ORIGINAL ARTICLE

Does changing the configuration of a motor racing circuit make it safer?

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Objectives: To assess the pattern of injuries presenting to a racing circuit medical centre in two three-year periods before and after two chicanes were built into the track.
Methods: Medical centre records were used to identify all patients assessed during the two time periods. Those referred to hospital were categorised by injury severity into three groups.
Results: The proportions of those attending the medical centre that were referred and admitted to hospital were the same in both periods (12–13% and 3% respectively). During the two study periods, the risk of a severe injury for a car driver decreased from 0.1% to 0.03% ($p<0.05$). For a motorcyclist, similar values were 0% and 0.2% (not significant).
Conclusions: Chicanes have improved the safety of the racing circuit for car drivers, reducing the risk of injury.

Few data are available on injuries to competitors, officials, and spectators during motor racing events. One previous study was identified documenting injuries at Brands Hatch, another British racing track.[1] In this study 0.24% of motorcyclists and 0.14% of car drivers who started races were referred to hospital. Hospital admission rates for these two groups were 0.08% and 0.05% respectively.

The incidence and patterns of injury associated with motor sport events at Castle Combe, a regional circuit, had previously been studied.[2] In this study, hospital referral rates of 0.86% for motorcyclists and 0.5% for car drivers were documented. The hospital admission rates were 0% and 0.13% respectively.

After this study, changes in the circuit layout were made in an attempt to improve safety. These changes comprised the introduction of two chicanes, built into the fastest sections of the track (figs 1 and 2). They increased the track length from 1.84 to 1.85 miles. The aim of this study was to examine the effect of these changes on the patterns of injury presenting to the medical centre.

METHODS

Records from the Castle Combe motor racing circuit in Wiltshire were retrospectively studied. Data previously studied for a three year period before the circuit changes (1994–1996) and data collected after the changes (2000–2002) were compared. The data collected included both the individual patient consultation records from the medical centre and the average number of attending medical personnel, competitors, and spectators recorded by the circuit management.

Information extracted from the medical records was as follows:

- Status of patient (driver/biker/mechanic/marshal/crowd)
- Mechanism of injury/presenting symptoms
- Presumed diagnosis
- Medical intervention required
- Need for hospital referral

Unfortunately no data were recorded on the position of incidents on the track circuit. The emergency department notes of those patients transferred to hospital were requested to determine the final diagnosis and short term outcome. The injury severity of those transferred to hospital was categorised into one of three groups:

- Group A: minor injuries. This included small lacerations requiring suturing, minor neck strains, etc.
- Group B: moderate injuries. This included fractures and dislocations not requiring admission.
- Group C: major injuries. This included all patients who were admitted to hospital.

Sufficient detail had not been included in most of the records to reliably use a more detailed scoring system, such as the revised trauma score.

Medical facilities provided at the circuit changed little over the study periods. These facilities consisted of two fully staffed rescue vehicles, a fast response medical car, up to four St John ambulances, and a medical centre. Medical staffing

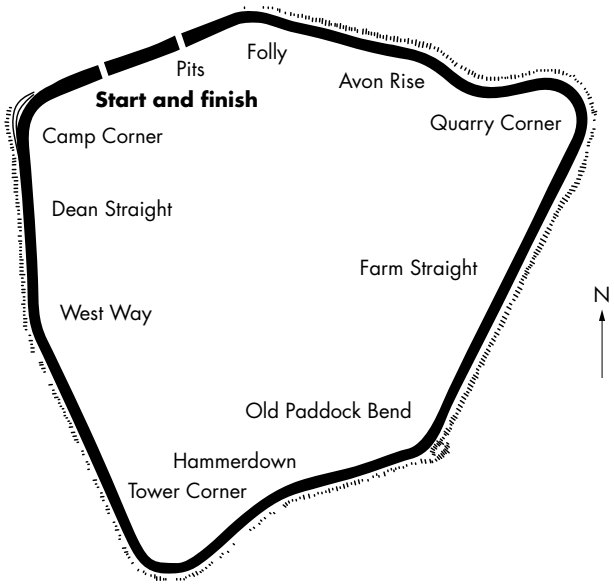

Figure 1 Castle Combe racing circuit layout before 1999.

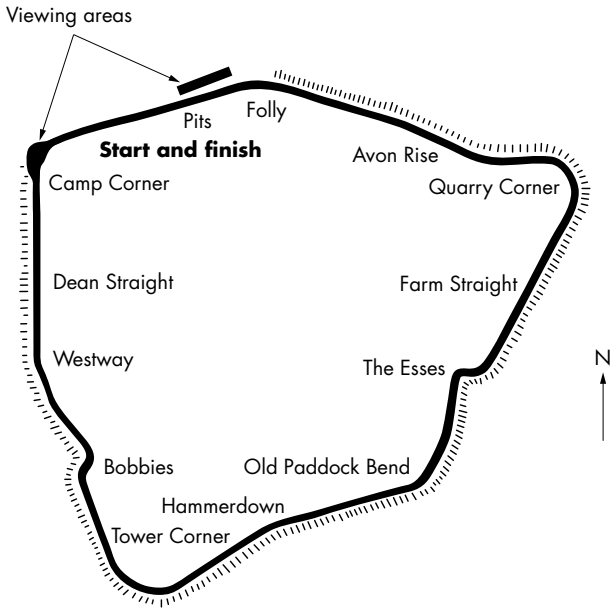

Figure 2 Castle Combe racing circuit layout after 1999.

included an average of eight doctors. The complement of medical staff always included an anaesthetist with further support from a variety of other specialties and general practice. All had an interest in trauma and resuscitation and most were advanced trauma life support instructors.[3] At least two nurses were present at each event.

Two doctors, at least one of whom was an anaesthetist, were located in the fast response car that followed each race on the first lap. This car was positioned on the track side for the remainder of the race. Medical staff were stationed in each of the two rescue vehicles, which attend every major incident on the track. The remaining practitioners were located at key corners around the circuit. The chief medical officer remained in the medical centre to coordinate medical care and to receive patients.

Table 1 Numbers presenting to the medical centre by patient subgroup

Patient group	1994–1996	2000–2002	p Value
Drivers	230 (62)	130 (39)	<0.001
Motorcyclists	27 (7)	62 (18)	NS
Crowd	82 (22)	103 (31)	–
Mechanics	14 (4)	20 (6)	–
Marshals	19 (5)	21 (6)	–
Total	372	336	

Values are numbers (% of total presenting to the medical centre in that time period). As accurate figures for the total number of crowd, mechanics, and marshals attending during each time period are not available, these data cannot be directly compared.

All rescue personnel and marshals received emergency medical training each year. All injured patients were treated in accordance with advanced trauma life support guidelines, with spinal protection and oxygen.[3] Drivers involved in accidents were initially assessed and stabilised on the trackside and then brought to the medical centre for further assessment. Hospital referral was made for radiographic screening of potential bony injuries and for further assessment and treatment of all seriously injured patients.

During the study periods, participating vehicles included modified road cars, single seat racing cars, and high performance saloon cars as well as motorcycles. The distribution of types of racing vehicles and the regulations relating to their construction did not vary greatly over the two time periods considered.

Proportions were compared using the χ^2 test.

RESULTS

During the first three year study period, car racing took place on 31 days, during which there were 329 races with 6693 drivers starting the races. During the same period, there were three days of motorcycle racing comprising 37 races with 818 starters.

In the second period, there were 33 days of car racing but only 290 races with 6090 starters. Four days of motorcycle racing were held with 47 races and 1575 starters.

Accurate records of the number of spectators were not available, but the circuit management made an estimate of 40 000 spectators a year. The attendance did not alter significantly during the period studied.

During the years 1994–1996, 372 patients attended the medical centre for assessment and treatment. In the years 2000–2002, this number was 336. Table 1 shows comparative numbers in each of the constituent groups (drivers/bikers/mechanics/marshals/crowd). The total number of patients referred to hospital was the same in the two study periods. Forty six patients (12% of attendances) were referred during 1994–1996, and 43 (13%) were referred during 2000–2002. Eleven (3%) of the referrals required admission in the first period, and nine (3%) required admission in the second period (3%). Table 2 lists referral patterns by patient group.

The percentage of car drivers presenting to the medical centre decreased over the two time periods. Between 1994 and 1996, 230 of 6693 (3.4%) of starting drivers presented to the medical centre compared with 130 of 6090 (2.1%) between 2000 and 2002 ($p<0.001$).

The proportion of severely injured patients decreased between the two time periods studied. In the first three years, 57% of hospital referrals were category A cases and 43% were category B or C. In the second three years, these figures were 71% and 29% respectively. These figures were significantly different ($p<0.01$).

There were two category C patients during 2000 and 2002. One sustained a deep laceration to the lower limb, which required surgical debridement, and the other had blunt thoracic trauma and was admitted with bilateral pulmonary contusions. In the first study period, there were nine patients

Table 2 Severity category of those referred to hospital

Injury category	1994–1996				2000–2002			
	Driver	Motorcyclist	Crowd	Other	Driver	Motorcyclist	Crowd	Other
A	17	6	2	2	10	5	4	2
B	4	1	1	0	2	6	3	0
C	9	0	1	1	2	3	4	0
N/A	1	0	1	0	0	2	0	0

N/A, In these cases, the accident and emergency data were not available, therefore a definitive diagnosis allowing categorisation was not possible.

Table 3 Risk of injury for the time periods studied

	1994–1996	2000–2002	p Value
Risk of attending medical centre per car competitor	3.4% (230/6693)	2.1% (130/6090)	<0.001
Risk of category C injury per car competitor	0.1% (9/6693)	0.03% (2/6090)	<0.05
Risk of attending medical centre per motorcycle competitor	3.3% (27/818)	3.9% (62/1575)	NS
Risk of category C injury per motorcycle competitor	0%	0.2% (3/1575)	NS

Values in parentheses are number injured/number of starters.

in category C, all of whom sustained significant injuries. There were two patients with a fractured pelvis, two with fractured ribs, one with a fractured glenoid, and one with a head injury. The other three patients sustained multiple injuries.

The percentage of motorcyclists presenting to the medical centre was comparable in the two periods (27 of 818 (3.3%) starters compared with 62 of 1575 (3.9%)). In the first three years, 86% of the patients referred to hospital were category A cases and 14% were category B or C. In the second three years, these figures were 36% and 64% respectively. These figures were significantly different ($p<0.05$). Between 1994 and 1996, there were no category C patients. In the second time period, there were three patients in this category. Their injuries comprised a displaced ankle fracture, a compound fractured humerus with an associated metatarsophalangeal dislocation, and a fractured femur with an associated shoulder dislocation.

Table 3 gives the risk of any injury or a category C injury per race and per competitor, for both car drivers and motorcyclists.

Spectators accounted for an increasing percentage of the workload presenting to the medical centre (31% in the second time period from 22% in the first time period). The range of presenting complaints was wide but generally minor—for example, headache, insect bites, and twisted ankles. One spectator was admitted during the first period, and four were admitted during the second period. None of these admissions were related to incidents on the track.

The racing support staff (marshals and mechanics) made up 9% of the workload in the first period and 12% in the second. Their conditions were generally minor, although there were some cases of burns and smoke inhalation. Only one of the race support staff required admission during the entire study period. This person suffered a compound, trimalleolar fracture of the ankle after being hit by the car of one of the competitors.

CONCLUSIONS

The introduction of two bends into the fastest part of the racing circuit studied seems to have dramatically improved the profile of injuries sustained by car drivers. The proportion of hospital referrals and hospital admissions can now be favourably compared with the previously cited Brands Hatch study.[1] That study found hospital referral rates of 0.14%, and, after the introduction of the chicanes, we have documented referral rates of 0.2%. Comparable hospital admission rates were 0.05% and 0.03%. A more detailed inspection of the actual injuries occurring at Castle Combe seems to confirm that much less severe injury patterns are now occurring.

What is already known on this topic

Few data are available on the relative safety of motor racing circuit layouts.

What this study adds

This study shows that introducing chicanes into one racing circuit reduced the number of serious accidents to car drivers.

The same track changes seem to have resulted in a tendency for motorcyclists to suffer slightly more serious injuries. Comparing again with the Brands Hatch study, we find hospital referral rates of 0.24% at Brands Hatch and 1% most recently at Castle Combe. The comparable hospital admission rates were 0.08% and 0.19%. The importance of the trend towards increasingly severe injuries among motorcyclists after the introduction of the chicanes is difficult to quantify; the figures obtained are based on a small number of races with few injured motorcyclists. Despite this reservation, the hospital referral and admission rates for motorcyclists during the second period at Castle Combe are higher than those for Brands Hatch, and this aspect of our results probably merits further study.

This study implies that the safety features introduced at the Castle Combe circuit have reduced the incidence of serious injury. The most significant change at the circuit between the two study periods was the inclusion of two chicanes in the track. However, other changes, such as better driving standards, could also have contributed to the reduction in serious injuries.

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