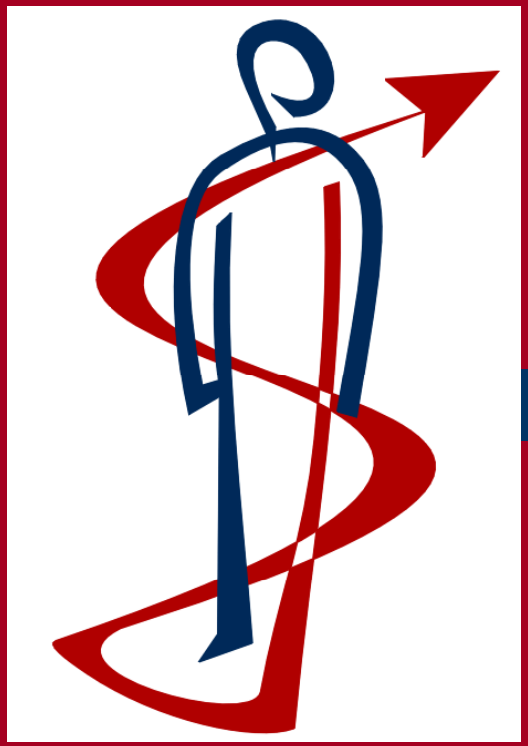
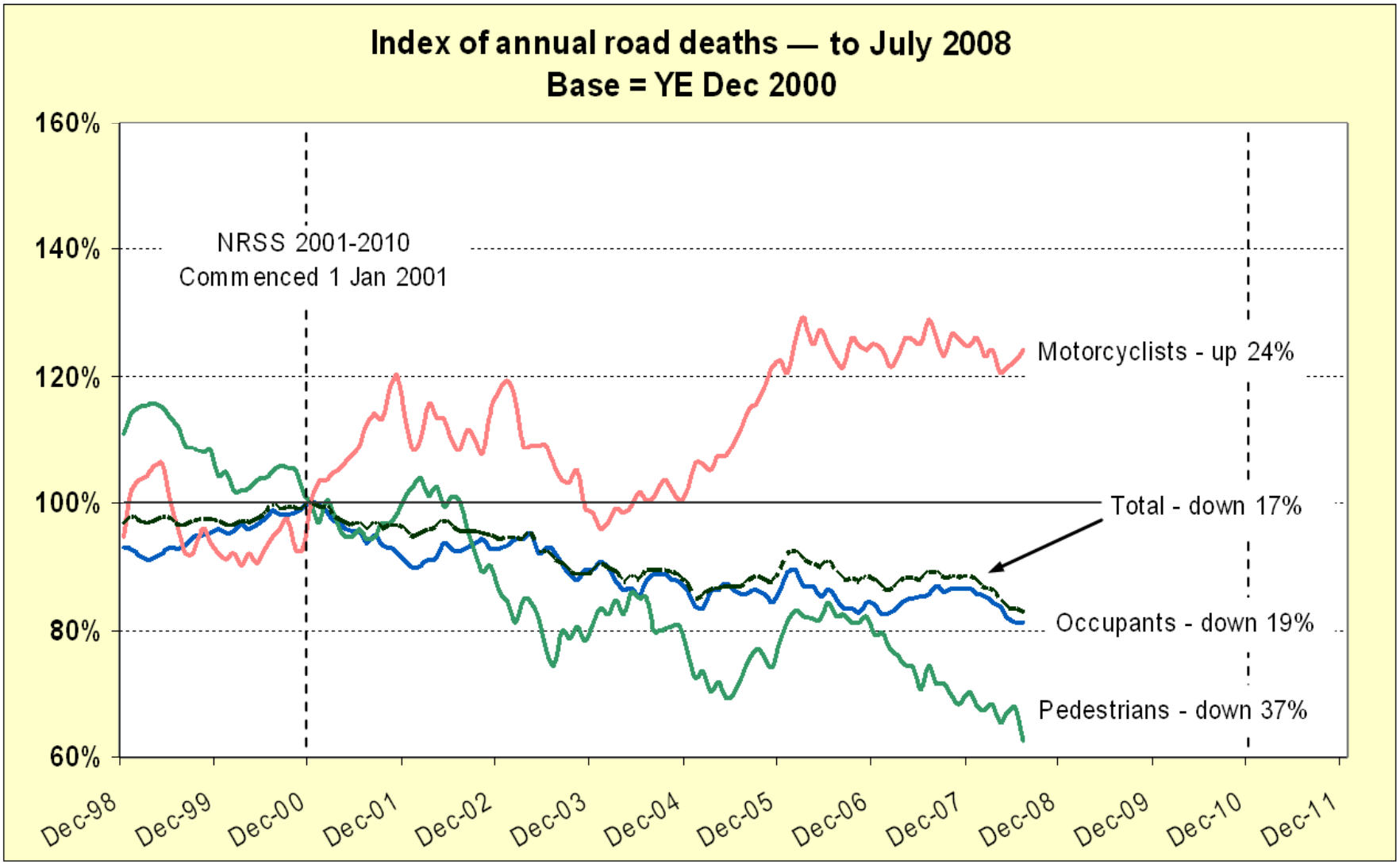
Motorcycle crashes into roadside & median road safety barriers



Raphael Grzebieta

NSW Injury Risk Management Research Centre

THE UNIVERSITY OF NEW SOUTH WALES



Source: Road Safety Strategy Panel
Road Safety Branch, Infrastructure and Surface Transport Policy,
Department of Infrastructure, Transport, Regional Development and Local Government

Road deaths by road user group and crash type

	1999	2000	2001	2002	2003	2004	2005	2006	2007	Change: last two years relative to first two years
Vehicle occupant single vehicle crash	577	648	604	658	634	598	594	619	645	3%
Vehicle occupant multiple vehicle crash	670	654	579	548	532	524	527	473	486	-28%
Pedestrian	299	287	290	249	232	220	225	227	202	-27%
Motorcyclist: single vehicle crash	66	80	89	101	61	80	94	112	103	47%
Motorcyclist: multiple vehicle crash	110	111	127	123	127	115	139	126	135	18%
Bicyclist: single vehicle crash	2	3	3	1	4	10	11	4	4	–
Bicyclist: multiple vehicle crash	38	28	43	33	22	33	30	35	37	9%
Articulated truck single vehicle crash	20	25	18	31	20	26	28	23	32	22%
Articulated truck multiple vehicle crash	154	165	142	153	138	110	116	124	121	-23%
Articulated truck pedestrian crash	17	18	18	16	13	14	11	21	19	14%
All road users	1,764	1,817	1,737	1,715	1,621	1,583	1,627	1,598	1,612	-10%

Source: Road Safety Strategy Panel
Road Safety Branch, Infrastructure and Surface Transport Policy,
Department of Infrastructure, Transport, Regional Development and Local Government

Motorcycle impacts into roadside barriers

IRMRC research project

Partners

- WA Office of Road Safety & WA Main Roads
- Australian Automobile Association
- NSW Centre for Road Safety (RTA)
- NSW Motor Accidents Authority
- Transit New Zealand

IRMRC

Motorcycle impacts into roadside barriers

IRMRC research project

Research Investigators

- Raphael Grzebieta (barriers)
- Andrew McIntosh (biomechanics)
- Rena Friswell (causation & epidemiology)
- Hussein Jama (analysis & modelling)
- Jake Olivier (biostatistics)
- Rob Smith (motorcycle expert)

IRMRC

Motorcycle impacts into roadside barriers

IRMRC research project

Methodology

- Statistics (fatalities & serious injury)
- Determine causal factors
  (other vehicle, speed, alcohol, fatigue, bad cornering, inexperience, human error?, etc)
- Determine biomechanical injury causal mechanism

IRMRC

Motorcycle impacts into roadside barriers

IRMRC research project

Methodology

- Determine survivable and non-survivable impact envelopes
- Reconstruct crashes & computer simulation
- Develop / investigate injury mitigation strategies and assess their effectiveness
- Carry out crash tests

IRMRC

Motorcycle into Barrier Fatalities

2001 - 2006 National Coroners Information System data

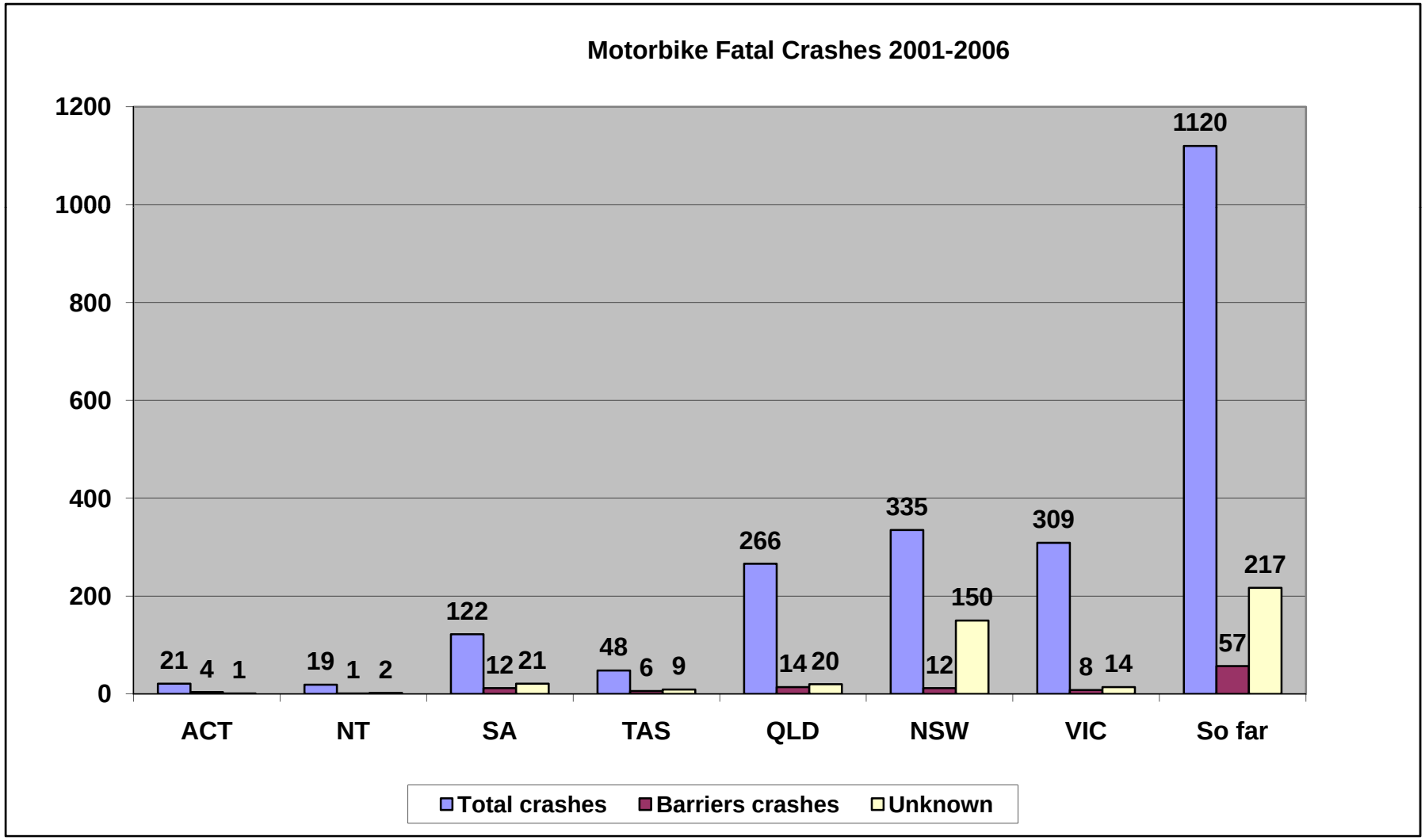
In-depth investigation of fatal crashes where information is available

In-depth investigation of serious injury crashes through trauma centres & recruitment will also be carried out

IRMRC

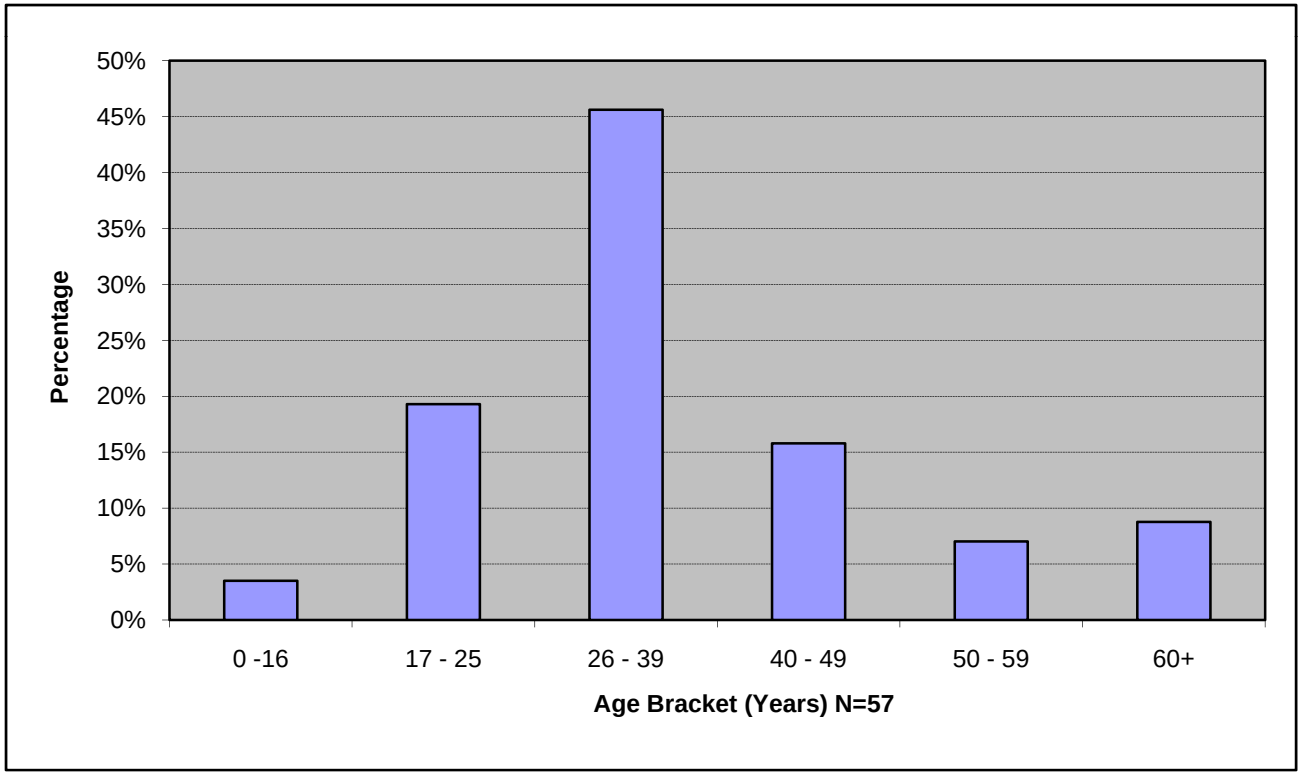
Motorcycle barrier crashes

National Coroners Information System - preliminary findings



Motorcycle into Barrier Fatalities

National Coroners Information System data 2001-2006



IRMRC

Motorcycle into Barrier Fatalities

National Coroners Information System data 2001-2006 (n=57 fatalities)

- Gender

  Male 52 Females 5

- Rider & Pillion

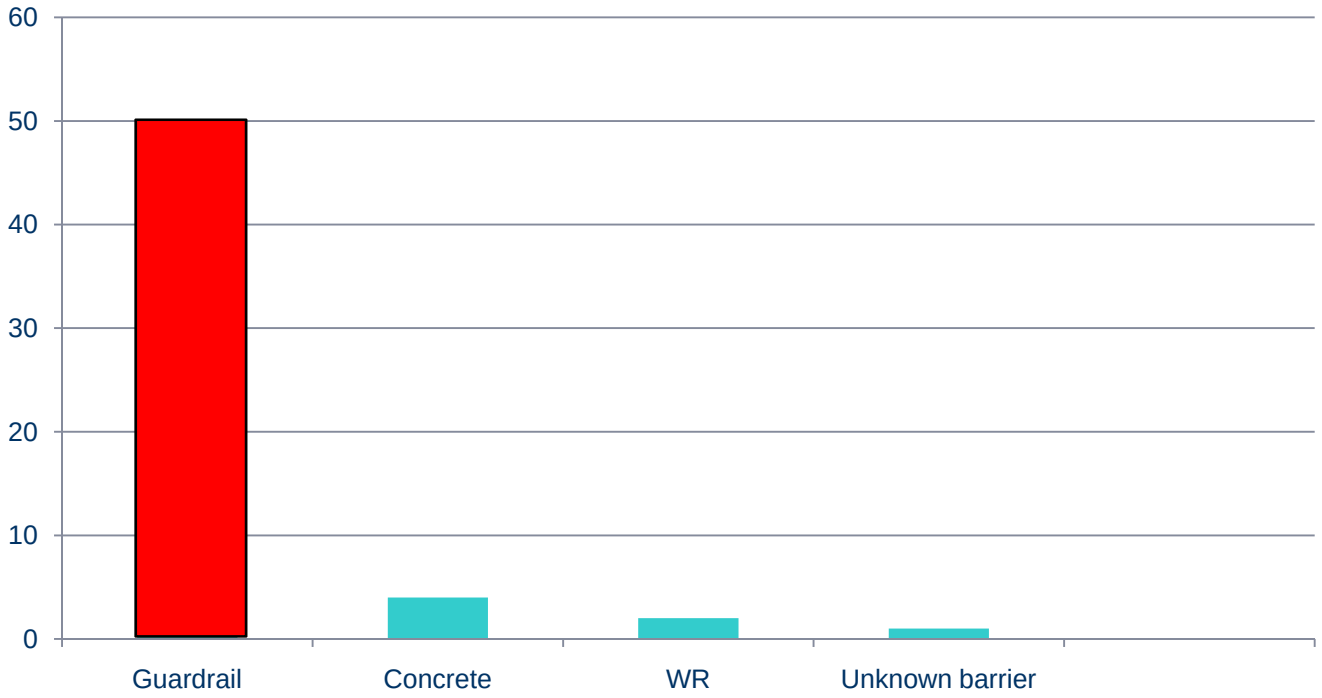
  Rider & pillion 4 (fatal crashes)
  (3 female pillions killed and 1 male rider)

  Rider only - 53

IRMRC

Motorcycle into Barrier Fatalities

National Coroners Information System data 2001-2006

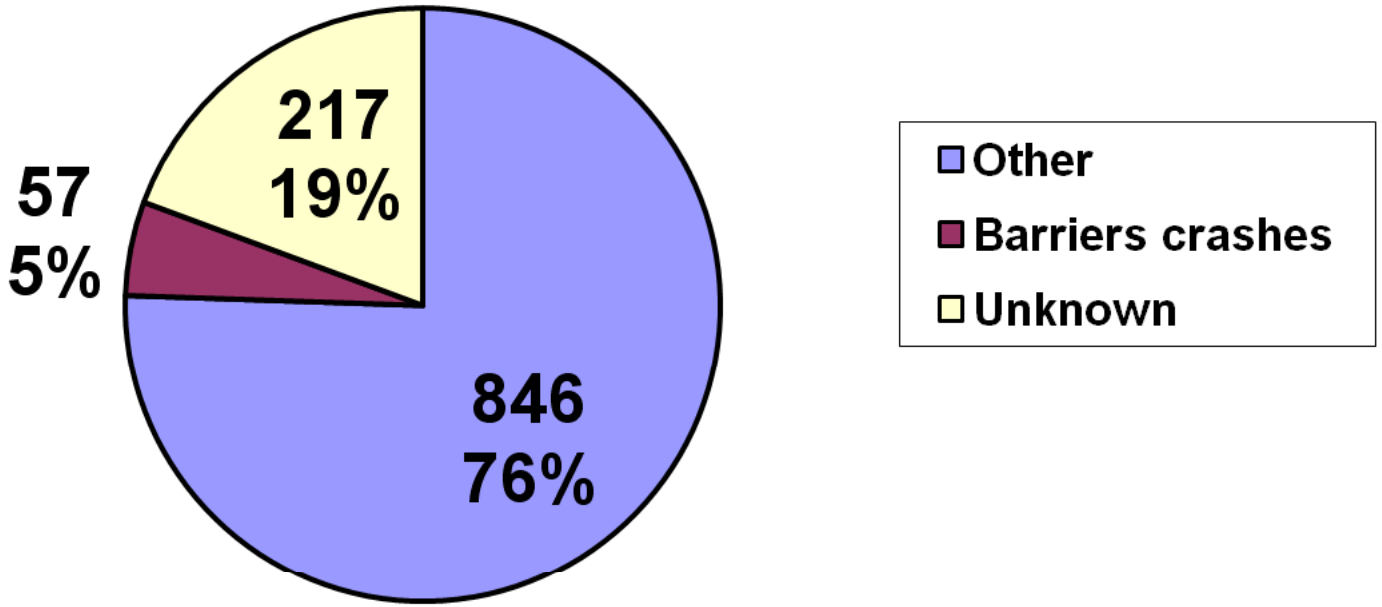


IRMRC

Motorcycle into Barrier Fatalities

National Coroners Information System data

Australian total so far (excluding WA)

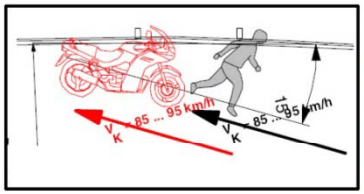


IRMRC

Motorcycle into Barrier Fatalities

Other studies

DEKRA – Germany



- **82% involved a steel barrier**
- **51% of 57 cases analysed motorcycle impacted the barrier while driving in an upright position**
- **45% occurred where the motorcycle slid on its side on the road surface before it first struck the barrier.**

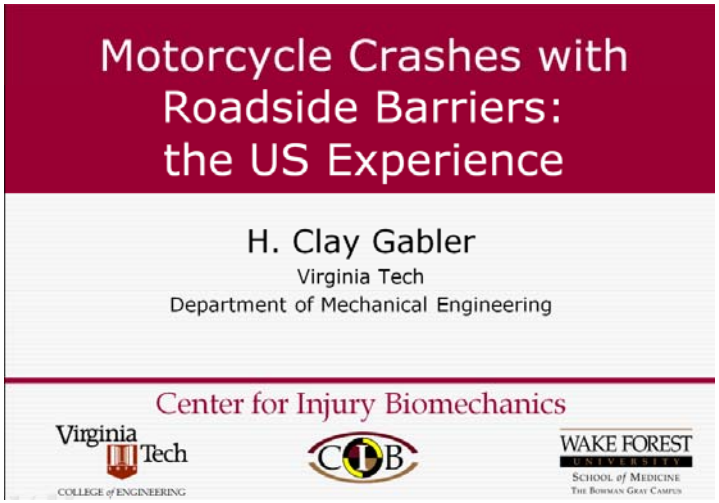
IRMRC

Berg A., Rücker P., Gärtner M., König J., Grzebieta R.H., Zou R., Motorcycle Impacts to Roadside Barriers – Real World Accident Studies and Crash Tests Carried out in Germany and Australia, *Proc. 19th International Technical Conference on the Enhanced Safety of Vehicles,* Washington, USA, June 2005**.**

Motorcycle into Barrier Fatalities

USA Gabler

- **39% of guardrail fatalities & 24% of concrete barrier fatalities but only 3% of registered vehicles**

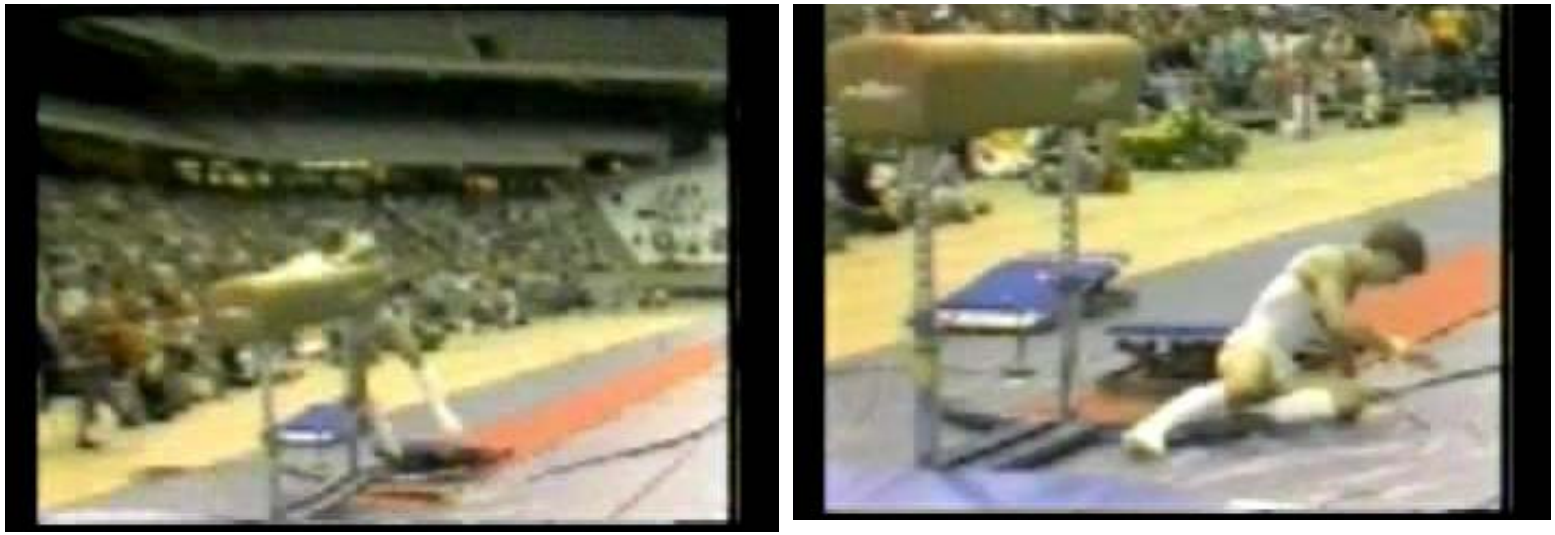


- **Motorcycle guardrail impact 80 times higher risk than car/LTV**
- **Motorcycle concrete barrier 68 times higher risk than car/LTV**
- **$0.5 million dollar US “in-depth” TRB study of barrier fatalities**

Gabler H., The Risk Of Fatality In Motorcycle Crashes With Roadside Barriers, 20th International Technical Conference on the Enhanced Safety of Vehicles, Lyon, Paper Number 07-0474, France, June 2007

IRMRC

What is a survivable impact ?



20 km/hr ?

IRMRC

Motorcyclist - What is a survivable impact?

Hitting an object at 30 km/h is equivalent to jumping off the roof of a house.

At 40 km/h is equivalent to jumping off a 3 story building and hoping you will survive.

At 50 km/h it is equivalent to jumping off a 5 storey building.

At 60 km/h, jumping off a 7 story building.

IRMRC

Motorcycle barrier crashes.

Rider is thrown over concrete barrier into hazard.

Berg A., Rücker P., Gärtner M., König J., Grzebieta R.H., Zou R., Motorcycle Impacts to Roadside Barriers – Real World Accident Studies and Crash Tests Carried out in Germany and Australia, *Proc. 19th International Technical Conference on the Enhanced Safety of Vehicles,* Washington, USA, June 2005**.**

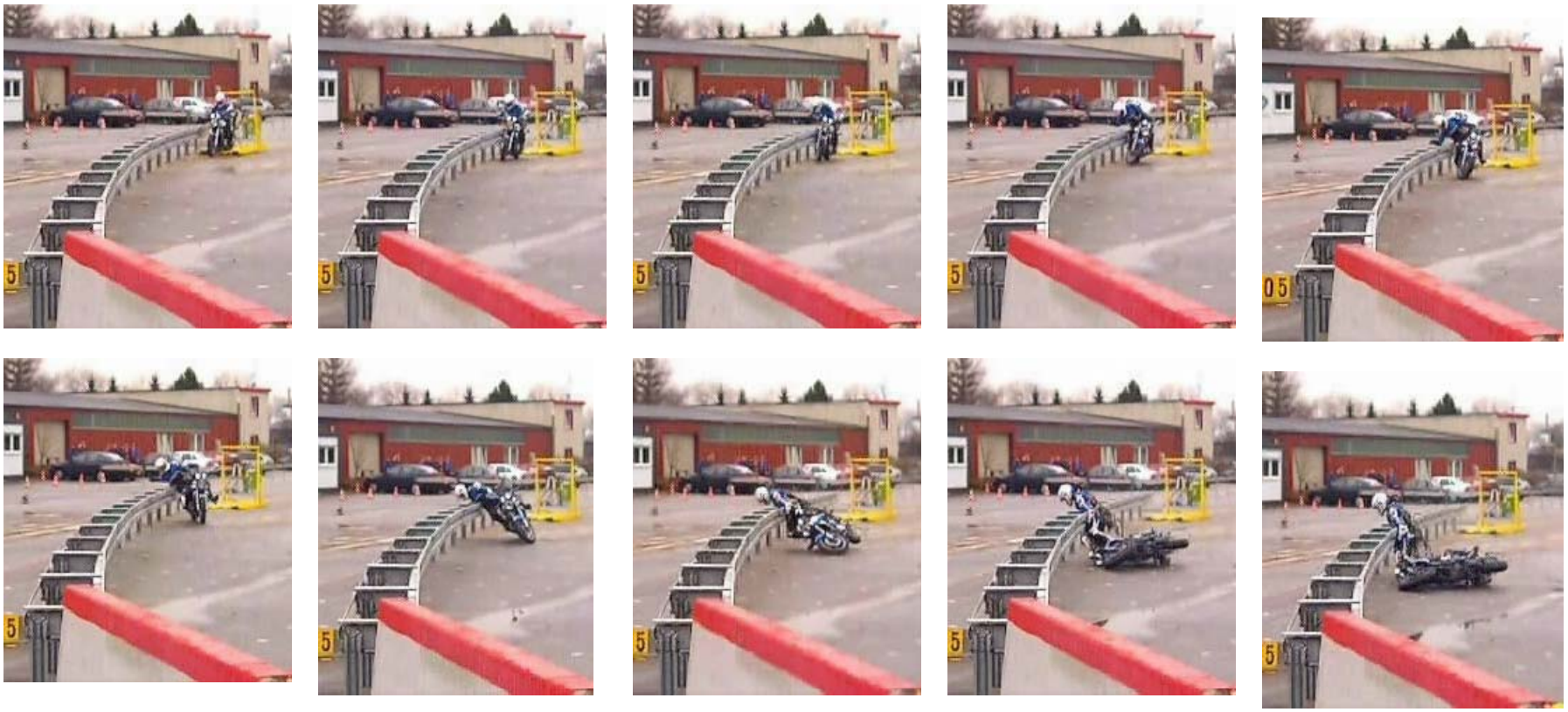
Motorcycle barrier crashes.

Rider is thrown over concrete barrier into hazard.

Berg A., Rücker P., Gärtner M., König J., Grzebieta R.H., Zou R., Motorcycle Impacts to Roadside Barriers – Real World Accident Studies and Crash Tests Carried out in Germany and Australia, *Proc. 19th International Technical Conference on the Enhanced Safety of Vehicles,* Washington, USA, June 2005**.**

Motorcycle barrier crashes.

Rider thrown onto steel barrier, elbow is torn when it strikes blockout & stomach cut apart when sliding along rail sharp edge.



Berg A., Rücker P., Gärtner M., König J., Grzebieta R.H., Zou R., Motorcycle Impacts to Roadside Barriers – Real World Accident Studies and Crash Tests Carried out in Germany and Australia, *Proc. 19th International Technical Conference on the Enhanced Safety of Vehicles,* Washington, USA, June 2005**.**

Motorcycle barrier crashes.

Rider slides and hits post at shoulder

Berg A., Rücker P., Gärtner M., König J., Grzebieta R.H., Zou R., Motorcycle Impacts to Roadside Barriers – Real World Accident Studies and Crash Tests Carried out in Germany and Australia, *Proc. 19th International Technical Conference on the Enhanced Safety of Vehicles,* Washington, USA, June 2005**.**

Motorcycle barrier crashes.

Rider impacts & slides along rubrail instead of post

Berg A., Rücker P., Gärtner M., König J., Grzebieta R.H., Zou R., Motorcycle Impacts to Roadside Barriers – Real World Accident Studies and Crash Tests Carried out in Germany and Australia, *Proc. 19th International Technical Conference on the Enhanced Safety of Vehicles,* Washington, USA, June 2005**.**

Motorcycle barrier crashes.

Rider is thrown over barrier into hazard.

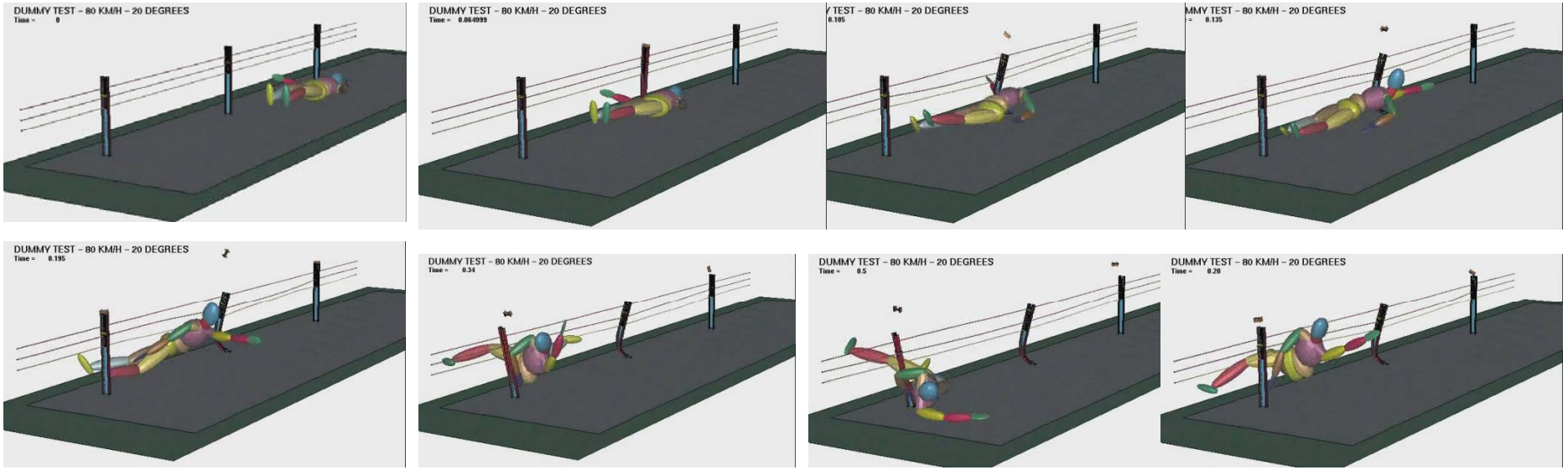





Berg A., Rücker P., Gärtner M., König J., Grzebieta R.H., Zou R., Motorcycle Impacts to Roadside Barriers – Real World Accident Studies and Crash Tests Carried out in Germany and Australia, *Proc. 19th International Technical Conference on the Enhanced Safety of Vehicles,* Washington, USA, June 2005**.**

Motorcycle barrier crashes.

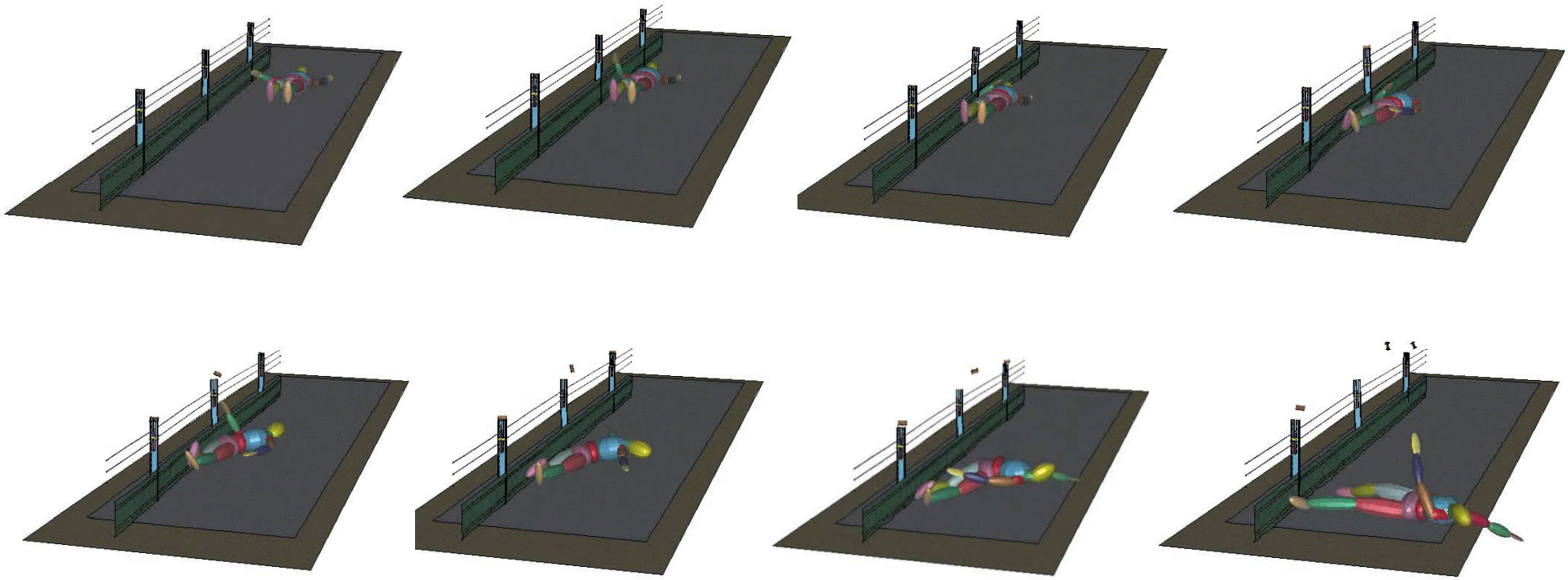
Rider slides and hits post and bends them



Reproduced with kind permission of Prof Marco Anghileri, Dipartimento di Ingegneria Aerospaziale, Politecnico di Milano, Italy.

Motorcycle barrier crashes.

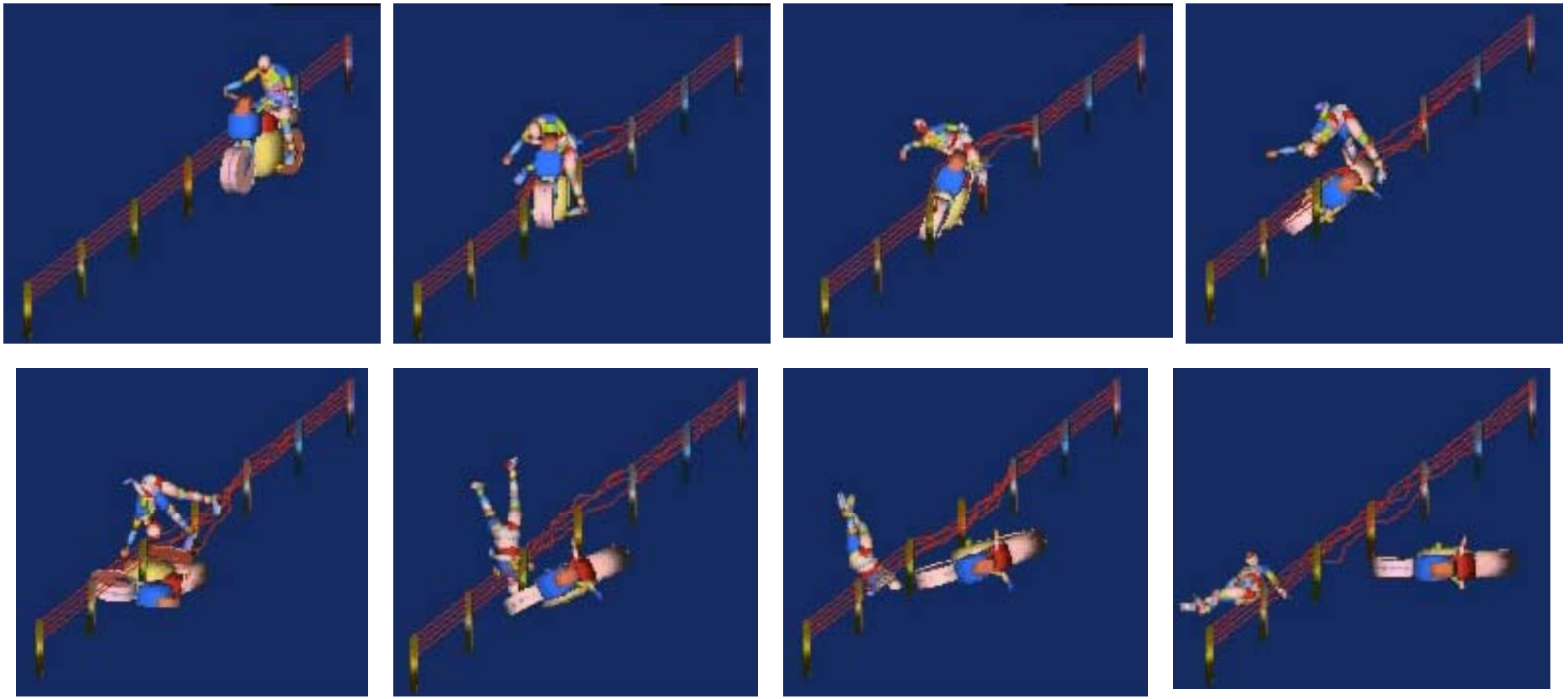
Rider slides along fabric instead of hitting posts



Reproduced with kind permission of Prof Marco Anghileri, Dipartimento di Ingegneria Aerospaziale, Politecnico di Milano, Italy.

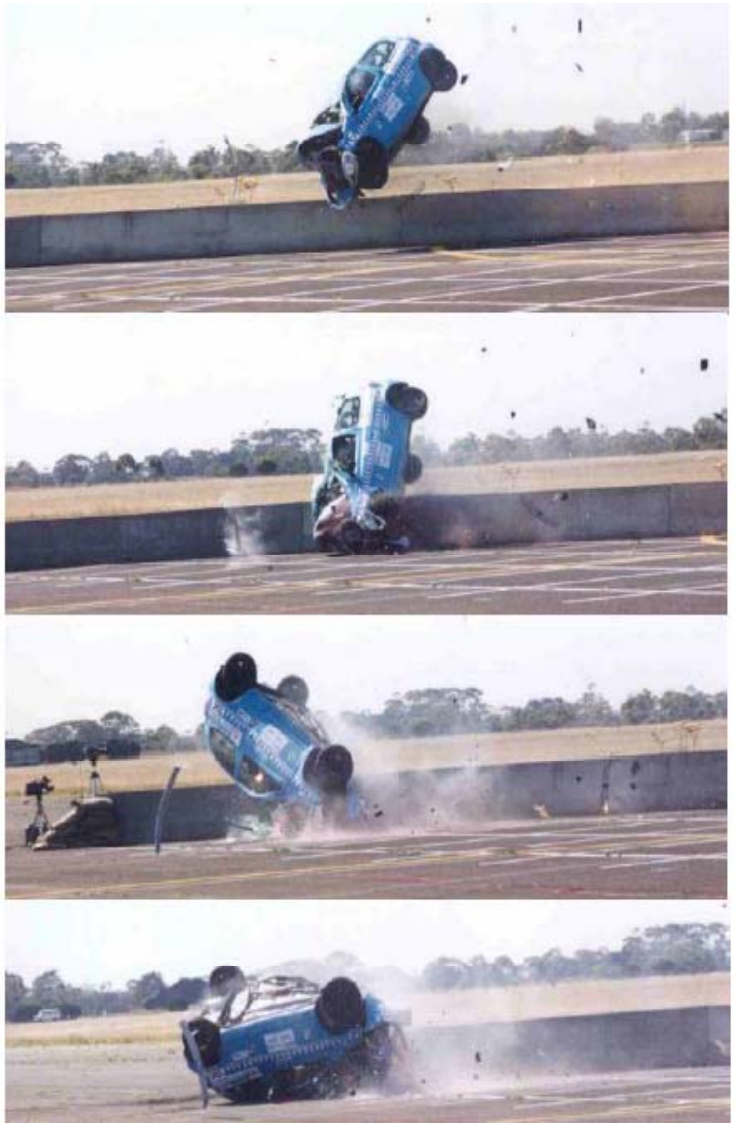
Motorcycle barrier crashes.

Motorcycle snags on posts and rider ejected over top of wire rope barrier



Berg A., Rücker P., Gärtner M., König J., Grzebieta R.H., Zou R., Motorcycle Impacts to Roadside Barriers – Real World Accident Studies and Crash Tests Carried out in Germany and Australia, *Proc. 19th International Technical Conference on the Enhanced Safety of Vehicles,* Washington, USA, June 2005**.**

Concrete at 80 km/hr @ 45° – Not survivable



Concrete at 80 km/hr @ 45° – Not survivable

Grzebieta R.H., Zou R., Corben B., Judd R., Kulgren A., Tingval C. and Powell C., Roadside Crash Barrier Testing, Proceedings ICRASH2002, 3rd International Crashworthiness Conference, Society of Automotive Engineers Australia, Melbourne, February 2002.

Car barrier crashes.

Car redirected by wire-rope with low deceleration

Survivable crash

Grzebieta R.H., Zou R., Corben B., Judd R., Kulgren A., Tingval C. and Powell C., Roadside Crash Barrier Testing, Proceedings ICRASH2002, 3rd International Crashworthiness Conference, Society of Automotive Engineers Australia, Melbourne, February 2002.

Wire rope 80 km/hr @ 45° – very survivable and soft crash – airbags did not fire

Vehicle redirected and can still be driven

Must comply with crash barrier standard AS3845 for cars as well.

Vehicle should not ride over barrier

Grzebieta R.H., Cameron J., Carey A. and Zou R., Water-filled plastic safety barrier systems, *Road & Transport Research*, Vol.10, No.3, Sept., 2001.

Barrier cannot be breached for all vehicles

Vehicle should not ride over barrier

Wire rope barriers - Statistics

Data Compiled by Nicholas Szwed - Vicroads

		Run-off-road crashes									
		Before					After				
Location	Length (km)	Years	Casualty Crashes				Years	Casualty Crashes			
			F	SI	OI	Total		F	SI	OI	Total
Eastern Fwy	8	10	2	16	20	38	1	0	2	0	2
Geelong Rd	5	5	3	7	6	16	3	0	0	0	0
Frankston Fwy (1)	0.42	5	1	2	1	4	5	0	0	0	0
Frankston Fwy (2)		5	1	1	1	3	3	0	1	0	1
Hume Fwy (1)	1.25	5	2	2	2	6	3	0	0	0	0
Hume Fwy (2)	2	5	0	5	3	8	3	0	0	0	0
Total ~	17	35	9	33	33	75	18	0	3	0	3

Before-and-after crash summary

Wire-rope barrier installation

- RTA – reductions of around 70-80% in fatalities – lowest road fatalities now in the Australia as a result in part of wire rope and tactile line marking – 5.6 per 100,000.

IRMRC

Wire-rope barrier installation

Arne Carlsson, Evaluation of 2+1 Roads With Cable Barrier, Swedish Road Administration, VTI Rapport 636A

- Sweden has noted similar reductions of around 76-82% in road trauma where such barriers have been introduced
- Motorcycle fatality reduction of 40-50%

IRMRC

Wire-rope barrier installation

- US DOT's are observing similar gains on their high volume (and high speed) freeways in North Carolina. Around 80-90% reductions in trauma.

IRMRC

Summary

- Motorcycle fatalities resulting from roadside barriers crashes are low at around 5-6% which is around 14 per year nation wide of 238 fatalities.
- Guardrail impacts are the most dangerous.
- Only 1 wire-rope rider impact found in WA – excessive speed striking another vehicle before striking barrier. Most likely died on impact with vehicle.

·IRMRC

Summary

- Concrete barrier impacts can also be dangerous but very low – 4 fatalities
- Guardrail impacts are the most dangerous and often struck.
- Wire-rope impacts are rare. 70 – 80% reduction in road fatalities wherever installed which is why they are being installed.
- Solutins exist to reduce motorcycle fatalities – but credible science must be used so as not to effect all road users and gains to date

·IRMRC