

Is Driving Safe with Upper Limb Plaster Casts?

Üst Ekstremitte Alçıları ile Sürüş Güvenli midir?

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Abstract

Objective: The purpose of this study is to investigate the ability and safety of driving with commonly used upper limb casts, and to determine the effect of hand dominance.

Material and Methods: Two healthy drivers, one of them right-handed and the other left-handed (confirmed with the Edinburgh handedness inventory), were selected. The vehicles used in this study were the 2006 model Volkswagen Golf with a manual-gear right-hand drive with power steering and the 2004 model Honda Civic with an automatic-gear right-hand drive with power steering. We assessed driving ability and safety whilst wearing a scaphoid cast and a Colles cast. Initially, a 20-min driving circuit was completed without immobilisation by each volunteer on a track which was closed to traffic. Six essential driving abilities, namely steering and turning, reversing, gear changing and panel control were assessed subjectively by the drivers. Each of the driving abilities was scored between 0 and 10 points. Each score acquired from the relevant section was added to obtain a total score. Scores taken from each section and the total scores were compared in terms of plaster cast type, gear option, body side and dexterity.

Results: Driving scores were statistically similar regarding dexterity and gear option in total and section scores ($p=0.878$, $p=0.442$). A difference between the Colles cast and the scaphoid cast was only observed in panel control ($p=0.010$). Immobilisation of the left hand significantly decreased the total score ($p=0.001$); however, gear shifting and panel control sections were similar between body sides ($p=0.105$ and $p=0.442$, respectively). All scores obtained from each section were significantly lower compared to controlled driving ($p=0.000$).

Conclusion: Driving with an upper limb cast is unsafe; furthermore, immobilisation of the non-dominant hand does not satisfy the necessary requirements for safe driving. We should discourage patients and warn them about the dangers of driving when wearing an upper limb plaster cast.

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Key words: Driving, fracture, motor car, plaster cast, upper limb

Özet

Amaç: Bu çalışmanın amacı yaygın olarak kullanılan üst ekstremitte alçıları ile araç sürüş yeteneği ve güvenliğini incelemek, sürüş güvenliğine el hâkimiyetinin etkilerini belirlemektir.

Gereç ve Yöntemler: Bir tanesi solak diğeri ise sağlak iki sağlıklı sürücü dominant el indeksi 'Edinburgh handedness inventory' ile doğrulanarak seçildi. Bu çalışmada 2006 model Volkswagen Golf marka manuel vitesli ve hidrolik direksiyonlu bir araç ve 2004 model Honda Civic marka otomatik vitesli ve hidrolik direksiyonlu bir araç kullanıldı. Çalışmada üst uzuv tespitinde en sık kullanılan skafoid alçısı ve Colles alçısı uygulanan sürücülerin sürüş yeteneği ve güvenliği değerlendirildi. Altı temel sürüş yeteneği sürücüler tarafından subjektif biçimde değerlendirildi. Her bölümden alınan puan ve toplam skor, alçı türü, vites seçeneği, alçılanan taraf ve dominant taraf açısından karşılaştırıldı.

Bulgular: Toplam puan ve her sürüş yeteneğinden alınan puanlar, vites seçeneği ve dominant taraf yönünden karşılaştırıldığında benzer bulundu ($p=0,878$ ve $p=0,442$). Colles alçısı ve Scaphoid alçı arasındaki fark sadece panel kontrolünde gözlemlendi ($p=0,10$). Sol elin immobilizasyonu toplam sürüş skorunu anlamlı olarak azaltmıştır ($p=0,001$). Ancak vites değiştirme ve panel kontrolü bölümleri her iki elde benzer bulunmuştur (sırasıyla $p=0,105$ ve $p=0,442$). Her bölümde elde edilen puanlar ve toplam skor, kontrol sürüş puanlarına göre anlamlı şekilde azalmıştır ($p=0,001$).

Sonuç: Üst ekstremitte alçıları ile araç sürüşü güvensizdir, ayrıca non-dominant elin immobilizasyonu güvenli bir sürücü için gerekli gereksinimleri karşılamamaktadır. Hastalarımızı, üst ekstremitte alçısı ile araç sürüşü sırasında oluşabilecek tehlikeler konusunda uyarmalı ve onları o şekilde araç kullanmaktan vazgeçirmeliyiz. (JAEM 2013; 12: 122-5)

Anahtar kelimeler: Sürüş, kırık, araba, alçı, üst ekstremitte

Introduction

Plaster casts are the most commonly used treatment method in the management of upper limb fractures and soft tissue injuries.

Plaster casts usually restrict almost all movement of the immobilised joint, thus alleviating the functions of the limb. On the other hand, many patients, usually young and active ones who are keen to return to their normal lifestyle as soon as possible, ask whether they can



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drive during their fracture treatment. As a result, it is expected that doctors who carry out the treatment will respond to this question and judge the fitness of their patients to drive during treatment.

Survey studies have demonstrated that the majority of patients who have a driver's license drive whilst wearing cast, regardless of whether the doctor has given them advice or not (1, 2). Studies conducted on the doctors found that doctors' knowledge on this issue was very limited and non-standardised (3-5).

Several factors may play a role in the safety of driving with upper limb plaster casts. The patient's driving experience, type of plaster cast, immobilised body side, nature of the injury and type of the vehicle are all factors to be considered. Previous studies have tried to provide an evidence-based answer to these questions (2, 6, 7). However, the effect of hand dominance was not taken into consideration.

We hypothesised that casting the dominant hand would further worsen the driving abilities and deteriorate driving safety more than casting the contra-lateral hand. The purpose of this study is to investigate the ability and safety of driving with commonly used upper limb casts, and to determine the effect of hand dominance.

Material and Methods

Two healthy volunteers who had held a driver's license for 15 years were selected. One of the subjects was right-handed and the other was left-handed, which had been confirmed with the Edinburgh handedness inventory. Neither volunteer had ever been treated with an upper-limb cast or had suffered an upper-limb fracture. The vehicles used in this study were the 2006 model Volkswagen Golf with a manual-gear right-hand drive with power steering and the 2004 model Honda Civic with an automatic-gear right-hand drive with power

steering. We assessed driving ability with the two most commonly used types of upper limb plaster casts: the scaphoid cast (below-elbow plaster in which the thumb is included in the cast up to the distal interphalangeal joint) and the Colles cast (below-elbow plaster with wrist flexion and in ulnar deviation). Initially, a 20-min driving circuit was completed without immobilisation by each volunteer in a track which was closed to traffic. Thereafter, all test drives were conducted by each volunteer using right and left hand plaster casts (both Colles and scaphoid casts), in the manual and automatic geared vehicles in an alternating manner, utilising the same circuit. Six essential driving abilities, namely steering and turning (right turn, left turn, U turn), reversing, gear changing and panel control (indicator, windscreen wipers, lights etc.) were assessed subjectively by the drivers. Each of the driving abilities was scored between 0 and 10 (Score 0 was when the action could not be carried out at all, and score 10 was when the action could be performed without any limitation). The scores acquired from each section were added to reach a total score. Scores taken from each section and total scores were compared in terms of plaster cast type, gear option, body side and dexterity.

Statistical analysis

Mann-Whitney U test and Wilcoxon signed rank test were used for statistical analysis; an alpha level less than 0.05 was considered significant. Descriptive data are presented in tables with means and standard deviations.

Results

Driving scores were statistically similar regarding dexterity and gear option in the total and section scores (Table 1, 2). A difference

Table 1. Comparisons regarding dexterity

	Right turn	Left turn	U turn	Reversing	Gear shift	Panel control	Total score
Right dominant	5.00±0.75	5.50±0.53	5.00±0.75	6.75±3.49	8.62±2.55	4.50±0.53	35.37±4.50
Left dominant	5.37±1.99	5.75±1.38	6.12±2.03	6.25±4.02	8.75±2.31	4.75±0.46	37.00±8.36
p value	0.798	0.721	0.505	0.574	0.959	0.442	0.878

Table 2. Comparisons regarding gear option

	Right turn	Left turn	U turn	Reversing	Gear shift	Panel control	Total score
Manual gear	5.12±1.55	5.62±1.06	5.50±1.69	6.50±3.77	7.37±2.82	4.62±0.51	34.75±5.49
Automatic gear	5.25±1.48	5.62±1.06	5.62±1.59	6.50±3.77	10.00±0.00	4.62±0.51	37.62±7.53
p value	0.878	1.000	0.798	1.000	0.105	1.000	0.442

Table 3. Comparison regarding cast type

	Right turn	Left turn	U turn	Reversing	Gear shift	Panel control	Total score
Scaphoid cast	4.50±1.19	5.25±1.16	5.25±1.75	6.50±3.74	8.62±2.55	4.25±0.46	34.37±6.78
Colles cast	5.87±1.45	6.00±0.75	5.87±1.45	6.50±3.81	8.75±2.31	5.00±0.00	38.00±2.18
p value	0.105	0.161	0.279	1.000	0.959	0.010	0.234

Table 4. Comparisons regarding immobilised body side

	Right turn	Left turn	U turn	Reversing	Gear shift	Panel control	Total score
Right hand	6.25±1.16	6.25±0.88	6.75±1.38	10.00±0.00	7.37±2.82	4.75±0.46	41.37±4.74
Left hand	4.12±0.83	5.00±0.75	4.37±0.51	3.00±0.75	10.00±0.00	4.50±0.53	31.00±2.77
p value	0.001	0.021	0.001	0.000	0.105	0.442	0.001

between the Colles cast and the scaphoid cast was observed only in panel control, since the scaphoid cast makes panel control difficult (Table 3). Immobilisation of the left hand significantly decreased the total score; however, gear shifting and panel control sections were similar between body sides (Table 4). All scores obtained from each section were significantly lower compared to controlled driving ($p=0.000$) (Table 5). All results are summarised in Table 6.

Discussion

This study proved that driving with an upper limb plaster cast significantly worsens driving abilities and driving safety. Plaster cast type, immobilisation of the dominant limb and gear option (automatic versus manual) had statistically similar effects on driving abilities. Left-handed plaster casts complicated the steering manoeuvres more than right-handed plaster casts, independent of dexterity. The reason for this result is believed to be the fact that the left hand is mainly used for steering in right-hand drive vehicles.

The current literature contains a few studies on this subject which compare different type of casts using different assessment methods. Blair et al. (6) compared short-arm plaster casts for Bennett, Colles and scaphoid fractures using a self-assessed test. They found that driving in a Bennett's and scaphoid casts impaired driving but driving in a right Colles cast did not. Therefore, they concluded that the right-arm Colles cast is safe for driving in most cases. Kalamaras et al. (2) compared long-arm casts and short-arm casts using a driving test performed by a driving instructor and a further assessment performed by an occupational therapist. Although individuals failed

the driving tests in the presence of all cast types applied to each body side, the right short-arm cast was deemed sufficient for safe driving by the occupational therapist. Similarly, in our study, right-sided casts achieved better scores compared to left; however, results were still significantly worse than controlled driving and were not deemed safe.

Gregory et al. (7) conducted a study using a driving simulator when wearing a standard short-arm cast in right-handed subjects. They created scenarios which may occur in real traffic flow and tested the response of the drivers to these specific hazards. They demonstrated that upper-limb immobilisation appears to lead to more cautious driving practices during routine rural and urban driving and caused deterioration in driving performance when responding to hazards such as pedestrian crossings. Immobilised drivers had a tendency to travel nearer to the centre of the road, at higher speeds, and to make less steering adjustments than when not immobilised. In certain situations, immobilised drivers were in closer proximity to the hazard before responding appropriately compared with when they were not immobilised. Contrary to previous research, they proposed that immobilisation of the right arm deteriorates driving safety markedly.

On the other hand, all of the previous studies did not consider the effect of hand dominance on driving safety when wearing casts. Hand dominance was not mentioned by Blair et al. (6) and Kalamaras et al. (2), whereas Gregory et al. (7) included only right-hand-dominant subjects to reduce variability. Therefore, it is hard to interpret the effect of hand dominance on driving safety in these previous researches. We failed to prove our hypothesis i.e. the restriction of the dominant hand would deteriorate the driving more than the restriction of the non-dominant hand.

Gregory et al. (7) proposed that immobilisation of the dominant hand or contra-lateral hand differs because limbs are in part controlled by contra-lateral hemispheres, and that the hemispheres are differentially involved in the processing of spatial information and decision making. Consequently, difficulty in controlling the immobil-

Table 5. Comparison with control group

	Total score
Driving without immobilisation	60.00±0.00
Driving with plaster cast	36.18±6.54
p value	0.000

Table 6. Summary of all results (L=Left, R=Right, M=Manual, A=Automatic)

	Dexterity	Gear option	Turn right	Turn left	U turn	Reversing	Gear shift	Panel control	Total score
Scaphoid Right	R dominant	M	5	5	5	10	4	4	33
		A	5	5	5	10	10	4	39
	L dominant	M	6	7	8	10	5	5	41
		A	6	7	8	10	10	5	46
Scaphoid Left	R dominant	M	4	5	4	3	10	4	30
		A	4	5	4	3	10	4	30
	L dominant	M	3	4	4	3	10	4	28
		A	3	4	4	3	10	4	28
Colles Right	R dominant	M	6	6	6	10	5	5	38
		A	6	6	6	10	10	5	43
	L dominant	M	8	7	8	10	5	5	43
		A	8	7	8	10	10	5	48
Colles Left	R dominant	M	5	6	5	4	10	5	35
		A	5	6	5	4	10	5	35
	L dominant	M	4	5	4	2	10	5	30
		A	5	5	5	2	10	5	32

ised arm selectively disrupts particular aspects of information-processing and thus the driver's ability to control the vehicle. We believe that driving a car is learnt as a whole in the same way by similar coordinated movements, regardless of the dexterity of the subject. We observed that both right- and left-dominant subjects use their left hands mostly for steering, and that immobilisation of the left hand deteriorates the steering more than immobilisation of the right.

Our study has some strengths and limitations. We used only two drivers, and the drivers' assessments were subjective, which may limit the power of the data obtained for statistical analysis. However, we used a 0-10 scale for self-assessments, which provided a more detailed and finely-tuned comparison. As the subjects did not have an actual fracture, they did not have avoidance reflex due to the pain caused by the fracture. Moreover, test drives were conducted on a track which was closed to traffic, so may not reflect situations that require sudden decisions and movement, which may occur in reality. Hence, the scores obtained are possibly higher than those that would be obtained in reality. We believe that the immobilisation of an upper limb would worsen the safety of driving in real traffic flow much more than in the test drives.

Conclusion

Driving with an upper limb cast is unsafe; furthermore, immobilisation of the non-dominant hand does not satisfy the necessary requirements for safe driving. We should discourage our patients and warn them about the dangers of driving when wearing an upper limb plaster cast.

Conflict of Interest

No conflict of interest was declared by the authors.

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Author Contributions

Concept - Ö.K.; Design - Ö.K., M.Ç.; Supervision - M.T.; Funding - Ö.K., M.Ç., O.C.; Materials - M.T.; Data Collection and/or Processing - Ö.K., S.G., M.Ç., M.T., O.C.; Analysis and/or Interpretation - Ö.K., S.G., M.T.; Literature Review - S.G., M.T., M.Ç., S.Ö.; Writer - Ö.K., S.Ö.; Critical Review - S.Ö., S.G., O.C., M.Ç., M.T.

Çıkar Çatışması

Yazarlar herhangi bir çıkar çatışması bildirmemişlerdir.

Hakem değerlendirmesi: Dış bağımsız.

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