



BLUNT CEREBROVASCULAR INJURY

The Unrecognized Epidemic of Blunt Carotid Arterial Injuries

Early Diagnosis Improves Neurologic Outcome

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BCVI – what is it?

- BCVI = Blunt cerebrovascular injury:
 - Dissection/occlusion, transection of carotid or vertebral arteries, or their branches
 - Pseudoaneurysm

TABLE 2. Denver Grading Scale for BCVI

Grade I: irregularity of the vessel wall or a dissection/intramural hematoma with <25% luminal stenosis

Grade II: intraluminal thrombus or raised intimal flap is visualized, or dissection/intramural hematoma with 25% or more luminal narrowing

Grade III: pseudoaneurysm

Grade IV: vessel occlusion

Grade V: vessel transection

BCVI Clinical Impact

- Blunt carotid dissection
 - mortality of 23-28 %
 - 48-58 % of survivors have permanent neurology
- All BCVI
 - 21% cerebral ischaemia in a screened population
- Untreated BCVI with traumatic neurologic injury
 - 56% cerebral ischaemia

Rationale for screening at Auckland

- Screening has increased the numbers of patients diagnosed with BCVI at centres who have introduced a protocol
 - Incidence 0.08%-0.50% pre protocol
 - 1-2.7% post
- Timely treatment appears to improve outcomes

Is Effective Treatment Available?

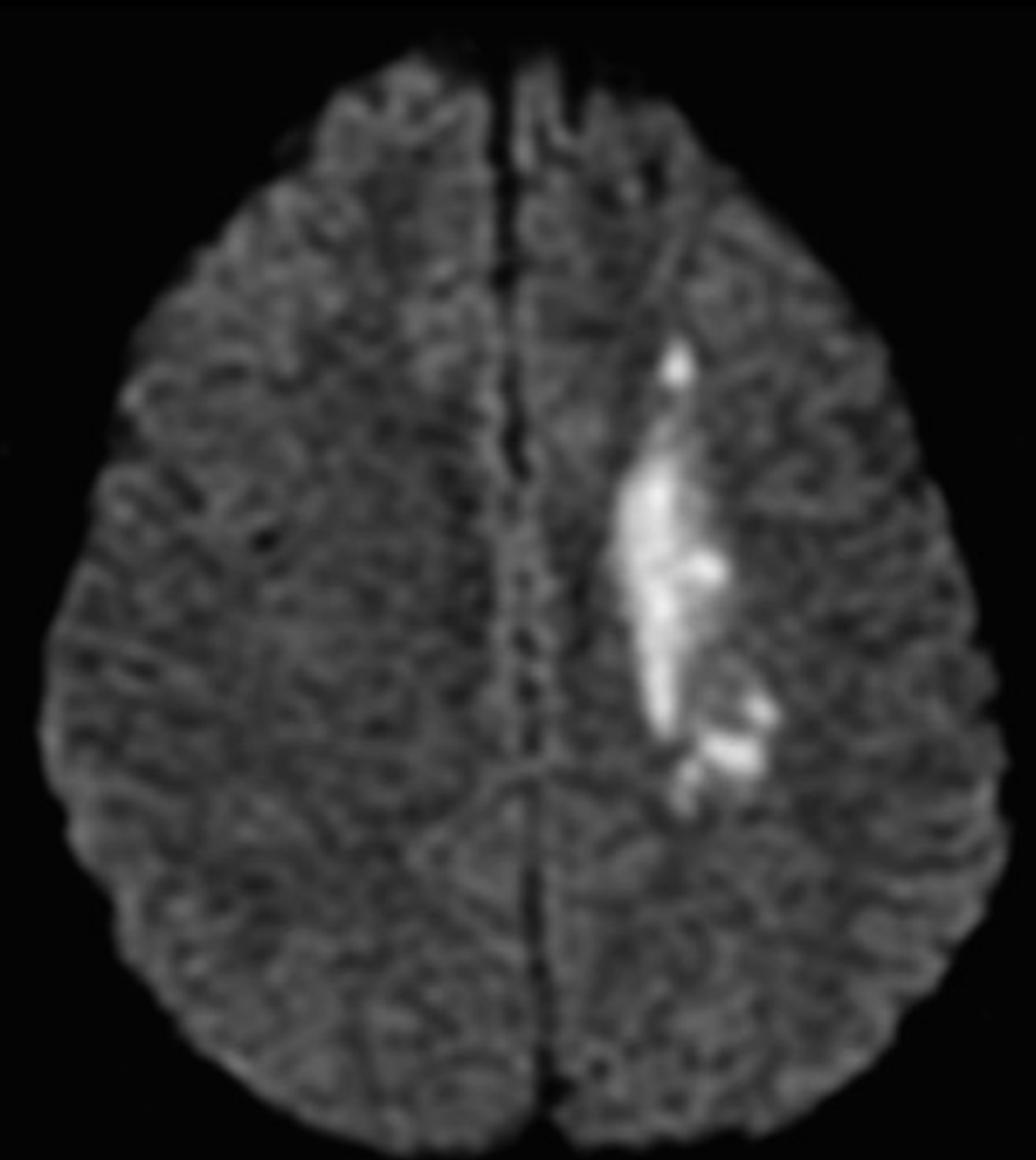
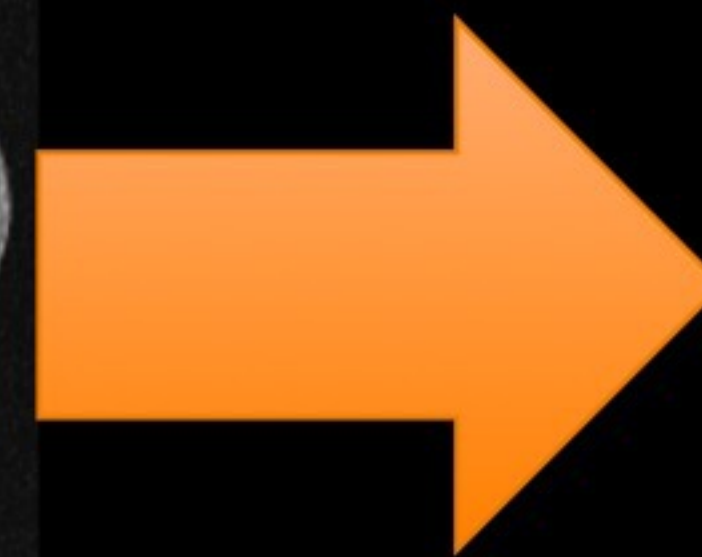
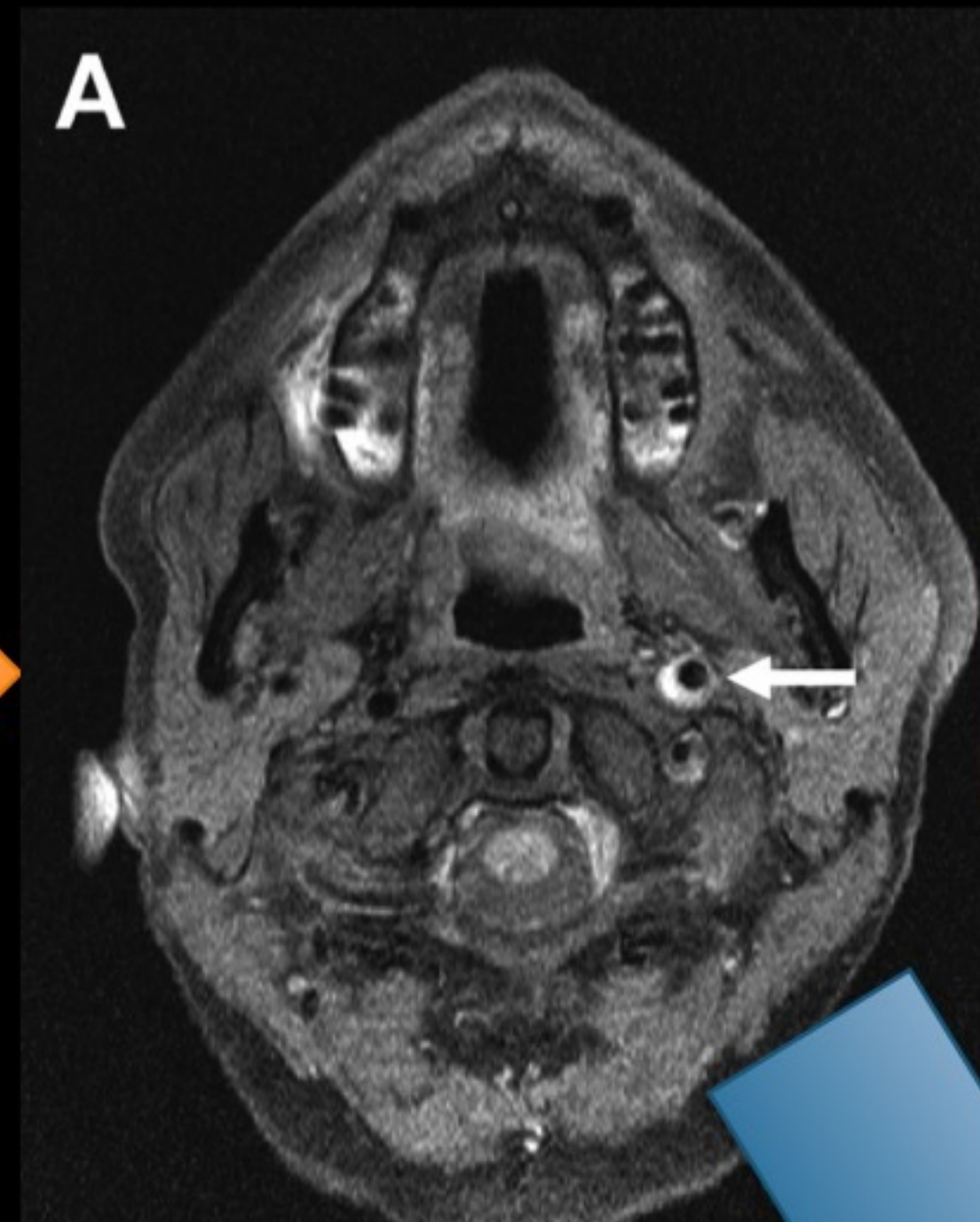
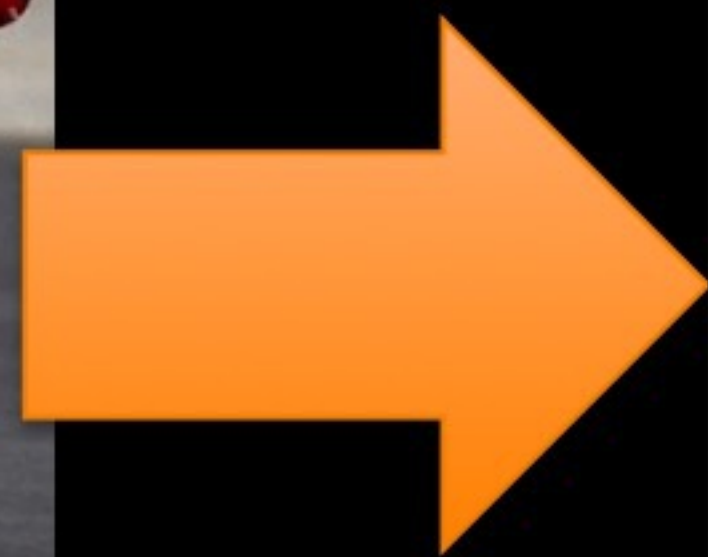
- **Stanford group, 2011**
 - Patients screened with CTA
 - Patients with stroke at presentation excluded
 - 73 patients with BCVI and TNI identified
 - Treatment (aspirin/heparin) provided on a case by case basis, statistically similar groups
 - 62% of patients treated, 38 % not treated
 - Stroke in untreated group: 56%
 - Stroke in treated group: 4%
 - Treatment status strongest predictor of stroke in multivariate analysis
 - OR 4.4 (3.0-6.5)

Is treatment safe?

- All patients in study had concomitant TNI
- No increased risk of hemorrhagic deterioration in treated vs untreated group (5% vs 6%).
- No patient had worsening of spinal cord injury

Asymptomatic BCVI

Up to 12 –
24 hours



Anticoagulation
Surgery
IR

Who should we scan?

Denver Screening Criteria for BCVI

- Signs/symptoms of BCVI
 - Arterial hemorrhage
 - Cervical bruit
 - Expanding cervical hematoma
 - Focal neurologic deficit
 - Neurologic examination incongruous with head CT scan findings
 - Stroke on secondary CT scan
- Risk factors for BCVI
 - LeForte II or III
 - Mandible fracture
 - Cervical-spine fracture patterns: subluxation, fractures extending into the transverse foramen, and fractures of C1–C3
 - Skull base fracture with carotid canal involvement
 - Petrous bone fracture
 - Diffuse axonal injury with GCS score 6
 - Near hanging with anoxic brain

Radiology Triage Tool

Radiologic Indications for CTA Neck in Trauma

(High Energy Transfer Mechanism)

Head:	Face:	C-Spine:
Acute Infarction DAI CHI consistent with DAI and GCS<6 Complex skull fracture Skull base fracture Occipital <u>condyle</u> fracture	LeFort II LeFort III Mandible fracture	Any C1-3 fracture Any vertebral body fracture Transverse foramen fracture Facet <u>subluxation/dislocation</u> <u>Ligamentous Injury</u>

Clinical Indications for CTA Neck in Trauma

(High Energy Transfer Mechanism)

Potential Arterial Haemorrhage from neck/nose/mouth Cervical Bruit, patient < 50 years old Expanding Cervical Haematoma	Focal Neurologic Deficit: TIA, hemiparesis, <u>vertebrobasilar</u> symptoms, Horner's Syndrome Neurologic Deficit inconsistent with CT findings
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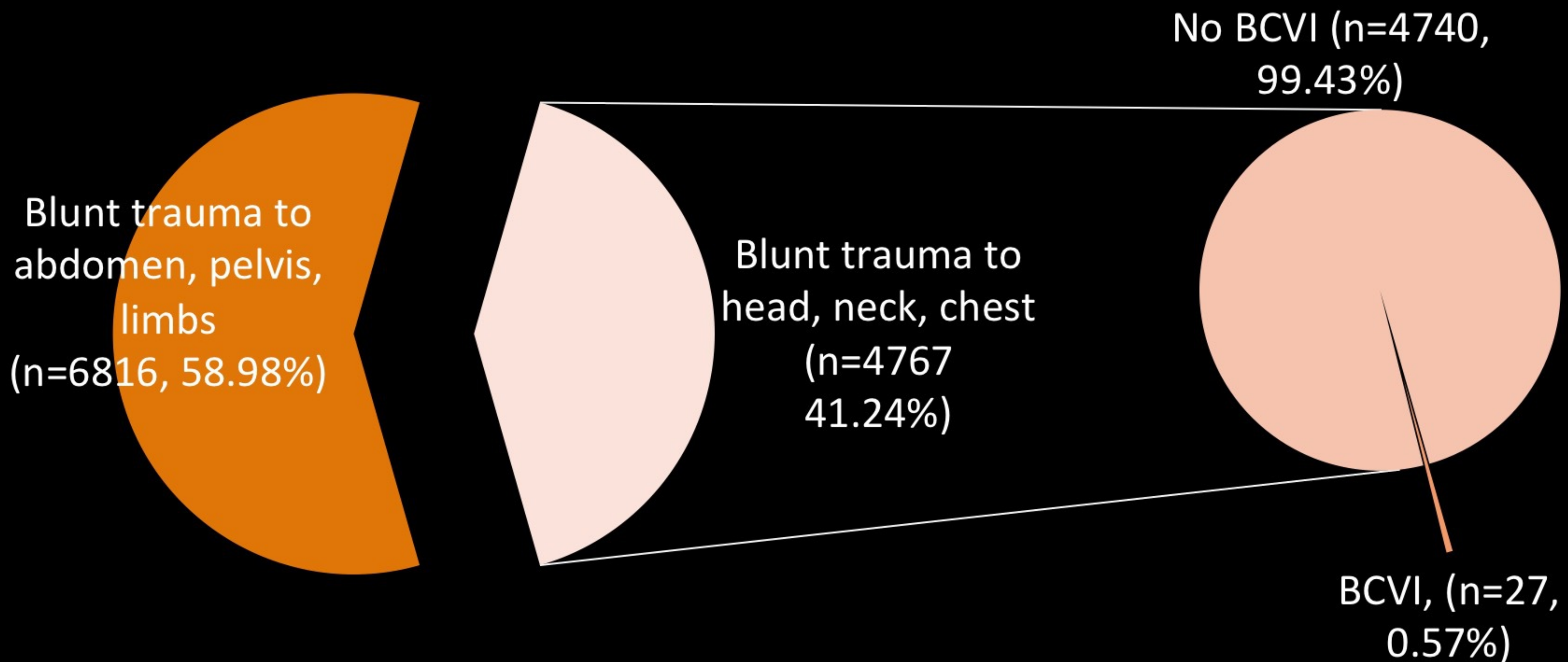
Triage tool implemented in ED
Radiology Nov 2013

BCVI at Auckland – before

Population:

- Auckland City Hospital Trauma Registry
- 10 year period Nov 2003-Nov 2013
- Blunt trauma to head, neck, face and chest
 - Two groups: BCVI present, BCVI absent
- 4767 patients, 27 with BCVI

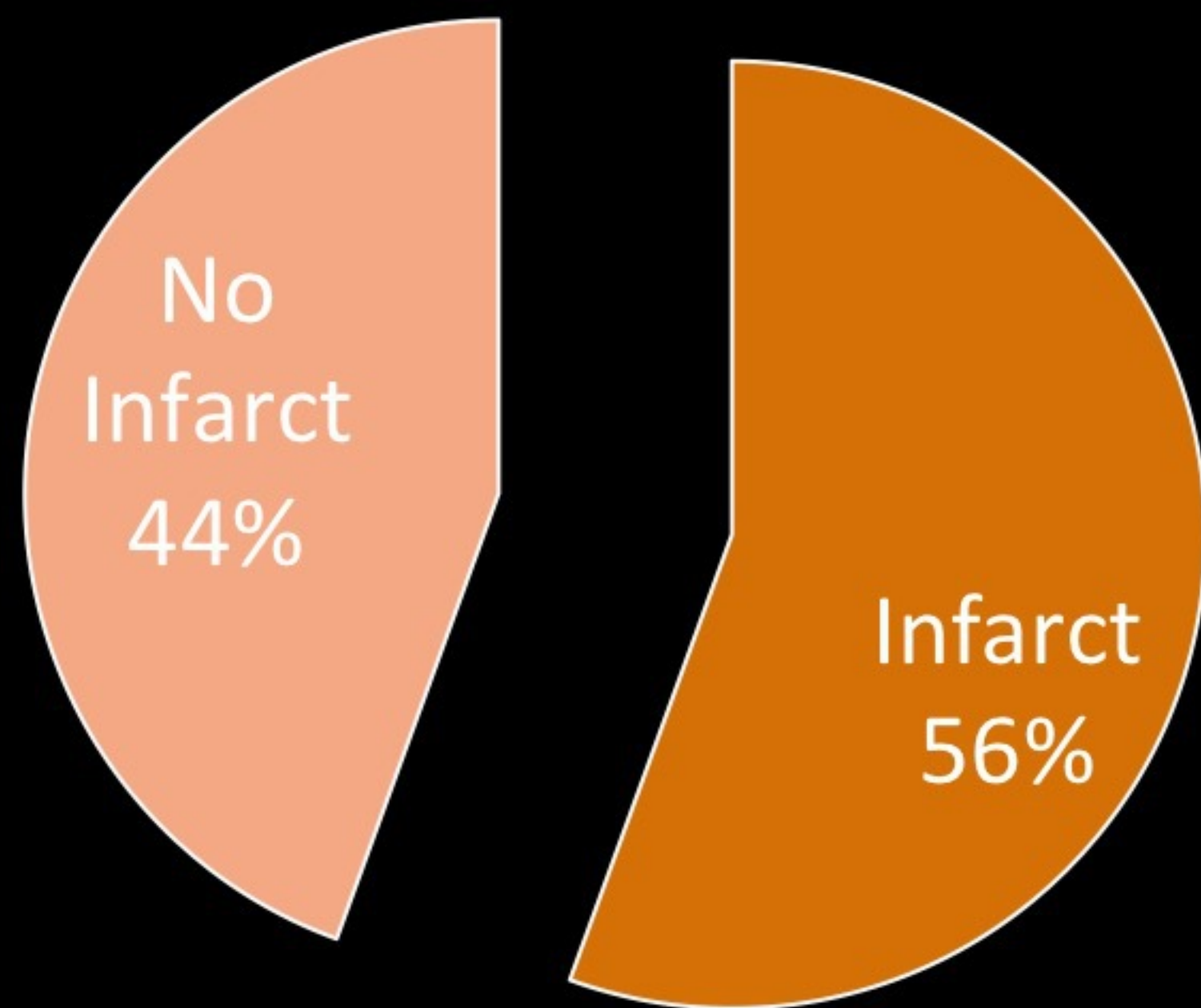
What was the rate of BCVI? (n=11,556)



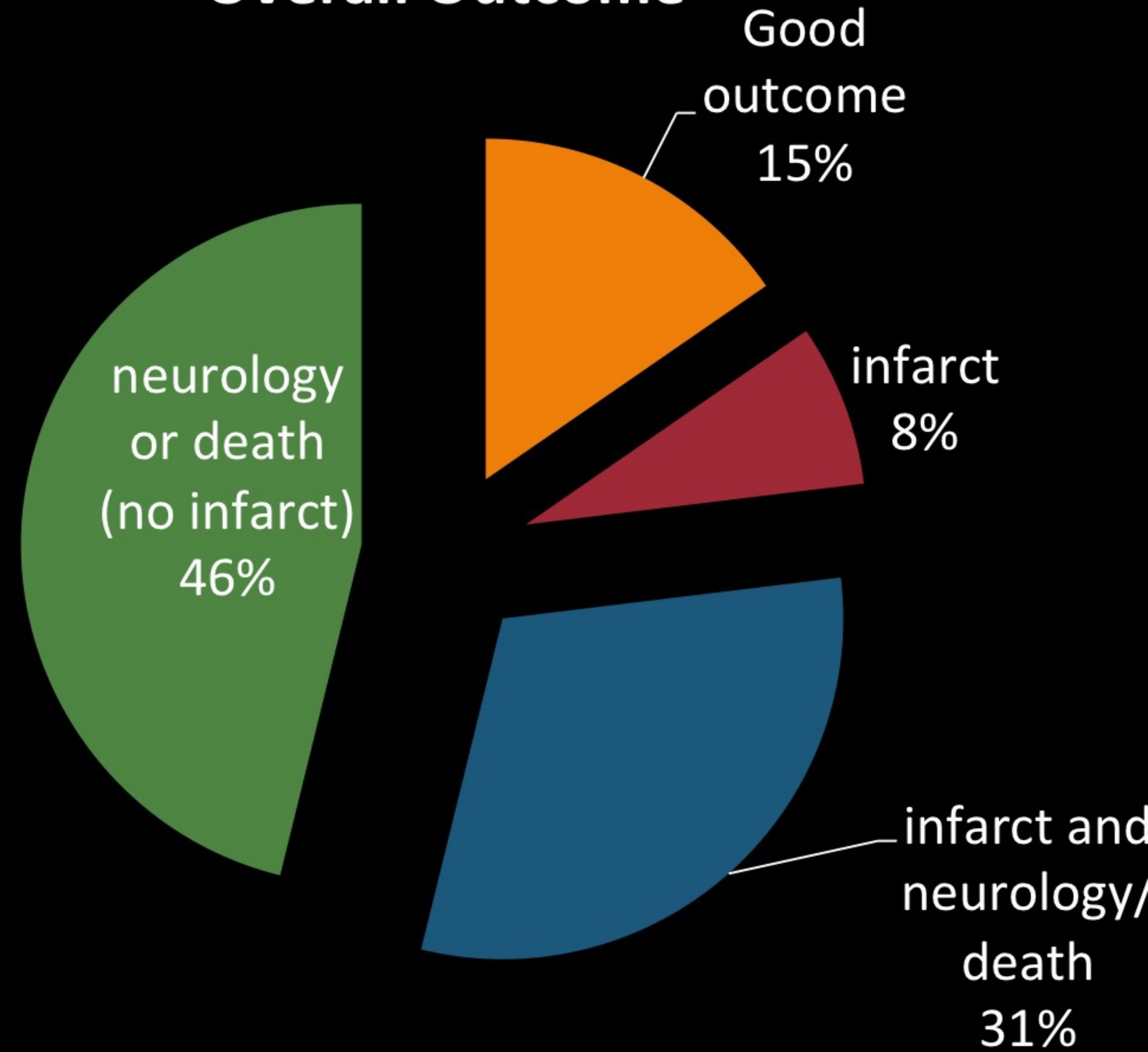
Internationally reported rate when screening program in place
1 – 2.7% of blunt trauma cases

What was the rate of poor outcome?

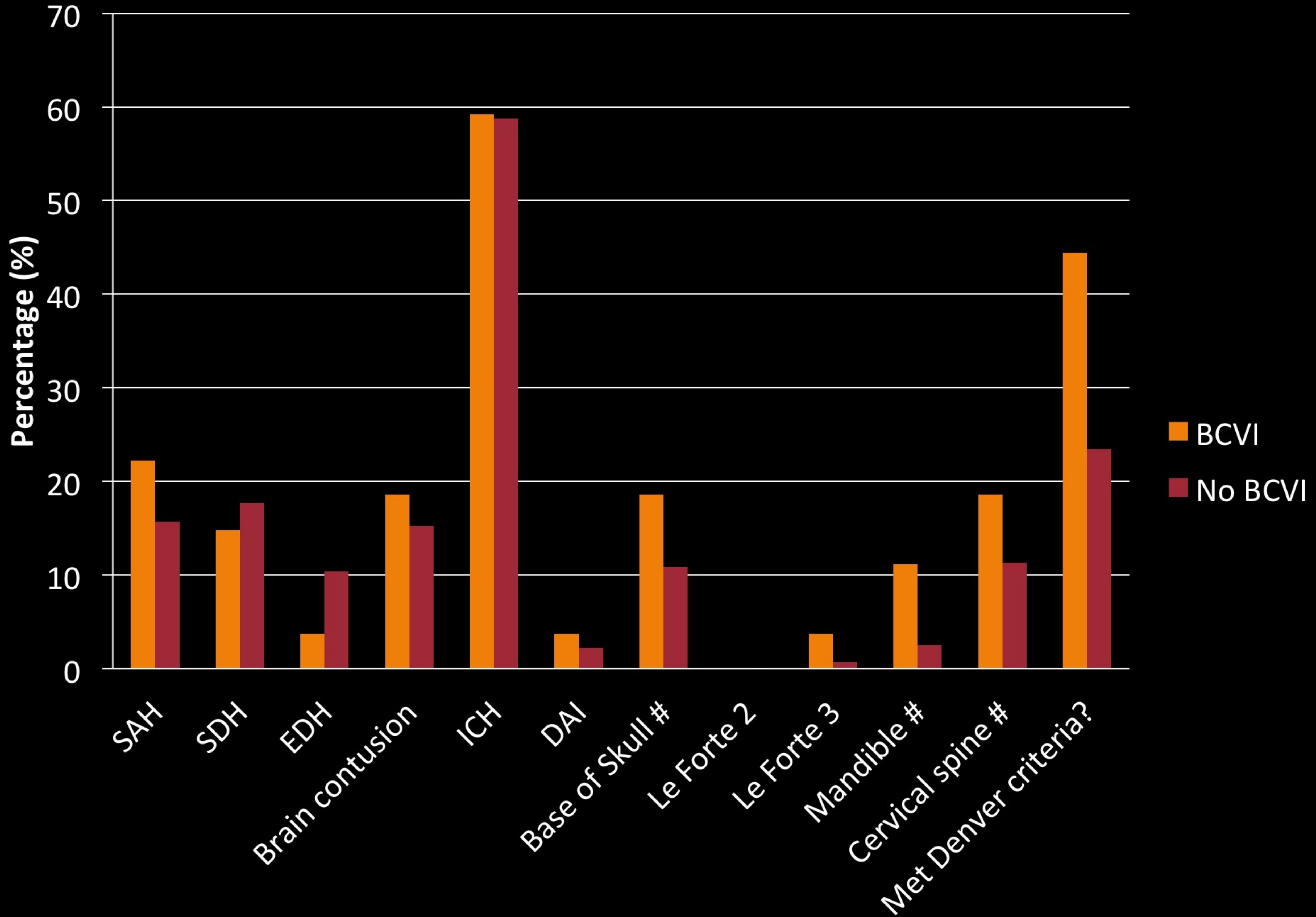
Presence of infarct in appropriate territory on discharge?



Overall Outcome



Injury Type



Injury type

Injury	BCVI /27 (%)	No BCVI /4740 (%)	P value
SAH	6 (22.2%)	738 (15.6%)	NS
SDH	4 (14.8%)	835 (17.6%)	NS
EDH	1 (3.7%)	493 (10.4%)	NS
Brain contusion	5 (18.5%)	717 (15.1%)	NS
ICH	16 (59.2%)	2783 (58.75%)	NS
DAI	1 (3.7%)	102 (2.1%)	NS
Base of Skull #	5 (18.5%)	514 (10.8%)	NS (p = 0.2077)
Le Forte 2	0 (0%)	5 (0.1%)	NS
Le Forte 3	1 (3.7%)	31 (0.7%)	NS (p = 0.1667)
Cervical spine #	5 (18.5%)	535 (11.3%)	NS (p = 0.2225)
Mandible #	3 (11.1%)	115 (2.4%)	
Met at least one Denver criteria?	12 (44.4%)	1108 (23.4%)	0.0197*

Effectiveness of screening criteria

	BCVI +	BCVI-	Total
Screening +	12	1096	1108
Screening -	15	3632	3647
Total	27	4728	4755

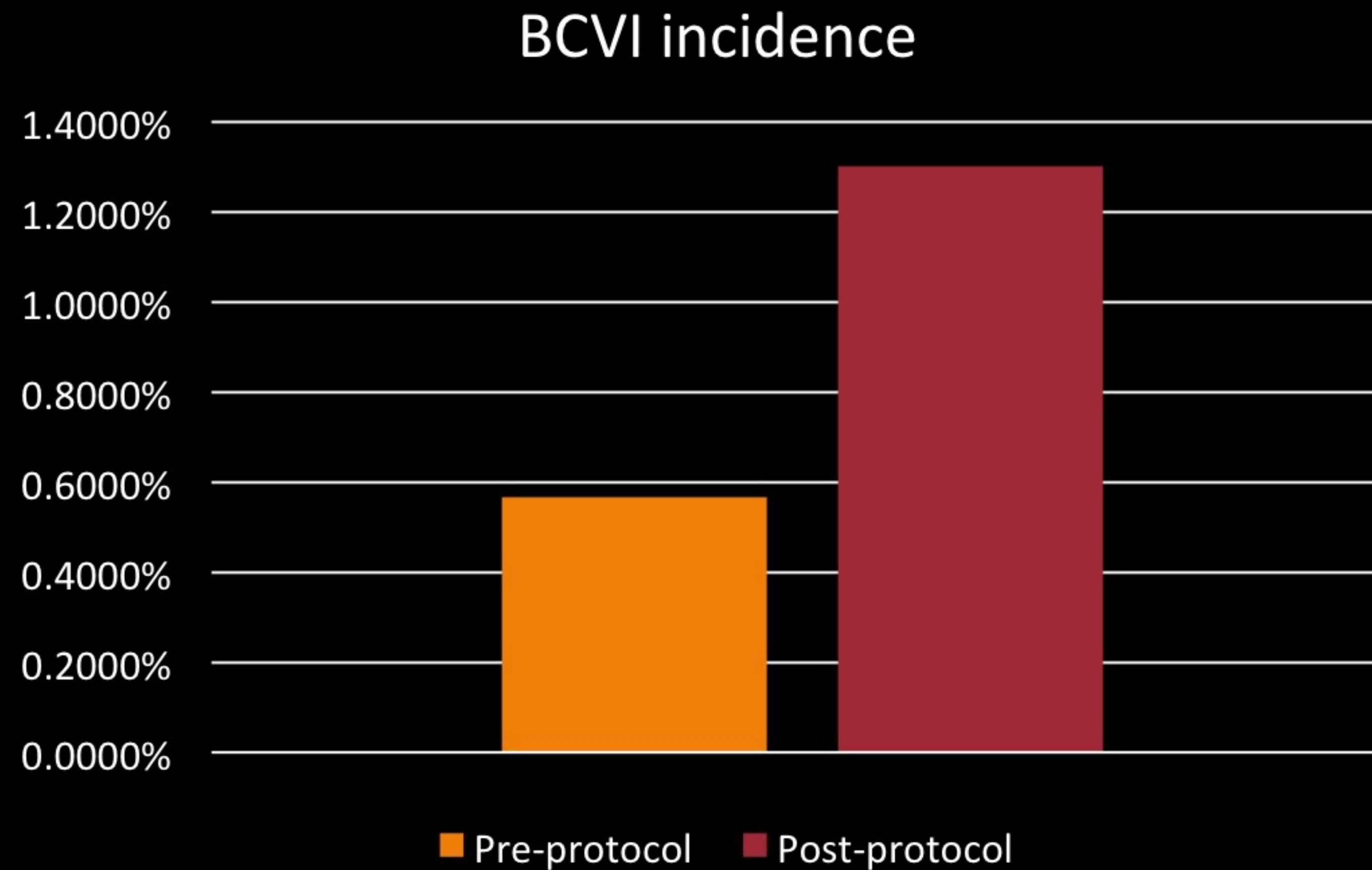
- Sensitivity of screening tool (retrospective)
 - 44%
 - Screening tool missed some cases of BCVI
- Specificity of screening tool
 - 77%
 - May be an underestimate as not all BCVI were diagnosed

BCVI at Auckland – after

Population:

- Auckland City Hospital Trauma Registry
- 2.5 year period Nov 2013-March 2016
- Blunt trauma to head, neck, face and chest
 - Two groups: BCVI present, BCVI absent
- 999 patients, 13 with BCVI

Improved detection of BCVI

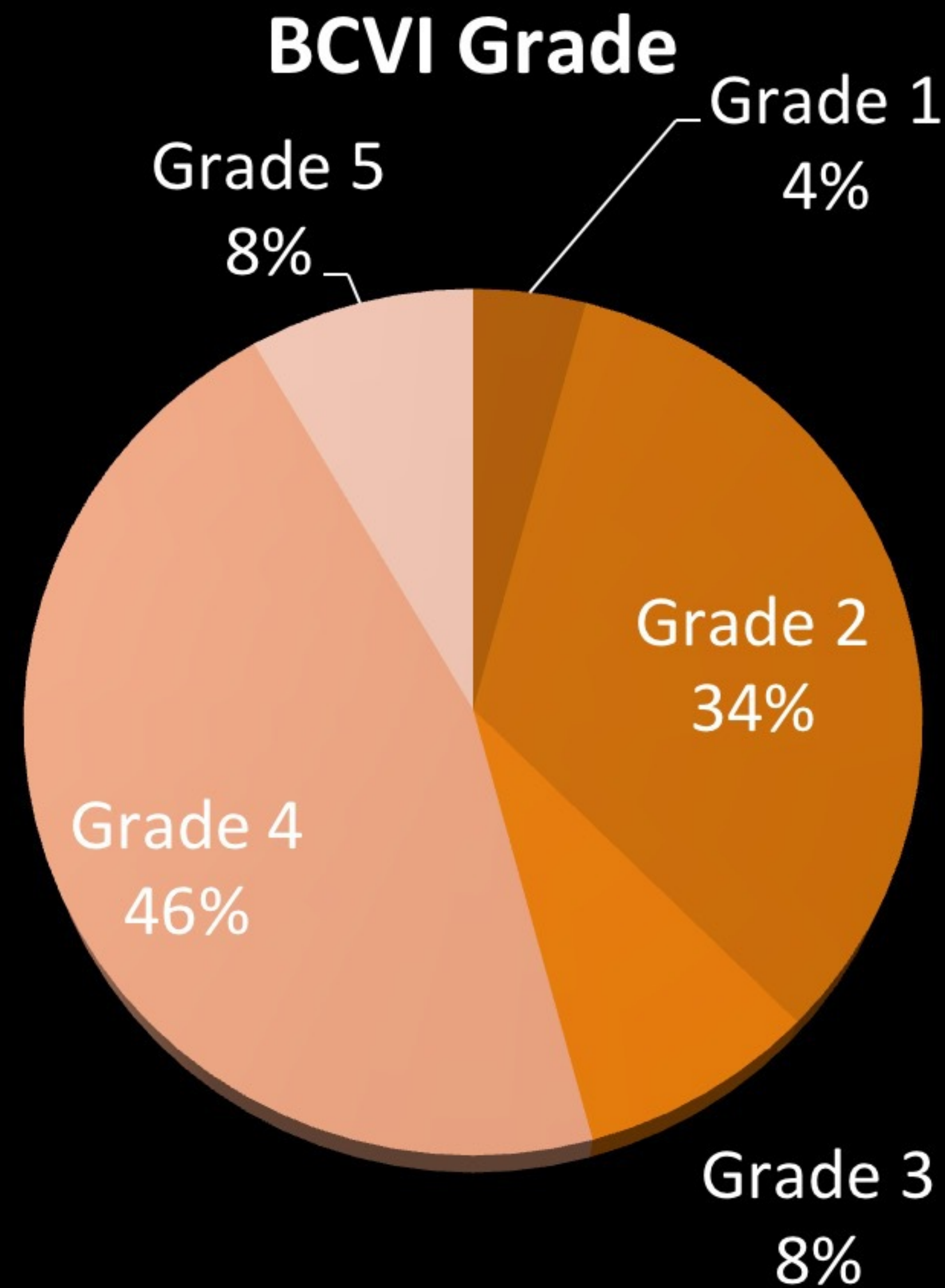


	Pre-protocol	Post-protocol	
BCVI	27	13	40
Non BCVI	4740	986	5726
	4767	999	
	0.5664%	1.3013%	p=0.01094*

POST PROTOCOL CHANGE

	Pre-protocol change	Post-protocol change	P value
CTA	20/27, 83%	13/13, 100%	0.04326*
Met radiological criteria	19/27, 70%	11/13, 85%	NS
Delay to diagnosis	9/27, 33%	2/13, 15%	NS
Met radiological criteria and delay to diagnosis	8/19, 42%	2/11, 18%	NS
Any treatment	20/27, 74%	11/13, 85%	NS
Residual neurology or death	18/27, 67%	4/13, 31%	0.03256*

Are we detecting injuries that matter?



Injury distribution

Auckland (not screened)

- Grade 1: 4%
- Grade 2: 34%
- Grade 3: 8%
- Grade 4: 46%
- Grade 5: 8%

MGH (screened)

- Grade 1: 18%
- Grade 2: 25%
- Grade 3: 12%
- Grade 4: 40%
- Grade 5: 5%

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MGH screened population

Highest risk for stroke:

Grade 1: 28.6%

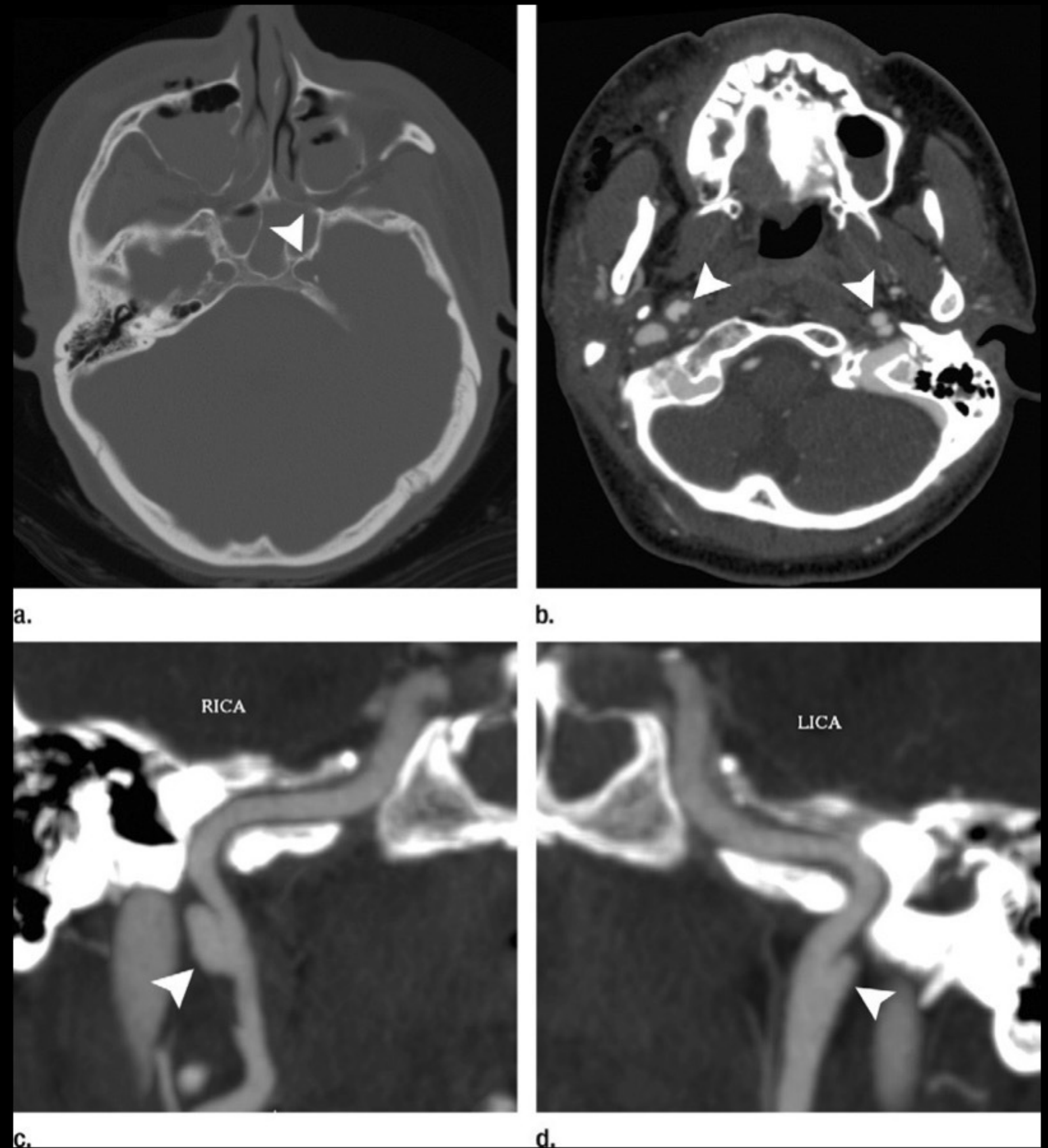
Grade 4: 25.5%

Frequency of grade:

Grade 4: 48%

Grade 1: 24%

Grade 2: 20%



Bilateral Grade 3 Injuries

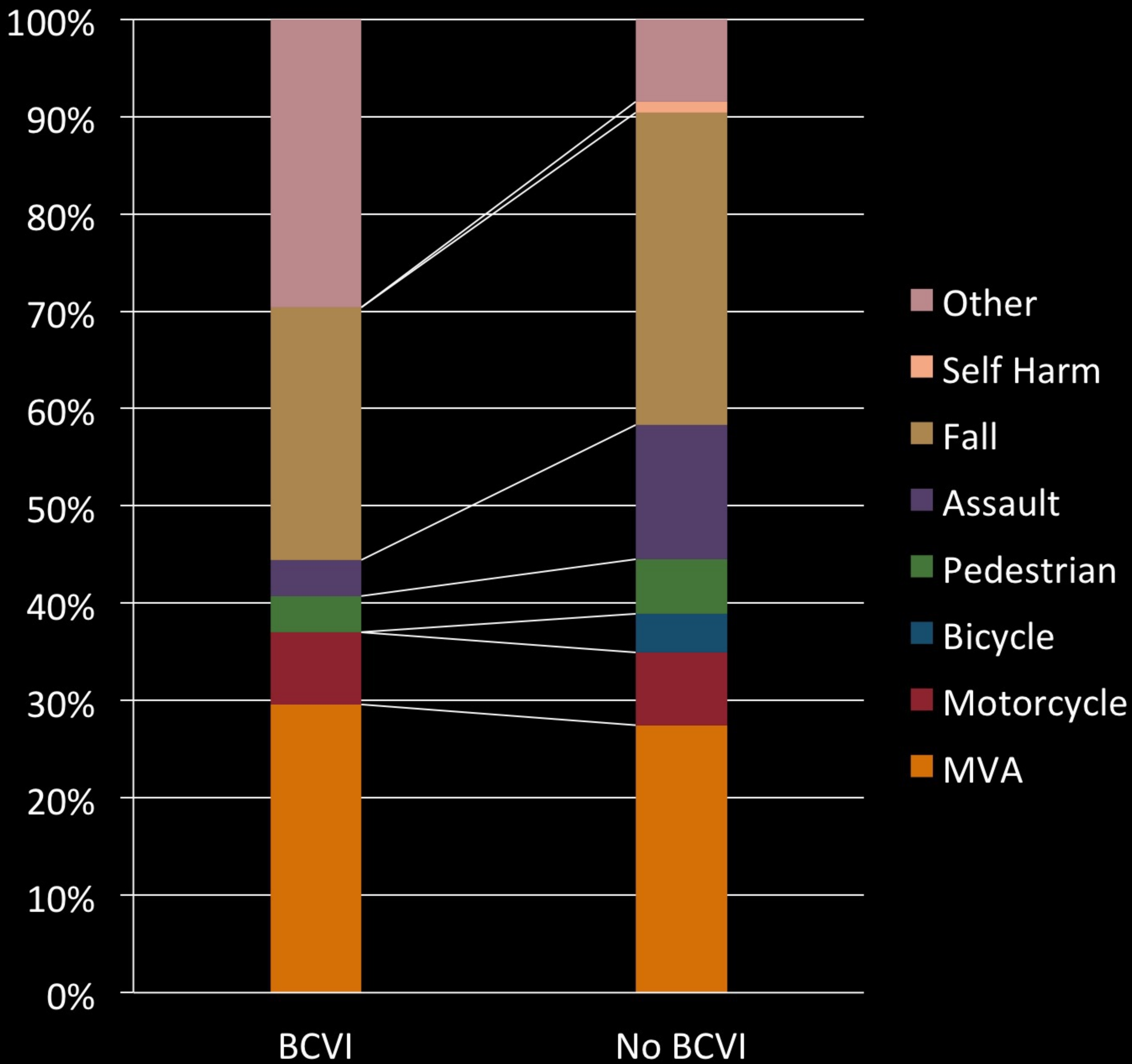
Challenges Studying BCVI Screening at Auckland

- **Small numbers**
 - Difficult to collect sufficient cases to have statistical power
- **Cost benefit ratio?**
 - Don't know 'yield' (positive cases/total screened) (role for including in trauma registry?)
 - Know nominal 'cost' to referring departments
 - Difficult to quantify 'cost' to radiology
- **Risk benefit ratio?**
 - Radiation exposure in young patients

Benefits to studying BCVI in our population

- Although not always statistically significant, numbers 'mirror' other studies increasing confidence that international data can be applied to our population
- Benchmark – compare our detection rate, morbidity/mortality rates to other centres
- New Zealand population unique

Injury Mechanism



P value	
MVA	NS
Motorcycle	NS
Bicycle	NS
Pedestrian	NS
Assault	NS (p = 0.1641)
Fall	NS
Self Harm	NS
Other	0.0016*

Rugby-related BCVI



	Age	Sex	Ethnicity	Mechanism of injury	Injuries	ICH ?	Fracture?	ISS	GCS	D/C
1	28	Male	Samoaan	Rugby	L ICA dissection with neurological deficit	0	0	9	15	Rehab
2	22	Male	Cook Island Maori	Rugby (transfer from Rarotonga)	R ICA dissection with neurological deficit	0	0	9	?	Rehab
3	22	Male	Samoaan	Rugby	# transverse process & lamina C4. Dissection L vert art with neurologic deficit	0	1	9	14	NSH
4	15	Male	Samoaan	Rugby	Dissection L ICA	0	0	9	15	Rehab
5	24	Male	NZ European	Rugby	Dissection R vertebral & PICA Ligamentous neck sprain	0	0	4	15	Home
6	32	Male	Tongan	Rugby	Traumatic dissection R vertebral artery	0	0	4	11	MMH

Conclusion

- Screening protocol for BCVI now bedded in at ED Radiology, Auckland City Hospital
- Adopted at regional hospitals
- Improved detection, with incidence similar to other screened populations
- Early follow up data suggests improved outcomes
- New baseline for further improvements in detection and outcomes

Thank you!

Will
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Rangi Dansey

Lynn Tucker

Rong Hu

