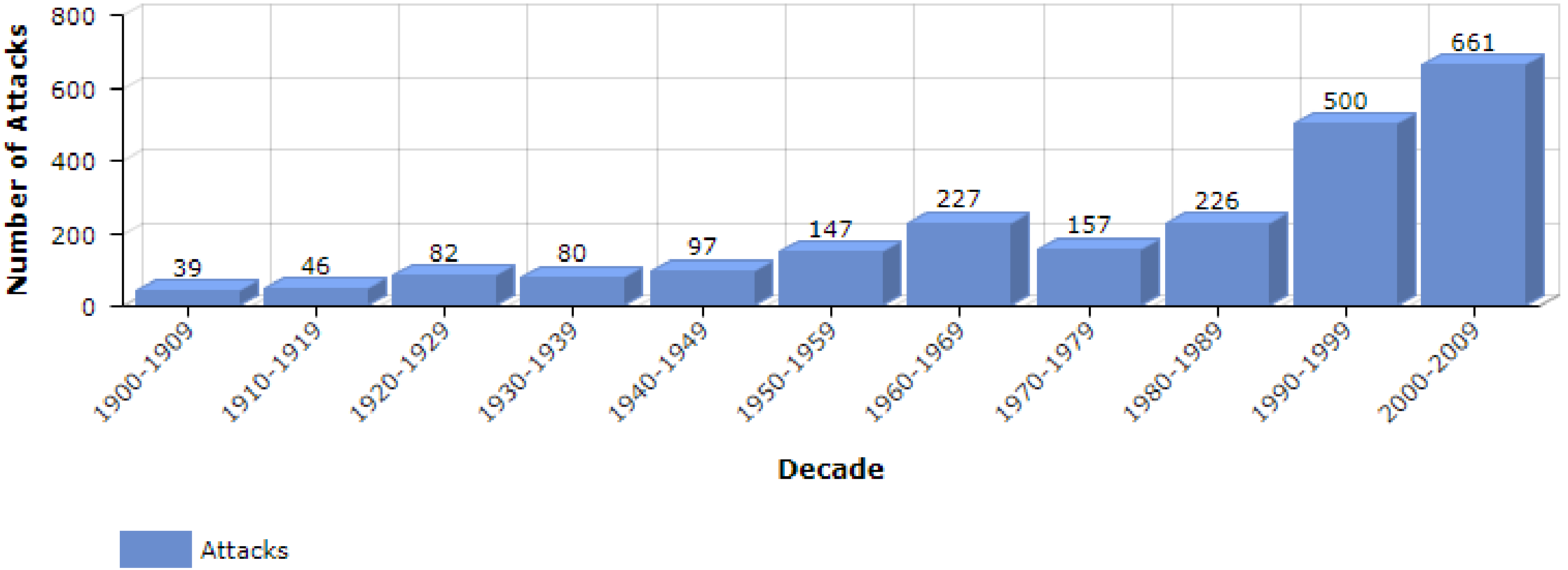
Surfer Seriously Injured In Shark Attack Off Ballina

Surfer suffers wounds to left thigh after being attacked at Lighthouse Beach on NSW north coast.

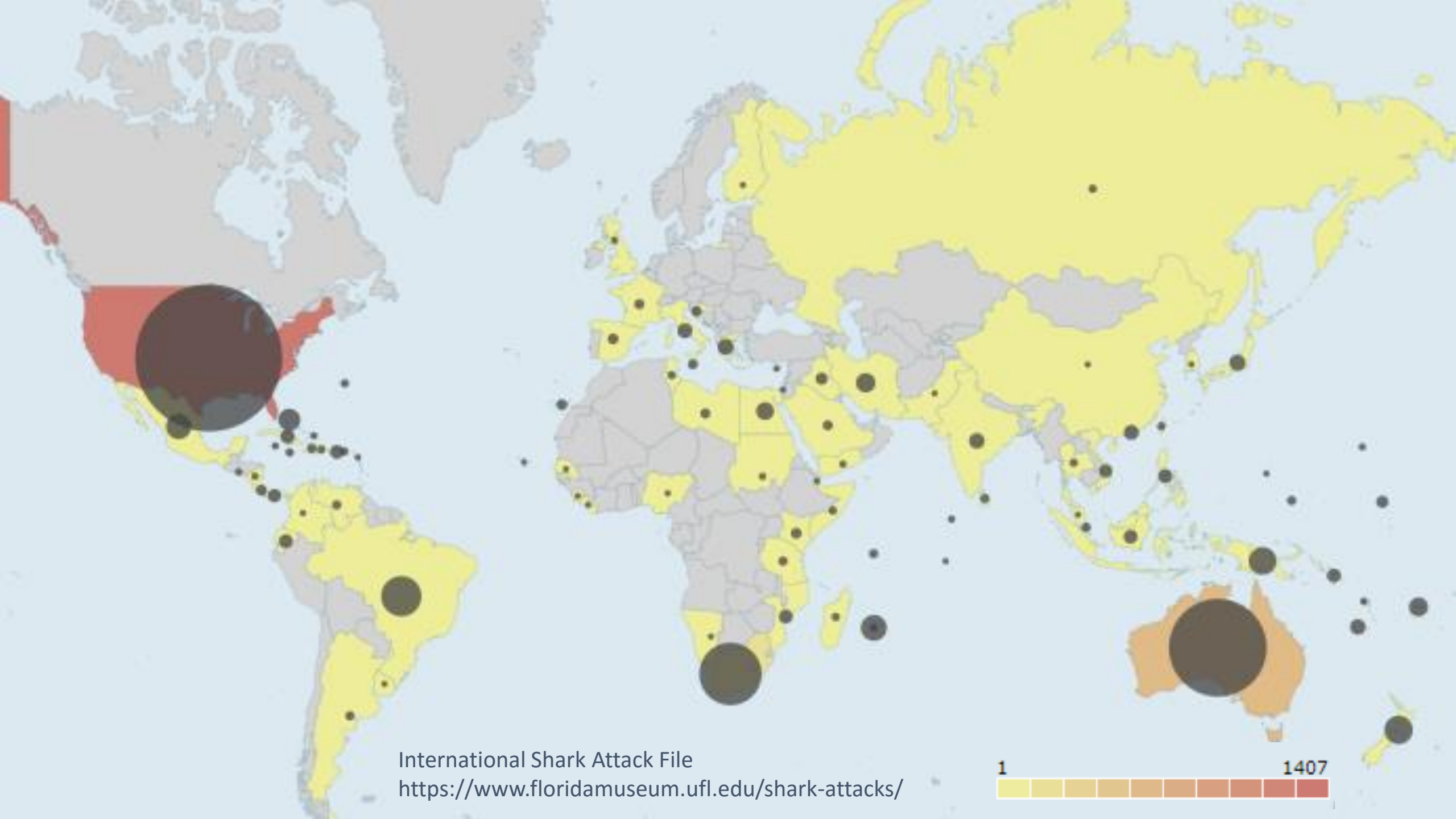
10 Nov 2015

The man mauled in the most recent attack was airlifted to Mackay Base Hospital on Monday night with critical leg and wrist injuries and rushed to surgery, but died a short time later.

Unprovoked Shark Attack Trends Worldwide Over the Past Century



International Shark Attack File https://www.floridamuseum.ufl.edu/shark-attacks/



International Shark Attack File
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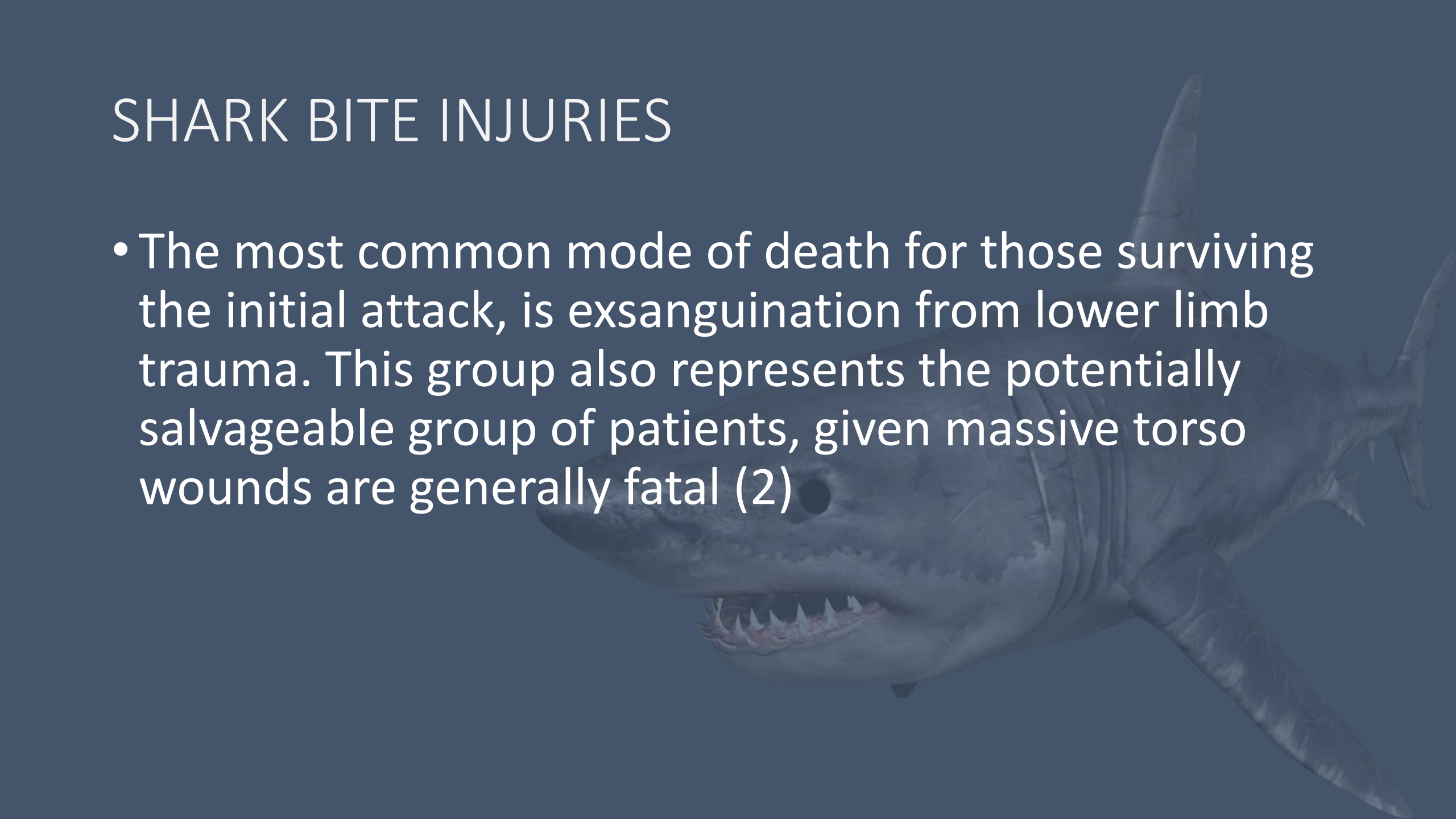
SHARK BITE INJURIES

- The most common mode of death for those surviving the initial attack, is exsanguination from lower limb trauma. This group also represents the potentially salvageable group of patients, given massive torso wounds are generally fatal (2)

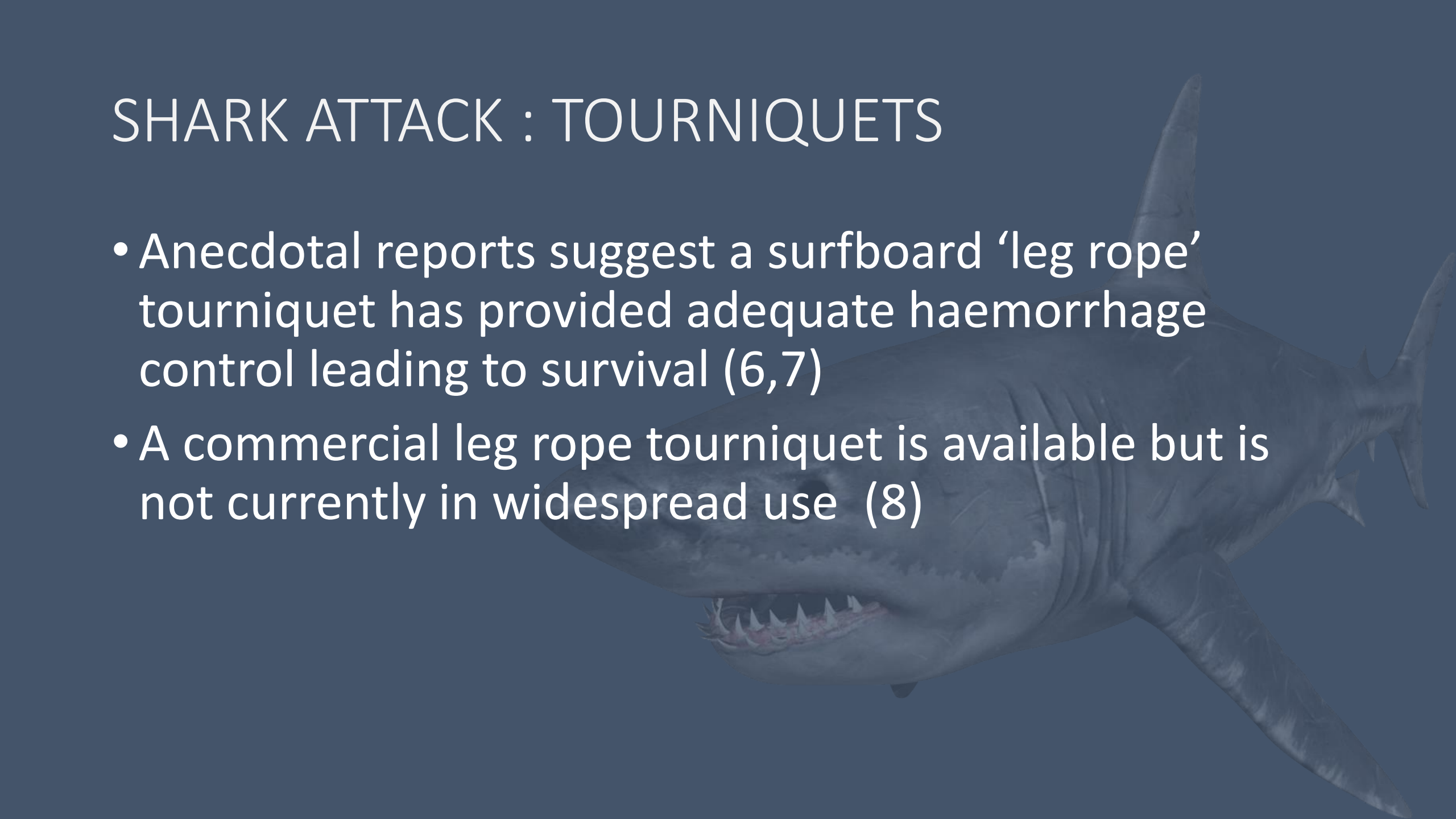


TOURNIQUETS

- The application of tourniquets to stem haemorrhage from limb injuries has been extensively studied in the prehospital military medical literature and has widespread support in this field (3,4,5)
- Tourniquets are unlikely to be carried by the average surfer or beach user

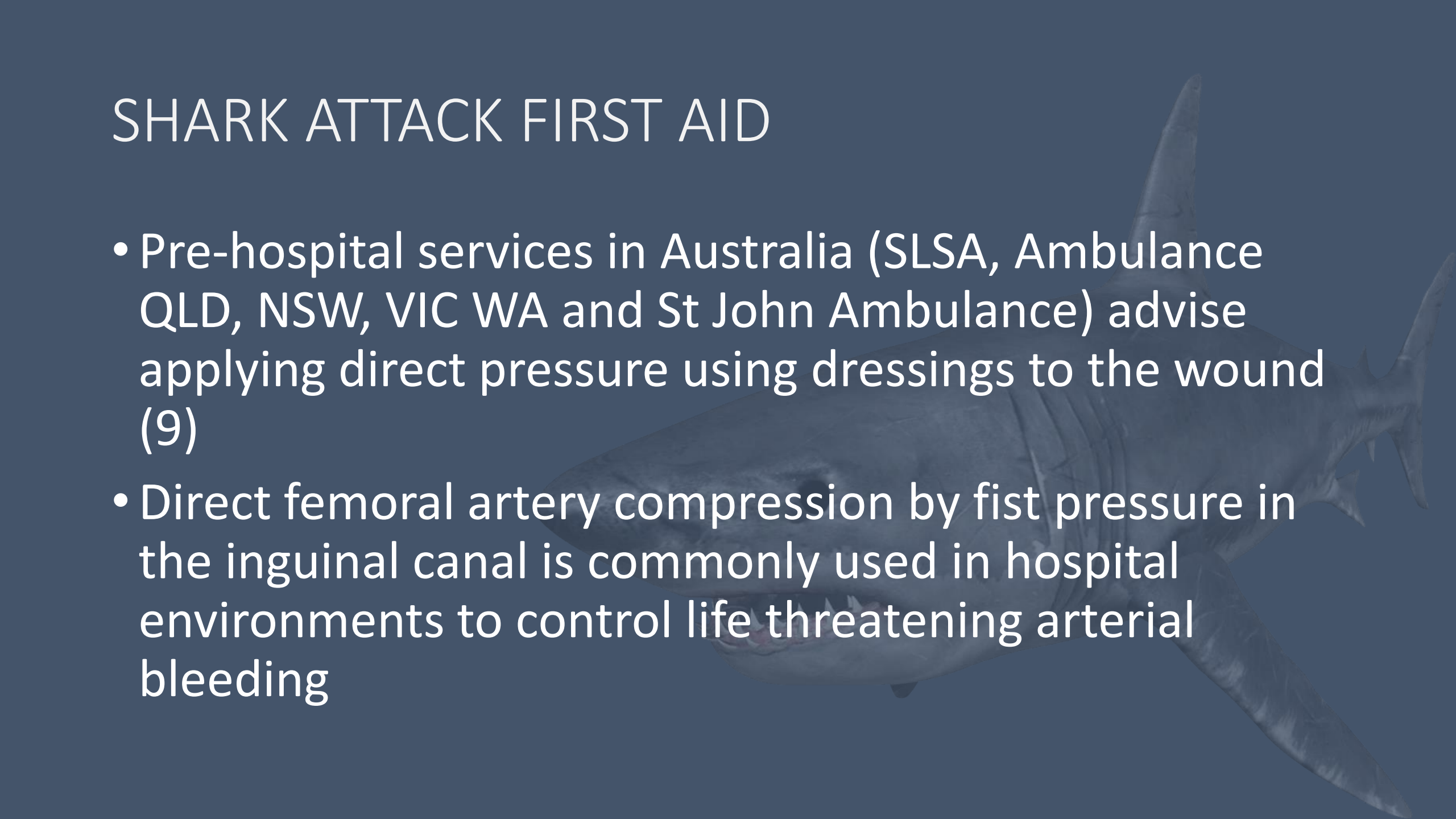
SHARK ATTACK : TOURNIQUETS

- Anecdotal reports suggest a surfboard ‘leg rope’ tourniquet has provided adequate haemorrhage control leading to survival (6,7)
- A commercial leg rope tourniquet is available but is not currently in widespread use (8)



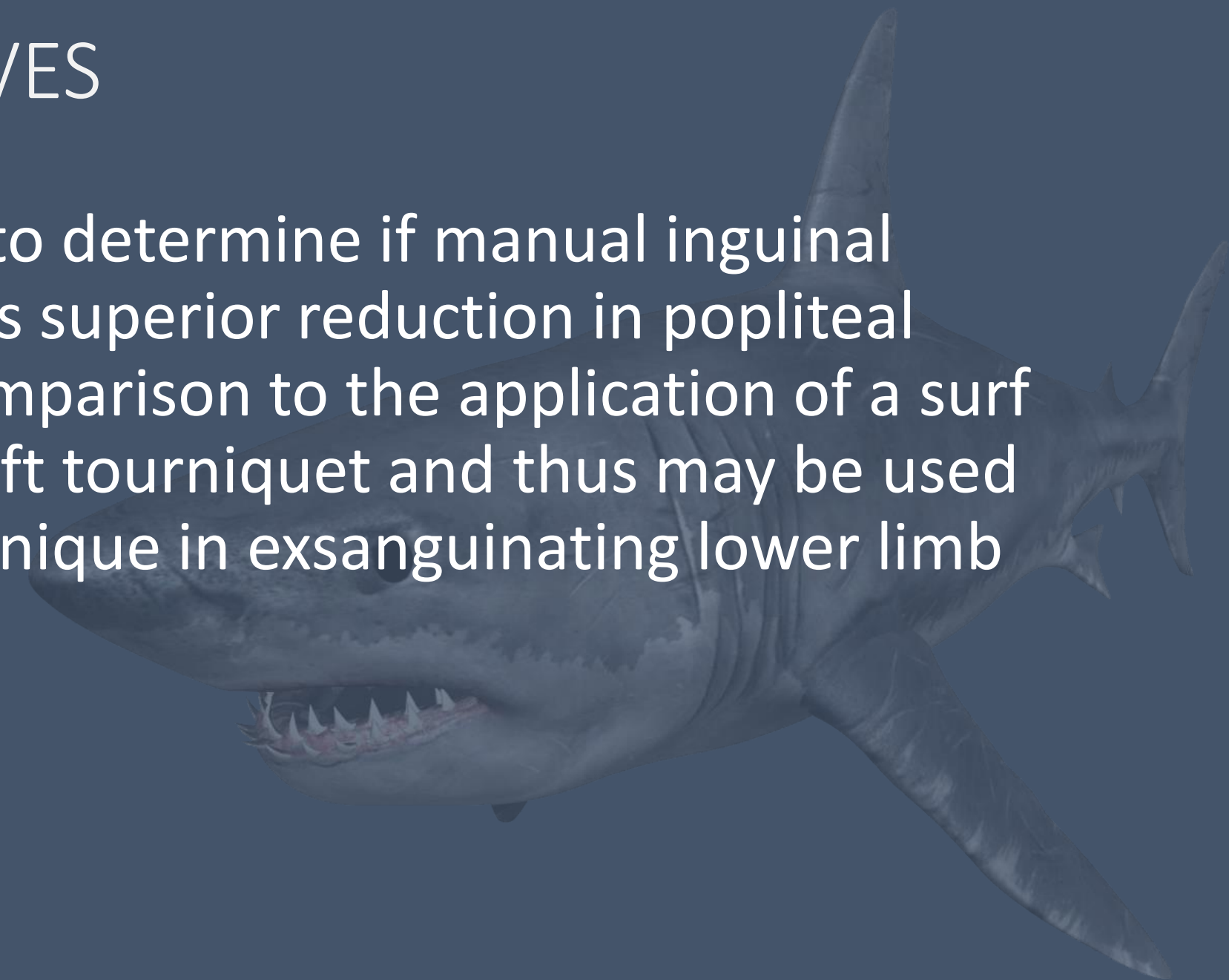
SHARK ATTACK FIRST AID

- Pre-hospital services in Australia (SLSA, Ambulance QLD, NSW, VIC WA and St John Ambulance) advise applying direct pressure using dressings to the wound (9)
- Direct femoral artery compression by fist pressure in the inguinal canal is commonly used in hospital environments to control life threatening arterial bleeding



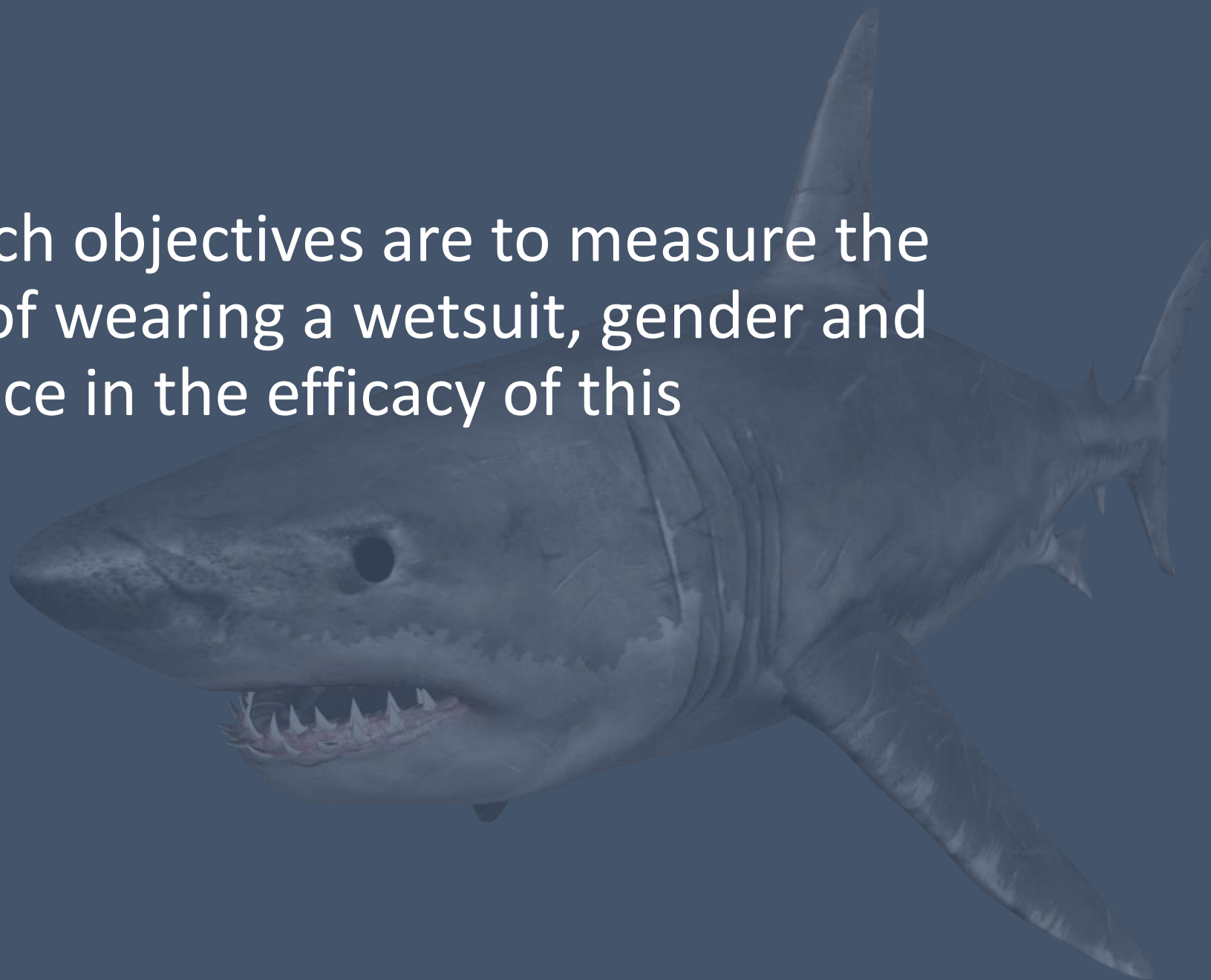
AIMS/OBJECTIVES

- This study aims to determine if manual inguinal pressure provides superior reduction in popliteal artery flow in comparison to the application of a surf leg rope makeshift tourniquet and thus may be used as a first aid technique in exsanguinating lower limb trauma



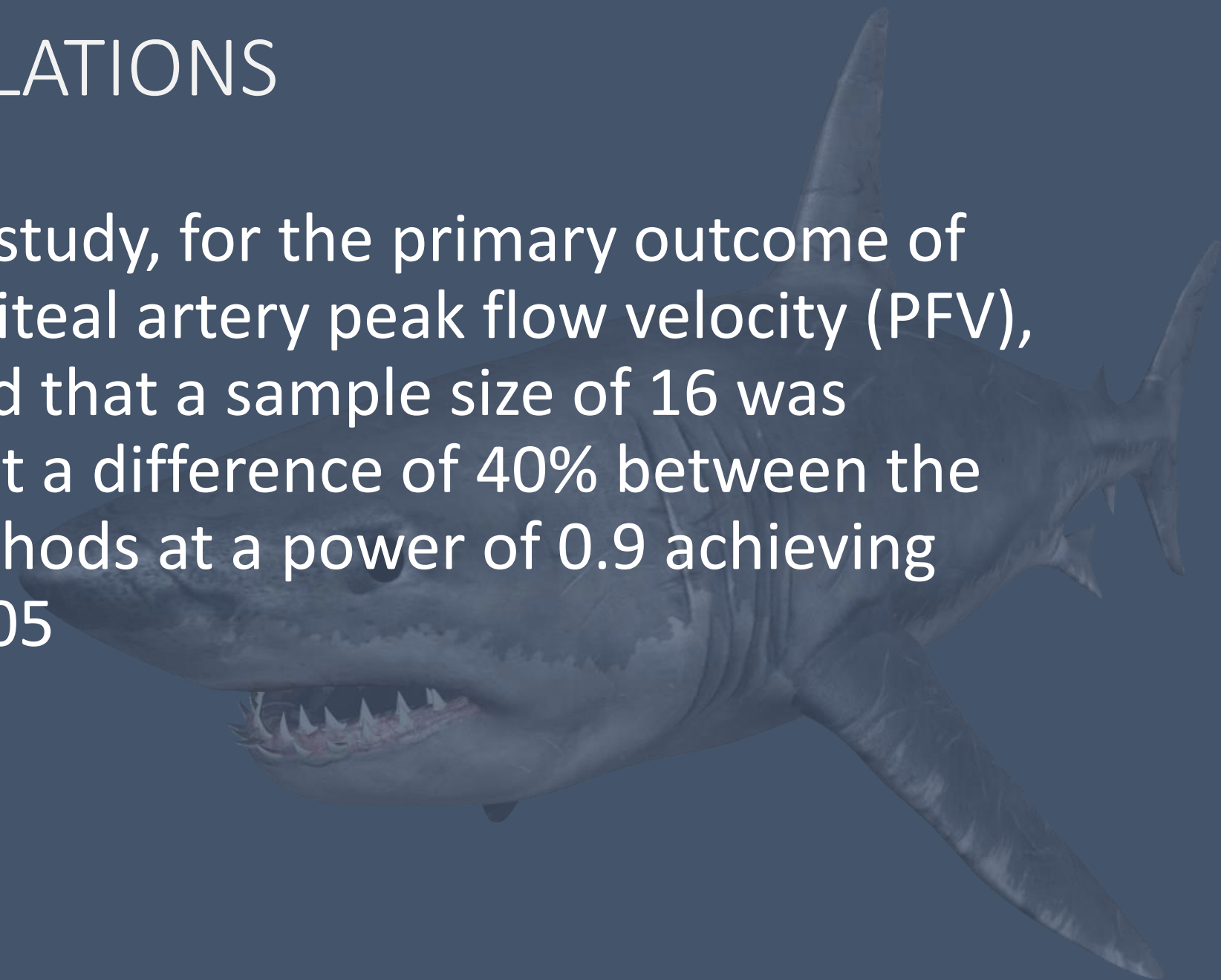
OBJECTIVES

- Secondary research objectives are to measure the modifying effect of wearing a wetsuit, gender and thigh circumference in the efficacy of this intervention.



POWER CALCULATIONS

- Following a pilot study, for the primary outcome of reduction in popliteal artery peak flow velocity (PFV), it was determined that a sample size of 16 was required to detect a difference of 40% between the compression methods at a power of 0.9 achieving significance of 0.05

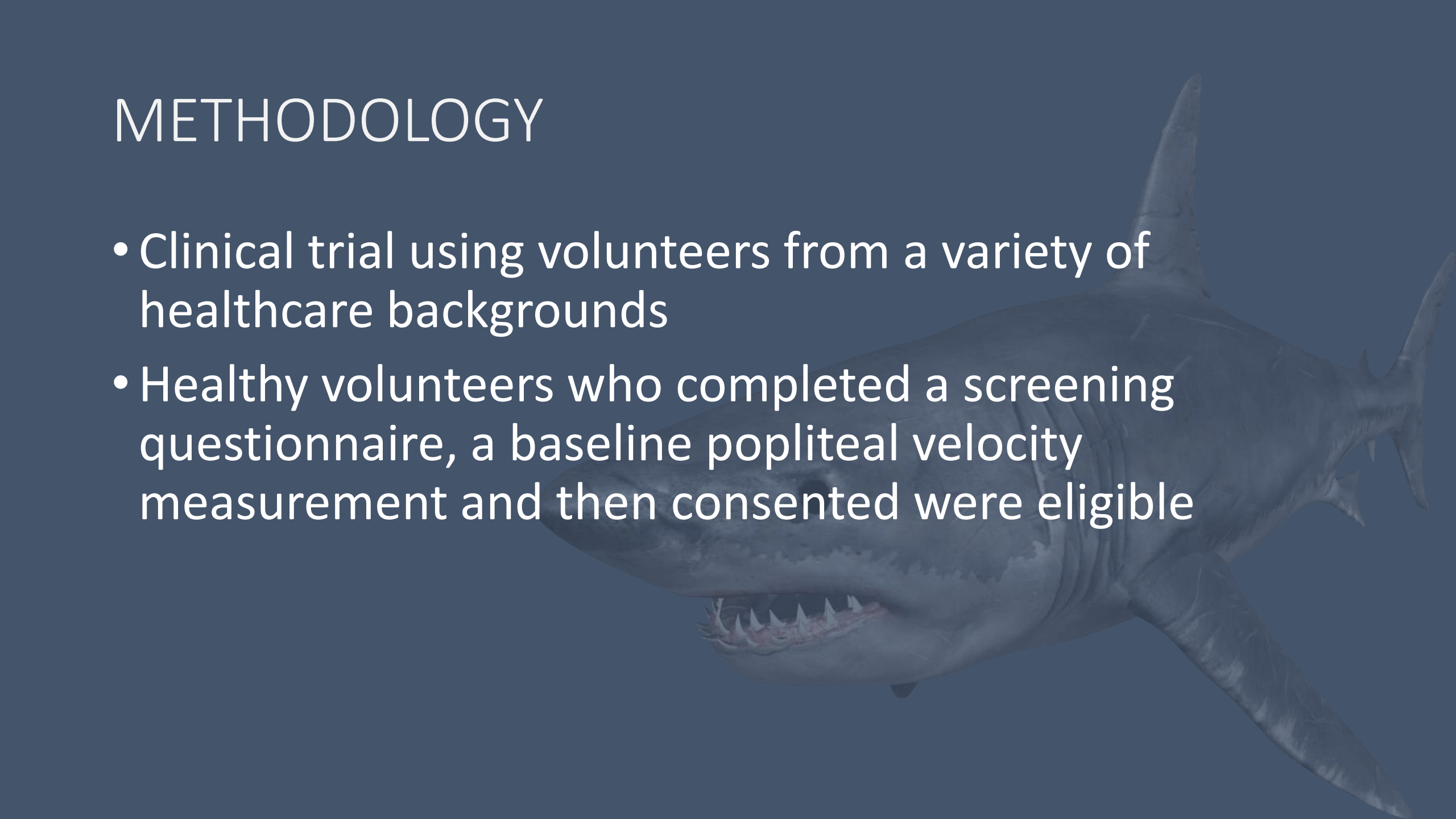


ETHICS

- Ethics approval granted by The ACT government Health Directorate Human Research Ethics Committee

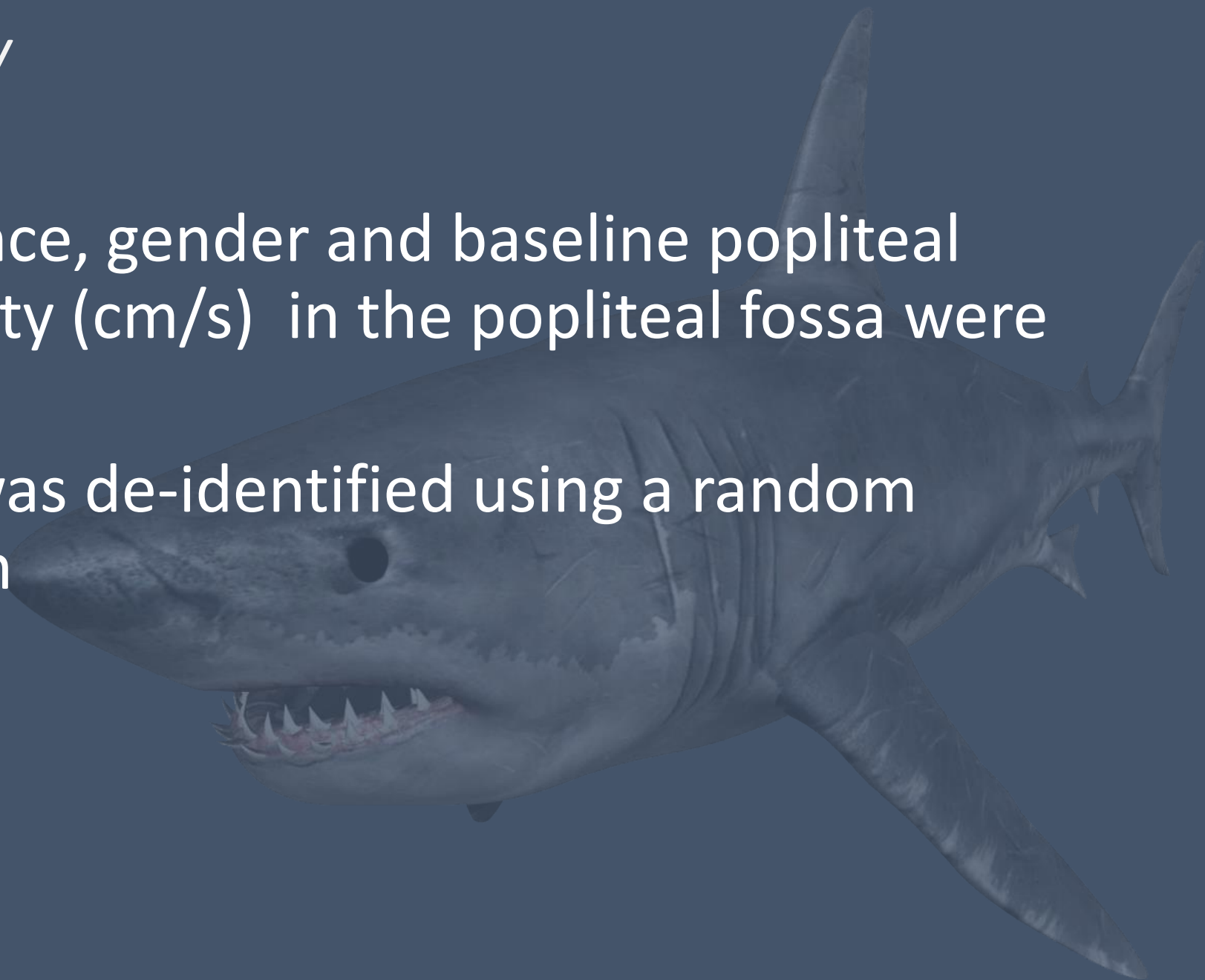
METHODOLOGY

- Clinical trial using volunteers from a variety of healthcare backgrounds
- Healthy volunteers who completed a screening questionnaire, a baseline popliteal velocity measurement and then consented were eligible



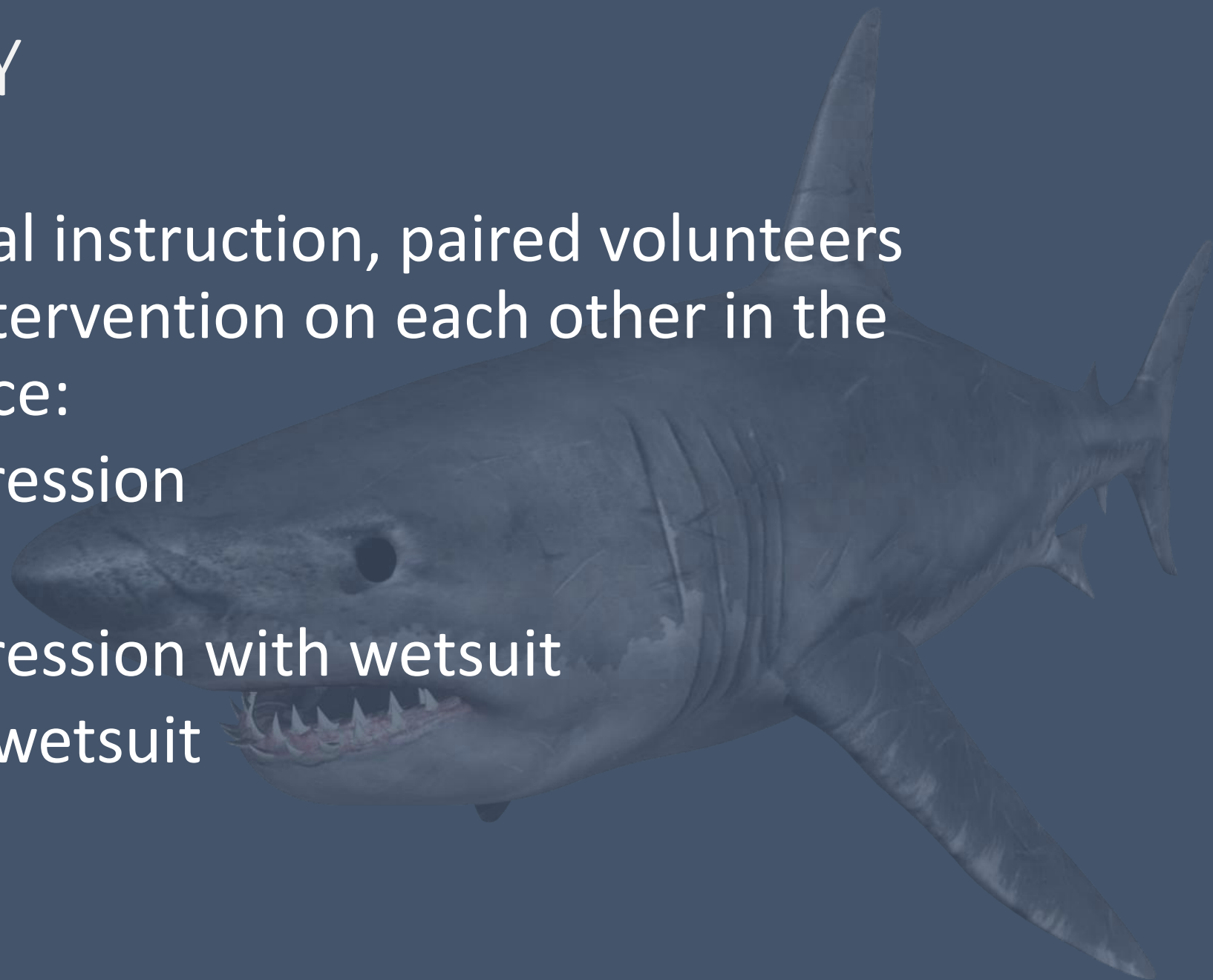
METHODOLOGY

- Thigh circumference, gender and baseline popliteal artery peak velocity (cm/s) in the popliteal fossa were recorded
- Volunteers data was de-identified using a random number allocation



METHODOLOGY

- After a brief verbal instruction, paired volunteers performed the intervention on each other in the following sequence:
  - Inguinal Compression
  - Leg Rope
  - Inguinal Compression with wetsuit
  - Leg Rope with wetsuit



METHODOLOGY

- Inguinal compression protocol:
  - Popliteal doppler gate placed with fist located at compression point (midpoint of the inguinal canal, midway between ASIS and pubic symphysis)
  - Compression was then performed by applying bodyweight pressure
  - Velocity was measured at 30 seconds and USS mode was then returned to 2D to confirm accuracy of Doppler gate placement

METHODOLOGY

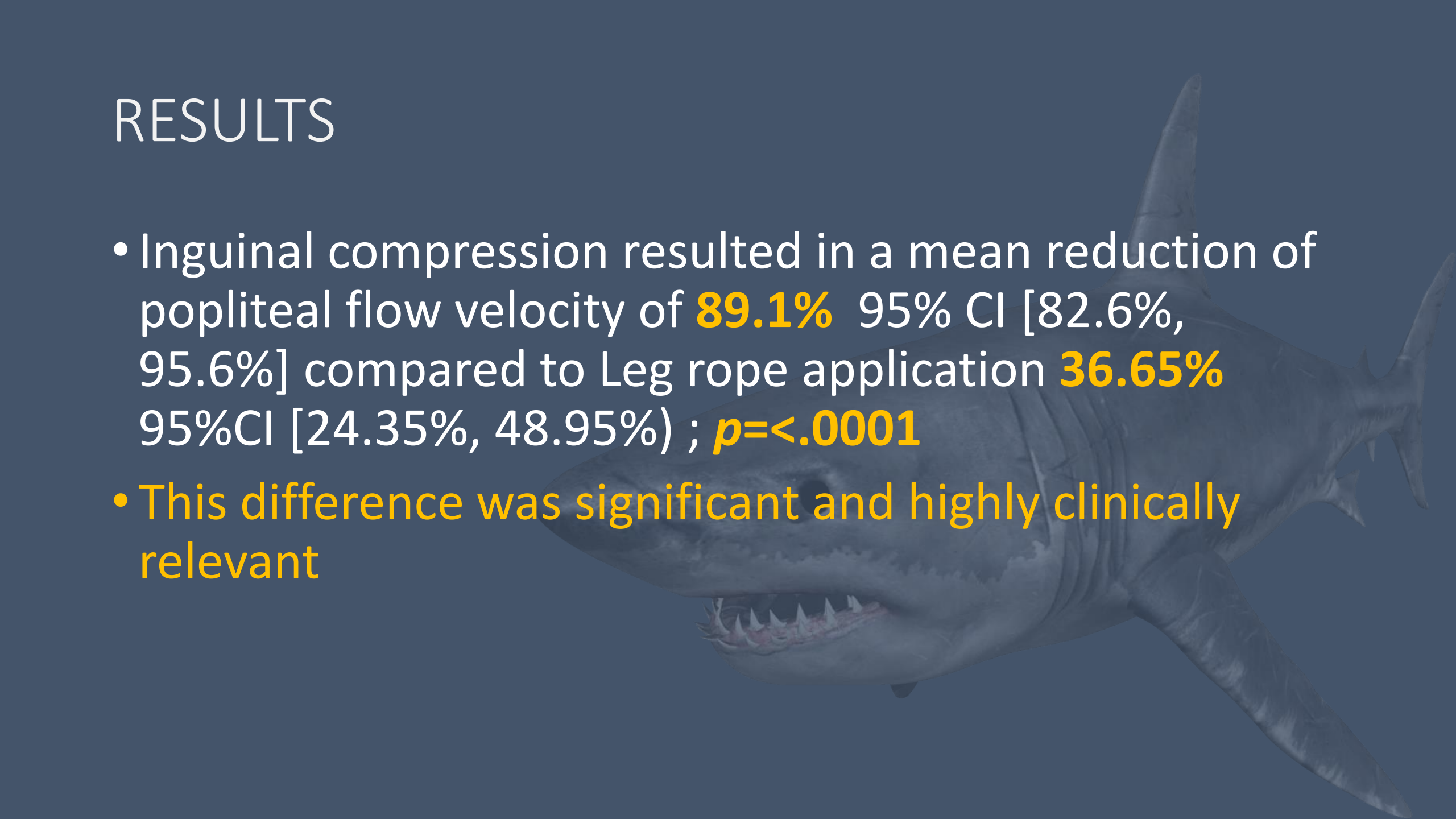
- Leg Rope tourniquet protocol:
  - A standard, commercially available surfboard leg rope was wrapped twice around the proximal thigh followed by a double hitch tied
  - Popliteal artery peak velocity was then measured at 30 seconds post tension application and USS mode was returned to 2D to confirm accuracy of Doppler gate placement

RESULTS

- 34 volunteers provided 136 post intervention velocity measurements (no volunteers withdrew)
- The raw velocity was converted to the more clinically relevant percentage reduction from baseline
- Students T test (paired, two tails, Microsoft Excel 2018) was used to compare the intervention effects and influence of gender
- Correlation (Pearson, Microsoft Excel, 2018) was used to determine the influence of thigh circumference

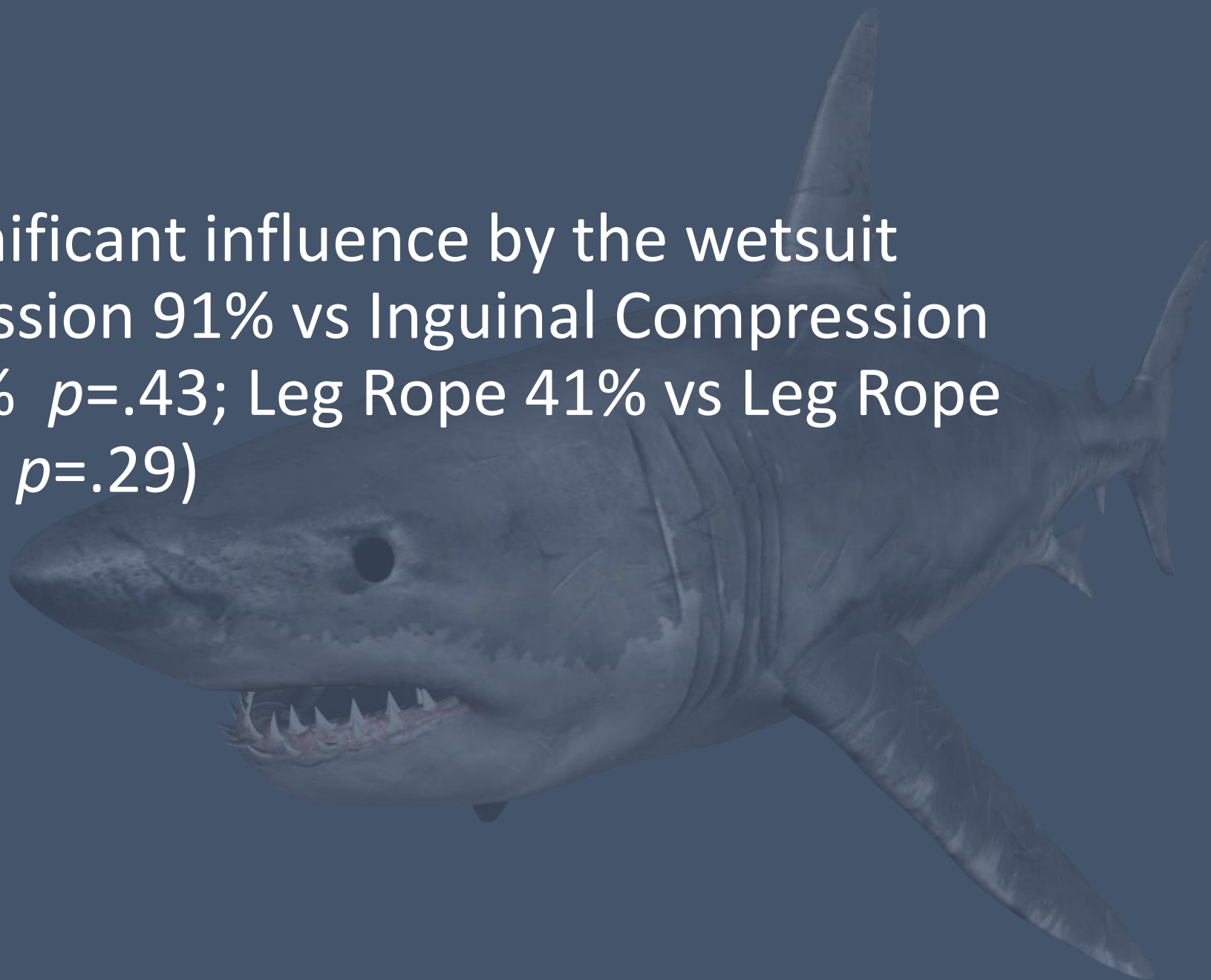
RESULTS

- Inguinal compression resulted in a mean reduction of popliteal flow velocity of **89.1%** 95% CI [82.6%, 95.6%] compared to Leg rope application **36.65%** 95%CI [24.35%, 48.95%) ; ***p*=<.0001**
- This difference was significant and highly clinically relevant

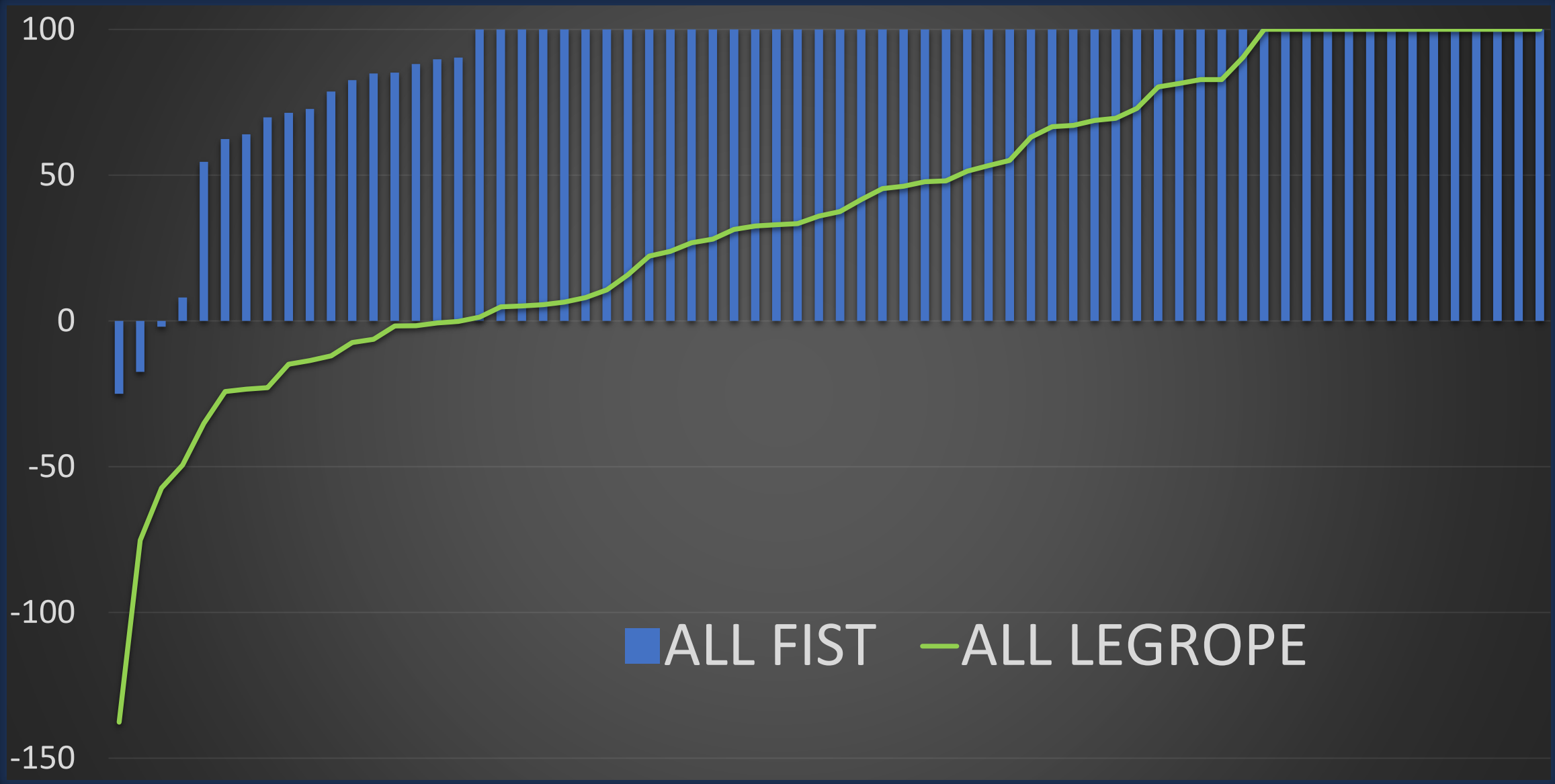


RESULTS

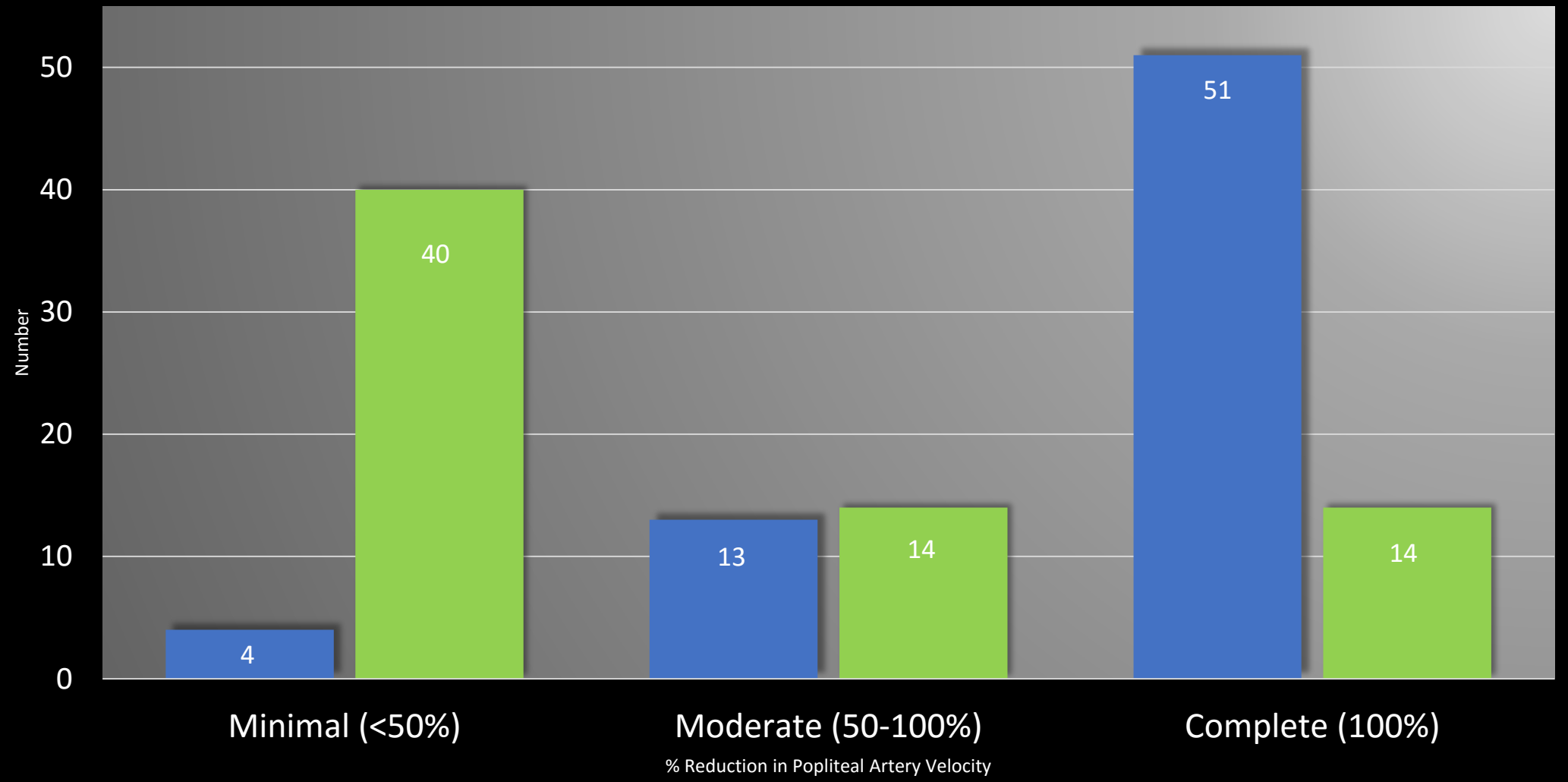
- There was no significant influence by the wetsuit (Inguinal Compression 91% vs Inguinal Compression with Wetsuit 87 % p=.43; Leg Rope 41% vs Leg Rope with Wetsuit 32% p=.29)



Percentage Reduction per Subject in Popliteal Artery Velocity

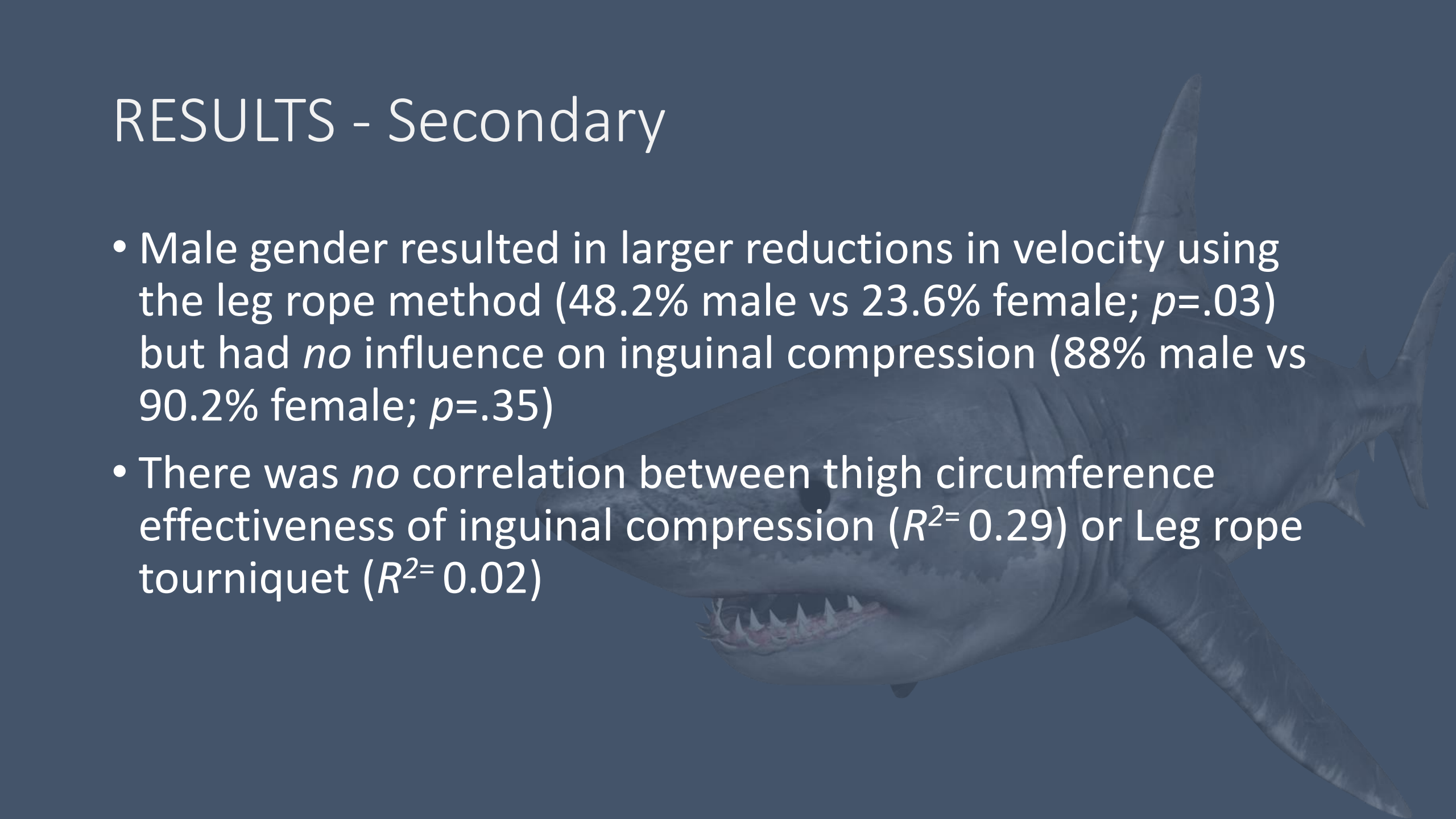


Clinically Relevant Percent Reduction



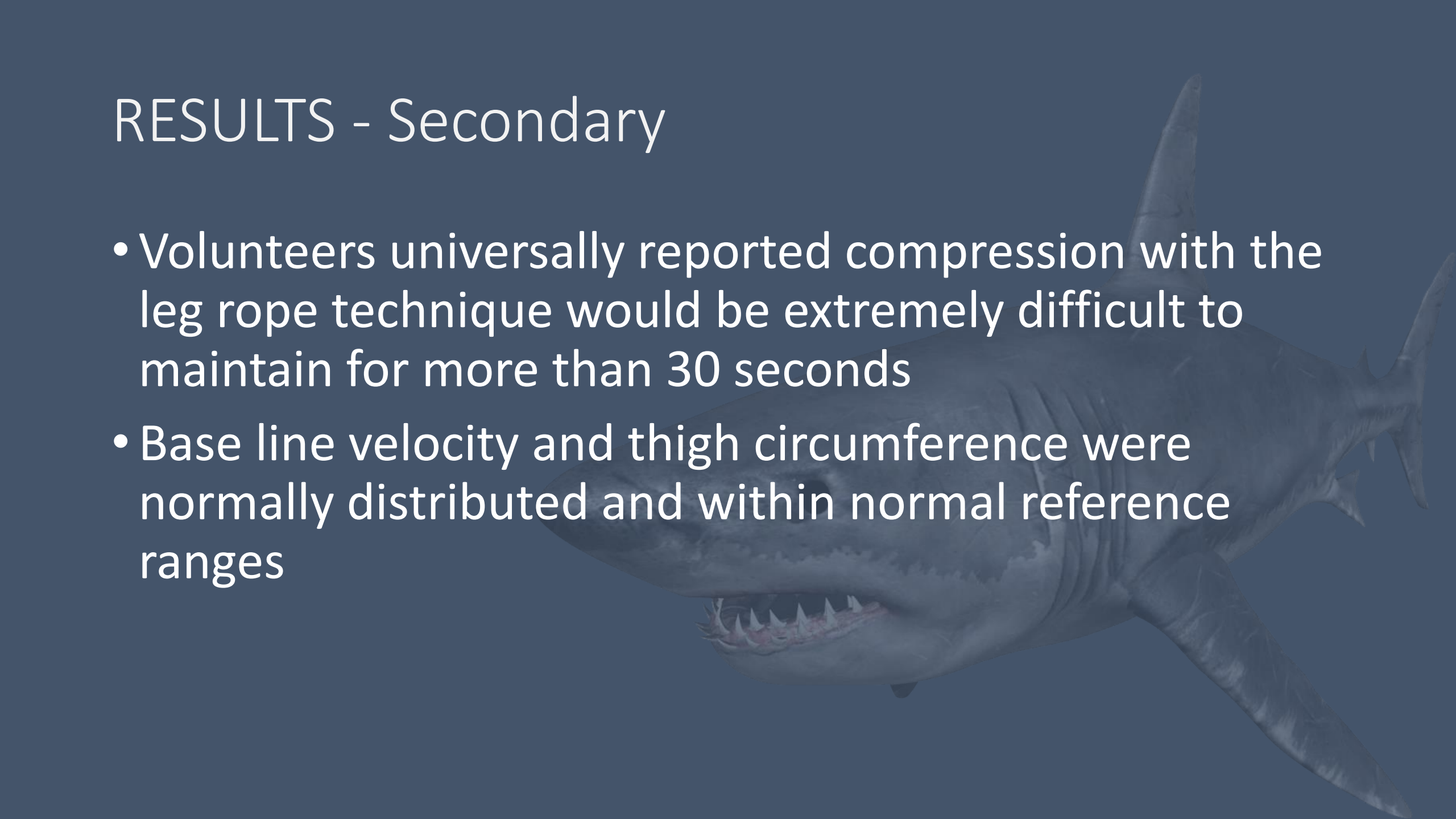
RESULTS - Secondary

- Male gender resulted in larger reductions in velocity using the leg rope method (48.2% male vs 23.6% female; p=.03) but had *no* influence on inguinal compression (88% male vs 90.2% female; p=.35)
- There was *no* correlation between thigh circumference effectiveness of inguinal compression ($R^{2=}$ 0.29) or Leg rope tourniquet ($R^{2=}$ 0.02)



RESULTS - Secondary

- Volunteers universally reported compression with the leg rope technique would be extremely difficult to maintain for more than 30 seconds
- Base line velocity and thigh circumference were normally distributed and within normal reference ranges

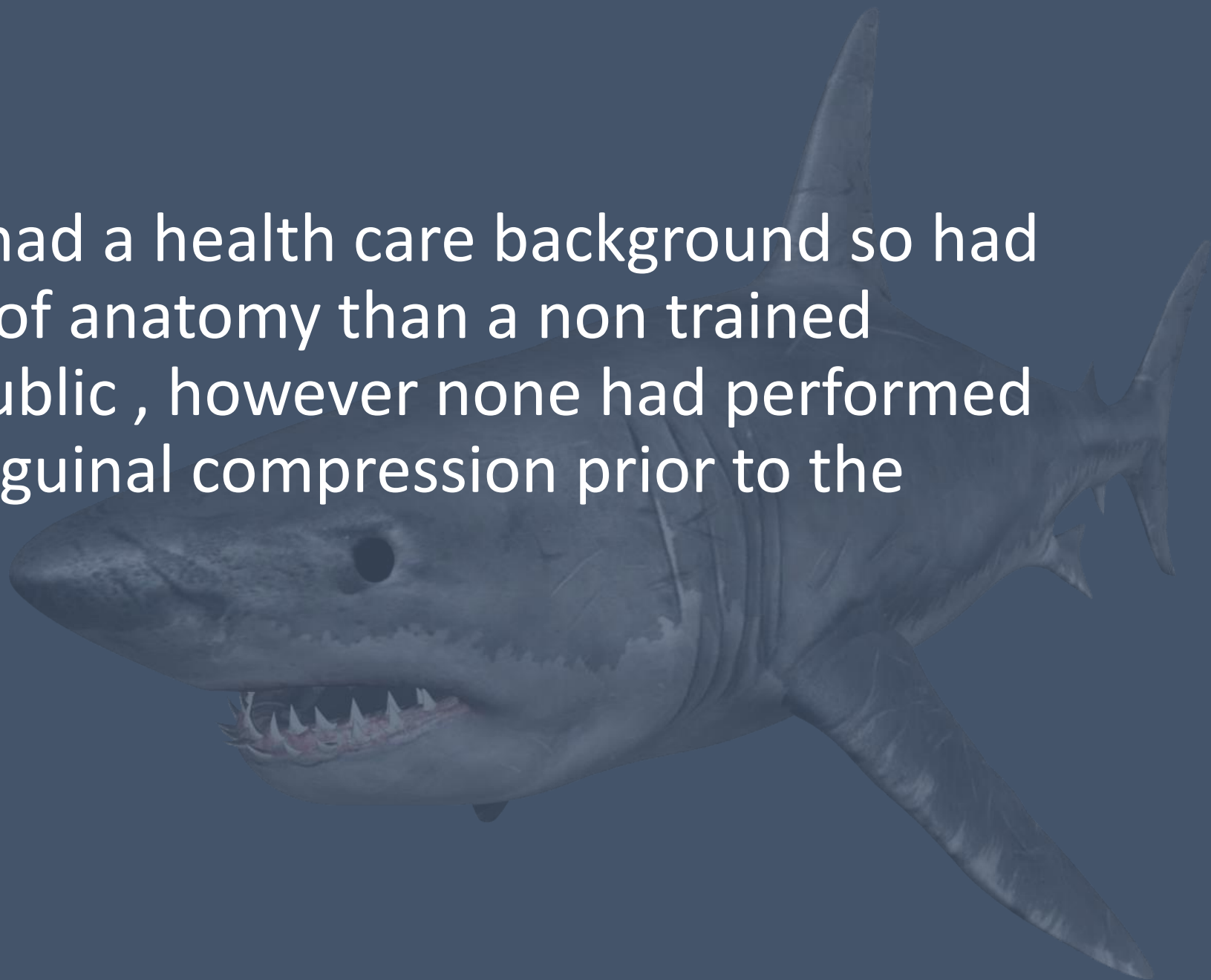


DISCUSSION

- This study has shown that an easily taught first aid technique can reliably completely stop or substantially reduce blood loss in the setting of a lower limb injury
- Although tourniquets may also beneficial, practicalities such as availability, speed of application and maintenance of ligation pressure without a commercial device, limit their use in a first aid situation

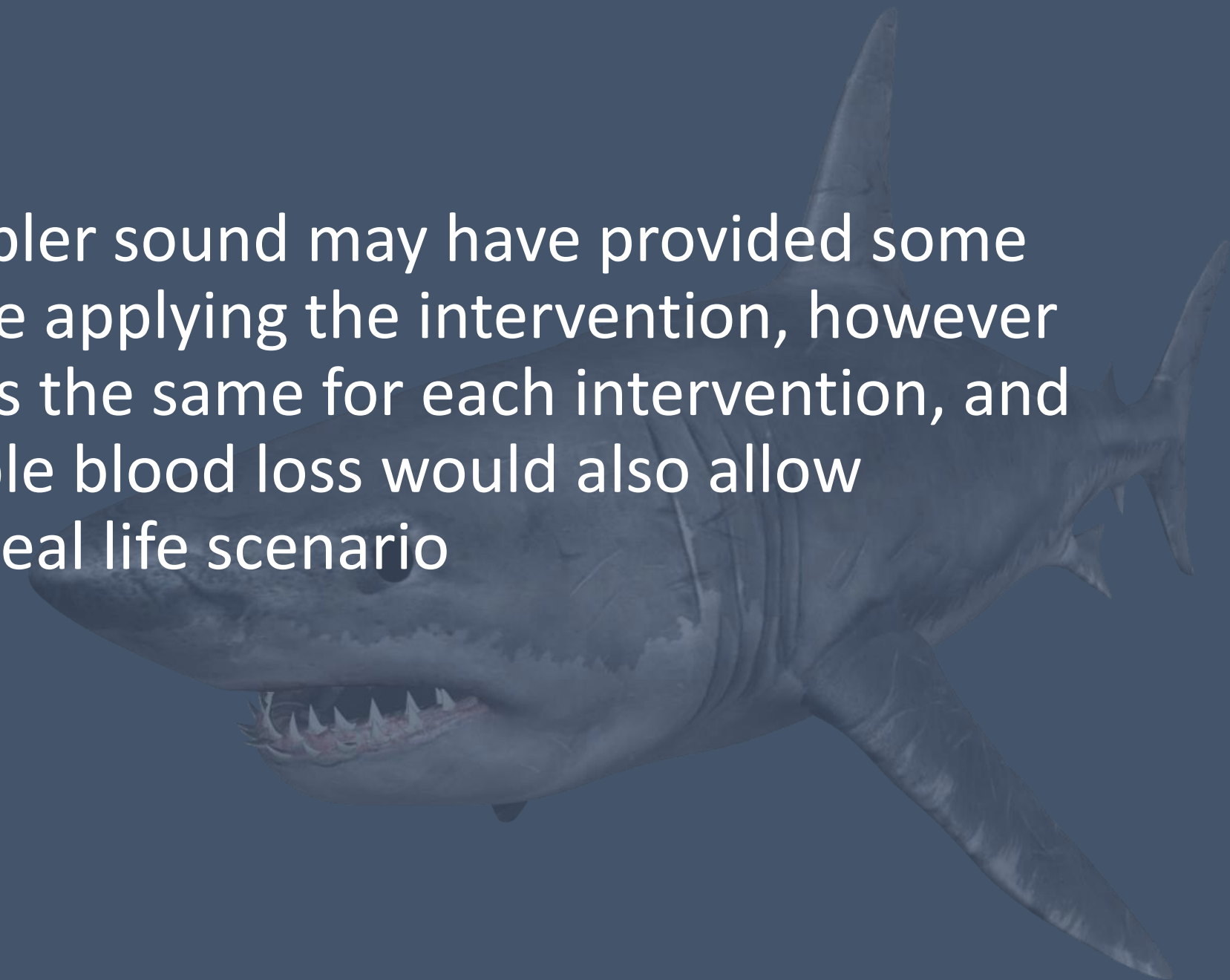
LIMITATIONS

- Most volunteers had a health care background so had more knowledge of anatomy than a non trained member of the public , however none had performed a tourniquet or inguinal compression prior to the study day



LIMITATIONS

- The audible Doppler sound may have provided some feedback to those applying the intervention, however this feedback was the same for each intervention, and feedback by visible blood loss would also allow adjustment in a real life scenario

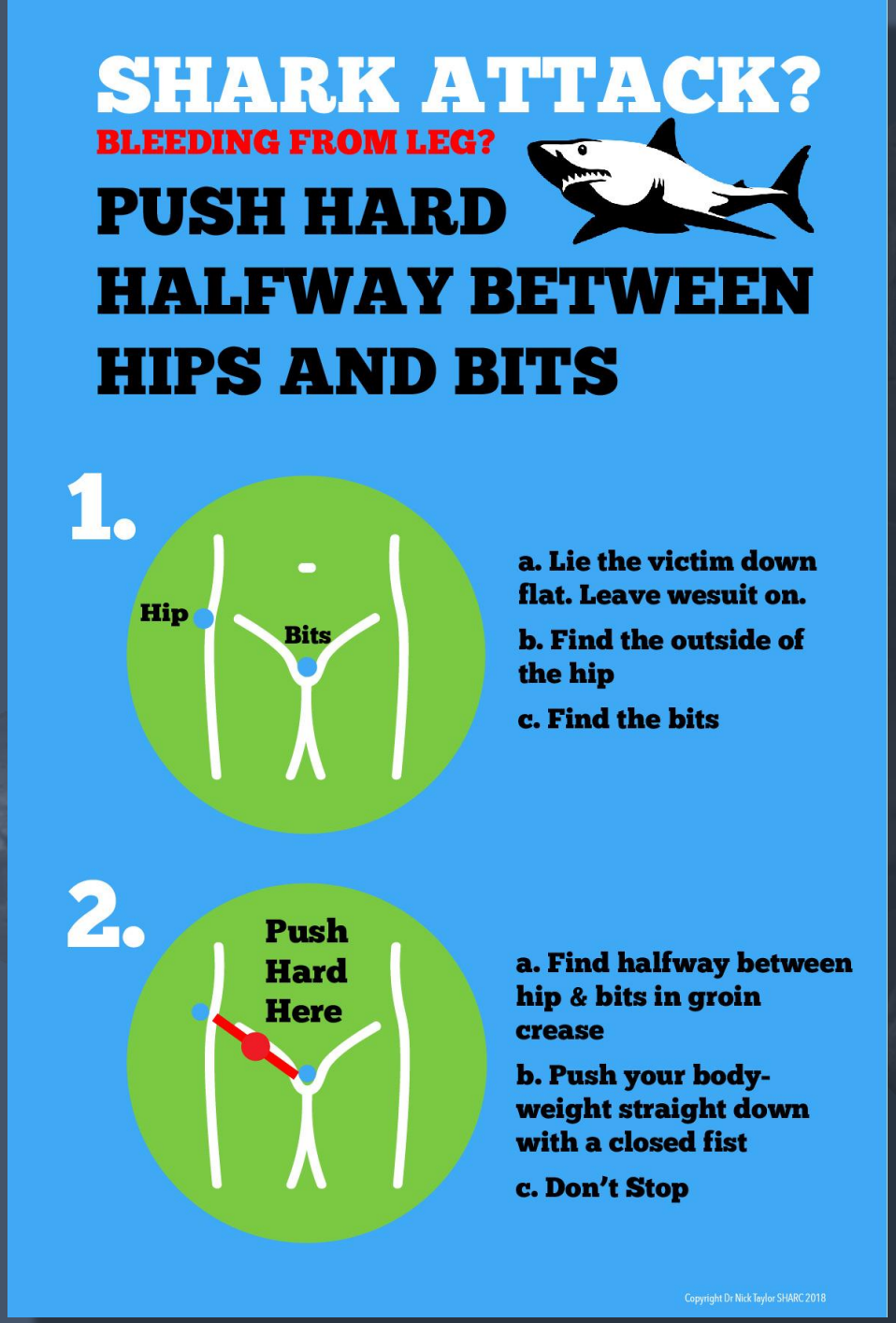


LIMITATIONS

- A jet effect occurred more often with the leg rope, leading to an *increase* in velocity – this did not significantly affect results
- Blood flow reduction would be *nil* in the case of a jet effect
- This effect was possible for both interventions and inguinal compression was far superior in providing complete blood flow cessation

NEXT STEPS

- Education campaign via first aid providers and surfing/coastal peak bodies



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9. N Taylor direct communication with SLSA, Ambulance QLD, NSW, VIC WA and St John Ambulance

THANKYOU

Participant No	Thigh Circumference (cm)	NORMAL Pop velocity	FIST	LEGROPE	FIST WETSUIT	LEGROPE WETSUIT	Gender
1	56	77.7	0	76.7	35.3	72.7	m
2	56	67.6	0	0	0	0	m
3	55	68.4	0	0	0	0	m
4	48	76.2	0	23.8	0	81	f
5	61	65.7	0	66.8	0	17.8	f
6	60	86.9	32.7	0	8.9	67.6	f
7	49	59.3	0	0	0	30.8	m
10	52	47.9	0	32.3	0	42.8	m
11	50	51.1	0	23.9	0	15.6	f
12	47	41.7	15	42	49	46.7	m
13	79	69.6	71	50.1	64	46.4	f
14	57	85.8	0	8.3	8.3	57.5	m
18	57	80.7	9.6	15	0	13.9	f
20	53	71.7	0	23.6	0	44.8	m
21	68	56.2	8.5	47.3	0	0	f
22	59	45.1	0	42.8	0	51.8	f
24	55	59	17.8	0	0	0	m
25	57	57.3	0	0	12.2	11.3	m
27	60	77.9	22.3	0	0	13.4	m
28	59	54	0	29.5	9.4	67.1	f
29	51	50.1	0	0	0	0	m
30	52.5	46.7	0	111	0	69.8	f
32	52	72.9	0	78.3	0	46.7	f
33	60	62.9	0	99	0	47.9	m
37	64	72	0	52.7	0	49.4	f
39	58	77.7	21.2	105	0	95.9	f
40	56	67.5	0	36.3	0	76.7	f
41	64	77.3	0	73.6	0	73	f
42	60	63.9	9.5	33.4	0	112	m
44	51	55.6	0	25	0	55.7	m
46	61	74.6	0	75.9	0	36.3	m
48	61	67.6	0	62.2	0	83.1	m
49	60	63.2	0	23.4	79	21.1	m
50	54	62.2	0	0	0	36.3	f

RESULTS : jet values = 0

- Inguinal compression resulted in a mean reduction of popliteal flow velocity of **89.7%** 95% CI [+/- 5.8%] compared to Leg rope application **43.77%** 95%CI [+/- 9.34%) ; **p=<.0001**