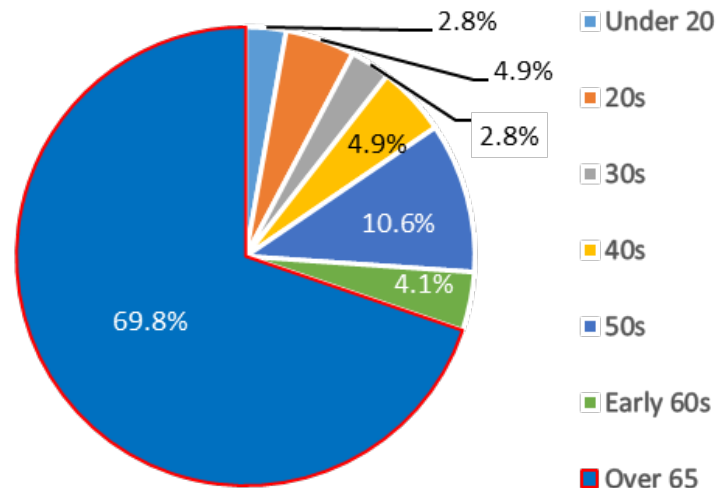


ヘルメット着用高齢自転車乗員の 対車両事故マルチボディ解析

Multibody analysis of vehicle accident for
elderly cyclist wearing bicycle helmet

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Accident countermeasures for elderly cyclists are required.

Effects of reducing head injuries in vehicle accidents of elderly cyclist after taking safety measures.



Fig. 1 Percentage of deaths while riding a bicycle by age (2019)⁽¹⁾

Analysis Models & Conditions

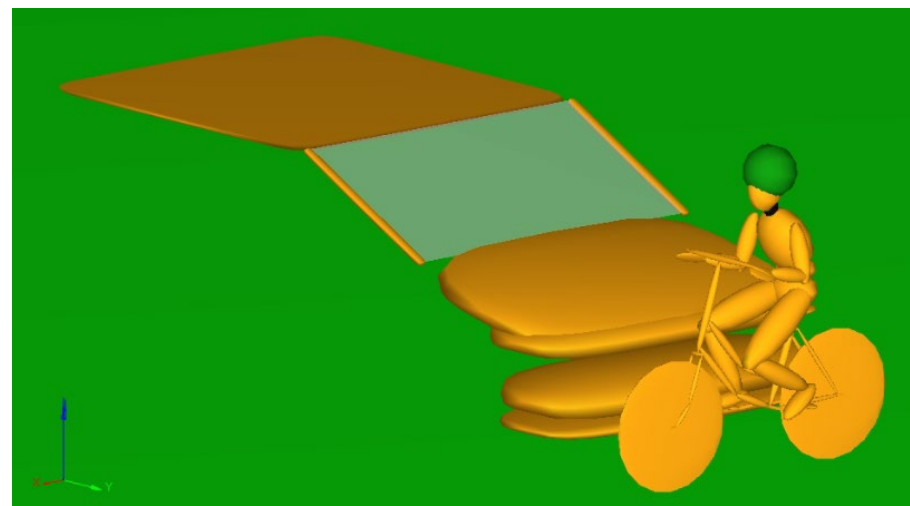


Fig. 2 Analysis models and simulation⁽²⁾⁽³⁾

Table 1 Analysis conditions

Condition	Content
Collision direction	Side
Car velocity [km/h]	10, 20, 30, 40, 50
Car model	Sedan type
Cyclist gender	Male, Female
Cyclist velocity	0km/h
Attitude of impact side leg	Front
Helmet	With, Without

(1)Statistics of the National Police Agency for 2020

(2)Sota Yamamoto, Koibumi Akihiro, Shoko Oikawa, Yasuhiro Matsui, Proceedings of the Society of Automotive Engineers of Spring Meeting (2015)

(3) Mizuno K., Ito D., Yoshida R., Nomura M., Fujii C., "Adult headform impact tests of three Japanese child bicycle helmets into a vehicle", "Accident Analysis and Prevention 73" (2014), pp. 359-372

Table 2 Effects of helmet use on HIC

	Male				Female			
	With helmet		Without helmet		With helmet		Without helmet	
Collision velocity (km/h)	1st HIC	2nd HIC	1st HIC	2nd HIC	1st HIC	2nd HIC	1st HIC	2nd HIC
10	2.8863	36.204	0	3491.4	2.3426	2.7938	0	3382.7
20	5.8771	47.234	179.06	179.06	8.3041	96.195	69.359	225.42
30	23.271	327.24	71.403	1410.1	5.0997	22.326	98.976	1318.0
40	28.268	178.52	150.29	1726.5	99.042	122.38	97.818	1087.3
50	133.88	125.65	246.65	11211	127.62	243.34	194.23	481.72

Behavior Comparison

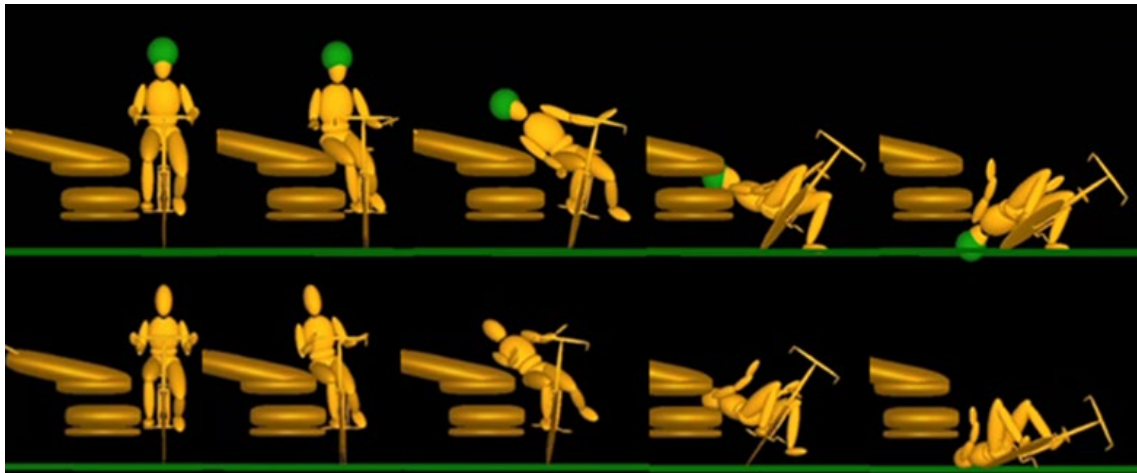


Fig. 3 Comparison of behavior with and without helmet at 10km/h (above: with helmet, below: without helmet)

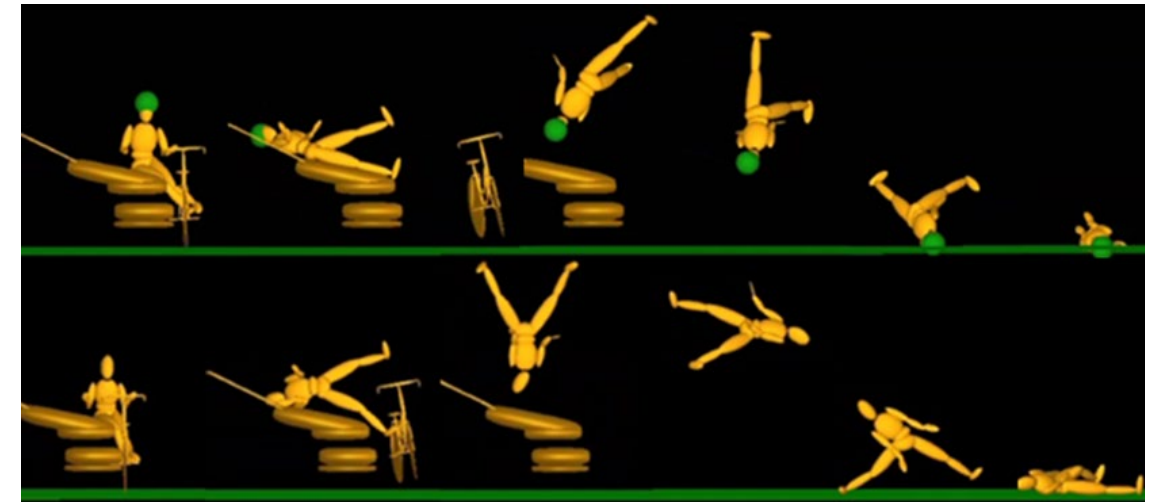


Fig. 4 Comparison of behavior with and without helmet at 50km/h (above: with helmet, below: without helmet)

- Wearing a helmet reduced head injuries that could lead to death.
- Wearing a helmet widens the contact area of the head.
- Female had smaller head moments than those of male.
- Wearing a helmet may cause injury other than the head.

Conclusion

- Bicycle helmets significantly reduced the death of elderly cyclists due to head injuries, especially in secondary collisions.
- When the collision speed is fast, the moment of the head was increased and the behavior of the cyclist was changed due to wearing the helmet.