The Incidence of Combined Facial and Cervical Spine Injuries

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Background: **The association between facial and cervical spine injuries has been documented. However, only severe spinal injuries were included in previous analyses. It was the purpose of this study to evaluate the incidence of and risk factors for these injury combinations including the complete injury spectrum.**

Methods: **Between 1995 and 1997, 4,907 patients with cervical spine injuries were treated at our hospital. One hundred five (2.14%) of these patients had suffered a concomitant facial injury. This group was compared with the group of patients with cervical spine injury but without facial trauma.**

Results: **The majority of cases (98%) consisted of minor lesions to both regions. With increasing severity of cervical spine trauma, the risk for facial injury increased. Age and male gender represent significant ($p < 0.05$) risk factors for combined injuries.**

Conclusion: **Patients sustaining cervical spine trauma have a small but real chance of injuring their face as well. The cervical spine must be examined carefully, whenever facial injuries are present.**

Key Words: **Facial injury, Cervical spine injury, Associated injuries.**

J Trauma. 2001;50:41–45.

Injuries to the spine account for 6.5% to 8.0% of all trauma hospital admissions, representing an incidence of 24 to 40 persons per 100,000.[1] Of these injuries, almost one third are located in the cervical spine.[1] Although the majority of injuries are minor in nature, severe trauma to the cervical spine can result in lifelong physical impairment and dependence. The major causes of cervical spine injuries are sports accidents and motor vehicle crashes, depending on regional variations. Age, gender, and mechanism of injury are factors influencing the magnitude of injury as well as the outcome. Concomitant lesions of the spinal cord can be detected in up to 50% of the cases, most frequently involving the upper and lower cervical spine.[2–4] Laceration of the spinal cord may result in the necessity of lifelong therapy, which is not only a physical challenge but also a major financial burden to individuals and society.[4]

Facial trauma is thought to be one of the most common types of injury accompanying cervical spine injury. Facial trauma by itself can result in an impairment of the ophthalmic, olfactory, and masticatory systems and can lead to esthetic problems. Motor vehicle crashes are the major cause, although injury severity has been reduced dramatically since the introduction of seat belts.[5] Approximately 1% to 4% of all facial injuries are associated with cervical spine lesions.[6–9] Conversely, 15% to 20% of all cervical spine injuries are associated with facial bone fractures.[1,10] These studies, however, focused on severe spinal injuries such as fractures and dislocations and did not include the less severe but more common cervical soft tissue injuries.

The present study represents a large number of cervical spine injuries of varying severity, and investigates their relationship with facial trauma. Additionally, patients with combined facial and cervical spine injuries are compared with a patient collective with isolated cervical spine injuries to determine the statistical patterns of combined facial trauma and cervical spine injury.

PATIENTS AND METHODS

Patients

At our hospital, patient information has been gathered and stored in a custom-designed database since 1994. This system allows for analyses and searches for various parameters. Between January 1, 1995, and December 31, 1997, 4,907 patients (4.2% of all patients evaluated during this time period) were treated after cervical spine trauma of varying magnitude. One hundred five (2.1%) of these had additional facial injuries (study group). This patient collective was compared with 4,802 patients with cervical spine injuries but without facial trauma (control group). Both groups were analyzed and compared with respect to age and gender. Associated injuries and injury mechanisms were assessed in detail in the study group.

Classification of Injuries

The severity of both facial and cervical injuries was classified as either simple or uncomplicated, or as severe or complicated. Uncomplicated facial injuries included contu-

Submitted for publication July 28, 2000.

Accepted for publication September 27, 2000.

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sions, hematomas, and superficial and deep skin and mucosa lacerations, whereas facial bone fractures and dentoalveolar trauma were categorized as complicated injuries. Neck sprains, most commonly as a result of whiplash-type injuries, were classified as simple injuries to the cervical spine, whereas fractures, dislocations, and combinations thereof were classified as severe. This classification system offers four possible injury combinations (Table 1).

Statistics

Patient characteristics were analyzed using descriptive statistics. Comparisons between study and control groups were performed with χ^2 tests, Fisher's exact test, and Mann-Whitney U test, as appropriate. This was followed by a logistic regression analysis determining independent factors for the occurrence of facial trauma. The final regression model included age, gender, and type of spinal injury. Odds ratios and their 95% confidence intervals were calculated to represent the relative risk of the variables.

RESULTS

Age and Gender

Within the combined injury study group, age distribution peaked in the third decade. Those under 20 years of age were almost unaffected for combined injuries, whereas for those over 30 years of age, the risk for combined and isolated cervical spine injury was similar. The mean age in the study group was 41.8 ± 19.3 years, with male patients being slightly older than female (Fig. 1). The mean age (32.8 ± 15.5 years) in the control group (cervical spine injury only) was significantly ($p < 0.05$) lower.

There was a significant difference ($p < 0.05$) in gender distribution between the two groups. Male patients predominated in the study group (75.2% male vs. 24.8% female), whereas an almost equal distribution between male and female patients was found in the control group (50.9% vs. 49.1%).

Cause of Injuries

In both groups, motor vehicle crashes (44.8%), followed by sports injuries (21.9%), were the major cause of injury. With the exception of category 2, where sports injuries predominated, motor vehicle crashes were the dominant cause for combined facial and cervical spine injuries (Fig. 2).

Cervical Spine Injuries

Of the 105 study group patients, 93 (88.6%) sustained a minor cervical spine injury and 12 (11.4%) suffered a major cervical spine injury. Seven of 11 cervical spine fractures (in 10 patients) were located in the upper part of the cervical spine and 4 in the lower part. A dislocation was diagnosed in two patients, one between C2/C3 and the other between C6/C7 (Fig. 3). In the control group, only 2.4% of the injuries were categorized as severe. The difference between the two groups was significant ($p < 0.05$).

Facial Injuries

More than two thirds of all injuries in the study group were categorized as mild or uncomplicated. Thirty-four patients (32.4%) suffered fractures of one (26 patients) or more (8 patients) facial bones. The nasal bones were the most frequent location of these fractures (23 of 34), followed by fractures of the orbital wall. Three patients (2.9%) sustained dentoalveolar trauma.

Table 1 Classification of Injury Combinations

Category	Cervical Spine Injury	Facial Injury
1	Simple	Simple
2	Severe	Simple
3	Simple	Severe
4	Severe	Severe

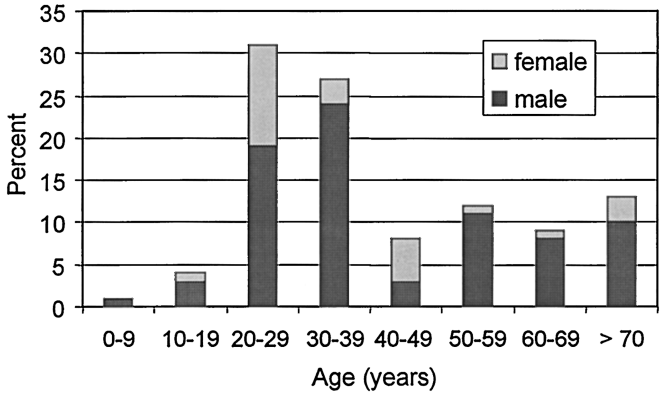

Fig. 1. *Distribution of age and gender within the study group.*

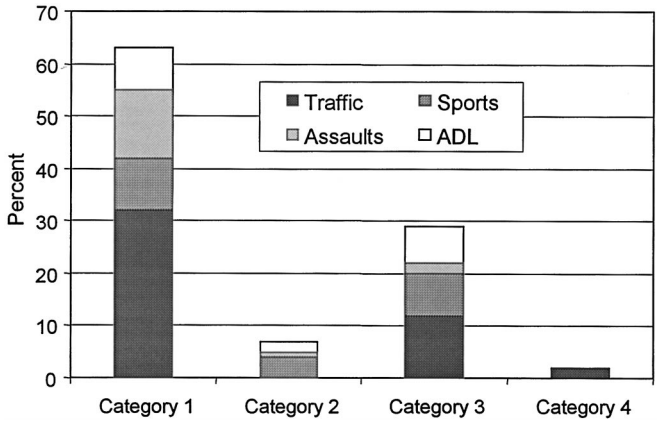

Fig. 2. *Causes of combined facial and cervical injuries with respect to the different categories. ADL, activities of daily living.*

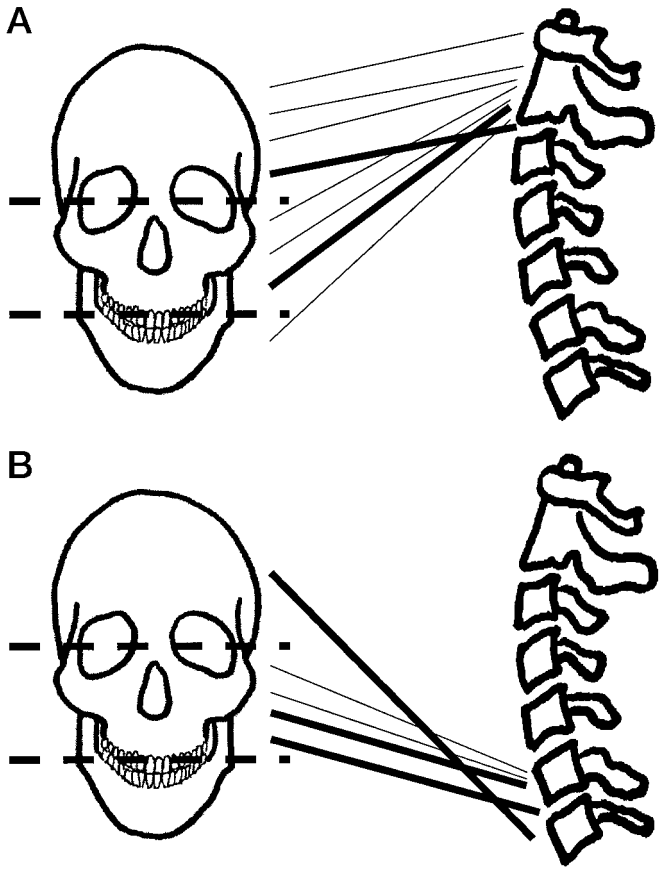

Fig. 3. *(A) Locations of fractures (n = 7) and dislocations (n = 1) of the upper cervical spine and their relationship to facial injuries.* Thick lines *represent severe injuries of both cervical spine and face.* Thin lines *represent combinations of severe cervical spine injury and simple facial injuries. (B) Locations of fractures (n = 4) and dislocations (n = 1) of the lower cervical spine and their relationship to facial injuries.* Thick lines *represent severe injuries of both cervical spine and face.* Thin lines *represent combinations of severe cervical spine injury and simple facial injuries.*

Combinations of Facial and Spinal Injuries

The vast majority of study group patients had combinations of simple facial and cervical spine injuries (categories 1, 2, and 3). Only five patients suffered severe injuries to both regions (category 4).

Additional Injuries

Additional brain injuries, mainly concussions, were present in 16 patients. In the case of minor injuries to the cervical spine or face, as well as combinations thereof, the risk of brain injury was either 0% (category 2) or less than 20% (categories 1 and 3**)** in this study. If a combination of severe injuries was present (category 4), additional brain injuries were found in 60% of cases (Fig. 4).

Lacerations of the skull or locations other than the facial regions were present in 22.9% of the study group patients. No additional cranial fractures (other than in the maxillofacial

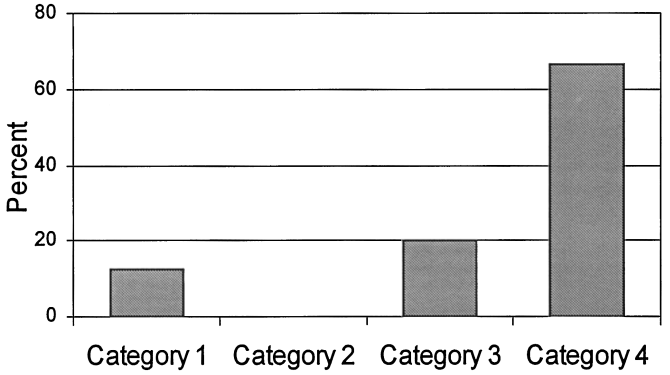

Fig. 4. *Percentages of associated brain injuries with respect to the different categories.*

regions) were found. In five cases, facial and cervical spine injuries were part of multiple injuries, with additional injuries distributed similarly between extremities and trunk.

Regression Analysis and Risk Assessment

Compared with an almost equal gender distribution in the control group, the study group showed a much higher presence of male patients. The risk of women to sustain a combination injury is therefore about 65% (adjusted odds ratio, 0.35; 95% confidence interval) lower than for men. Age was an important risk factor, with an increasing risk of 2.8% per year for combined injuries compared with isolated spine injuries. If a severe cervical spine injury (fracture or dislocation) was present, the risk for facial injuries was found to be increased 3.5-fold (Table 2).

DISCUSSION

The results of our study suggest that patients who sustain cervical spine injuries have a small but real chance of injuring their face as well. It further characterizes the 20- to 30-year-old male age group as a population at risk for this injury combination. The study revealed that the presence of a cervical spine fracture or dislocation coincides with a fivefold increase in occurrence of a facial injury compared with a simple cervical spine injury. The combination of severe facial and cervical spine injuries, although rare in the overall patient collective, has a high incidence of associated brain injury.[11]

Clinical diagnosis of cervical spine injuries is difficult, especially if signs are masked by those of facial injuries, shock, or intracranial lesions. In the overall spectrum of cervical spine injuries, fractures and dislocations represent only a minor fraction. The majority of injuries consists of less severe soft tissue injuries. Most investigators[1,2,4] did not include the latter in their analyses of injury combinations. Although most patients recover fully within a few weeks from neck injuries that involve strain or sprain to the soft tissues of the cervical spine, about one third of patients with whiplash injuries will have prolonged disability.[12] Furthermore, whiplash injuries represent a major part of medicolegal

Table 2 Concomitant Facial Injuries

	Facial Injury		Significance, Crude	Odds Ratio, Adjusted	Odds Ratio, 95% CI	Significance, Adjusted
	Yes	No				
Age (y)	41.8 ± 19.3	32.8 ± 15.5	$p < 0.0001$	1.028	1.018–1.039	$p < 0.0001$
Sex						
Female	26 of 105 (24.8%)	2,355 of 4,802 (49.1%)	$p < 0.0001$	0.35	0.223–0.549	$p < 0.0001$
Male	79 of 105 (75.2%)	2,445 of 4,802 (50.9%)				
Spinal injury						
Simple	93 of 105 (88.6%)	4,685 of 4,802 (97.6%)	$p < 0.0001$	3.293	1.714–6.327	$p < 0.001$
Severe	12 of 105 (11.4%)	117 of 4,802 (2.4%)				

issues,[12,13] and they are responsible for a high number of missed work days.[14] Therefore, it is important for these injuries to be included in a comprehensive evaluation of cervical spine trauma.

Injuries to the cervical spine are commonly the result of indirect trauma, with hyperflexion, hyperextension, and axial compression representing the main mechanisms.[15] Facial injuries, conversely, are commonly the result of direct trauma. In car crashes, which are responsible for a high number of both injuries, three factors determine the injury patterns: use of a seat belt, the magnitude of impact, and the properties of the steering wheel.[16–19]

Injury combinations involving both the facial and the cervical regions can be analyzed from two different viewpoints: cervical injuries accompanying facial injuries and vice versa. Both aspects are of great importance (with the latter being more the trauma surgeon's point of view and the former favoring the interest of a maxillofacial surgeon). Most of the time, however, maxillofacial injuries are more obvious, and the task is to avoid missing an accompanying spinal injury.

Sinclair et al.[9] reported injuries to the cervical spine in the presence of facial injury to be 4%. In their patient collective of 168 facial injuries, they found associated head injuries in 85%. In the study by Beirne et al.,[7] the incidence was only 1.04%, and Lalani and Bonanthaya[20] found an incidence of 3%. The latter report further described characteristic injury patterns for cervical spine and facial injuries with respect to location. Injuries to the upper segments of the cervical spine were associated with lesions of the lower third of the face (mainly fractures of the mandibula), whereas injuries to the lower segments of the cervical spine were associated with facial injuries in the middle third. However, although there is only a low incidence (approximately 1–4%) of cervical spine injuries in the presence of facial injuries, all investigators emphasize the importance of exact clinical and radiographic examination of the cervical spine.

Only a few reports have analyzed the frequency of facial injuries associated with injuries to the cervical spine. In a retrospective analysis of 982 patients with injuries to the cervical spinal cord, Lewis et al.[21] found additional facial soft tissue injuries and fractures in 14% and 8.6%, respectively. In accordance with Lalani and Bonanthaya,[20] they also detected a similar pattern with respect to location of either facial or cervical spine injuries. Our results, as well as the results of other investigators,[7,10,16] do not support the finding of definitive injury patterns for cervical spine injury and varying hard or soft tissue facial injuries.

The results of our study indicate that, if facial injuries are present, a high index of suspicion must be maintained and the cervical spine has to be examined by an experienced clinician. Attention has to be given not only to the detection of fractures and/or dislocations, but also to the less severe but nevertheless important soft tissue injuries. If radiographic evaluation is difficult, or in the case of an unconscious patient with facial trauma, we strongly recommend computed tomographic scan.[22]

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