

## Maxillofacial Fractures. Analysis of demographic distribution and treatment in 2901 patients (25-year experience)

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**SUMMARY.** Introduction: The aim of this study was to analyse retrospectively the demographic distribution, treatment modalities, and complications of maxillofacial fractures in 2901 patients treated in this department in Southeast Anatolia between 1978 and 2002. In addition, the use of internal fixation was evaluated in an effort to determine whether there were changes in using internal fixation techniques. Patients and methods: Two thousand nine hundred and one cases of facial trauma were assessed according to age, sex, and aetiology, in addition to the distribution of the fractures relating to facial bones and seasons. Results: It was found that facial fractures were most frequent in males (77.5%) and in the 0-10 year age group; they tended to be more frequent during summer (36.3%); and traffic accidents were the most common aetiological factor (38%). 77.9% of cases were treated with conservative methods, and 22.1% with one or more internal fixation techniques. The most favoured technique was miniplate osteosynthesis; the complication rate associated with internal fixation was 5.7%. Conclusion: Currently there are many techniques to be used in treating maxillofacial trauma. However, the experience of the surgical team is also an important factor in achieving satisfactory functional and aesthetic results, and in minimizing complications. © 2004 European Association for Cranio-Maxillofacial Surgery

**Keywords:** Maxillofacial fractures; Demographic distribution; Conservative treatment; Internal fixation

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### INTRODUCTION

Maxillofacial trauma is frequent and requires diagnosis of fractures and soft-tissue injuries, sometimes emergency intervention, and appropriate treatment (Tanrikulu, 1997). Today the number of individuals suffering trauma is missing due to increased participation in social life, advancing technology, the continuing rise in traffic, and the failure to take preventive measures in traffic, particularly in developing countries. Each year more patients are admitted to hospital with facial trauma (Tanrikulu, 1997).

Since the 1980s, this department has been the only facial trauma centre serving the Southeast Anatolia region of Turkey. The population is mostly rural with approximately 7 million inhabitants. Many patients are treated for facial trauma (either as out-patients or as in-patients); most often in the summer, hence the opportunity to assess postoperative outcomes of a large number of cases.

There are many studies in the literature in which the demographic distributions of facial trauma patients are analysed according to various criteria (van Hoof et al., 1977; Güven, 1988; Güven, 1992; Erol and Ozer, 1996; Anwar, 1998; Bo et al., 1998; Erol et al., 1998; Iida et al., 2001; Iida and Matsuya, 2002; Gassner et al., 2003). The aim of the present study was not only to compare these statistical data with

those of other populations and countries, but also to analyse the treatment modalities (internal fixation in particular), determine changes in the techniques favoured during the study period (1978–2002) and consider the reasons for these changes. Another aim of this study was to share 25 years of experience.

### PATIENTS AND METHODS

The basis of this study was the data obtained from the medical records of patients seeking treatment for oro-facial trauma in the Department of Oral and Maxillofacial Surgery at the University of Dicle, Faculty of Dentistry. This department has served as the facial trauma center for Turkey's Southeast Anatolia region, since 1978. Two thousand nine hundred and one out of 3140 patients presenting with maxillofacial trauma were included in the study: 239 were not included since it was not possible to obtain complete data. Parameters assessed included not only age, sex, and aetiology, but also season and facial bones involved. In addition, the treatment modalities were analysed. Those were figure of 8 wire ligature, arch bar, hook traction, elevation of the zygomatic bone with a temporal or oral approach; cases followed with no treatment; and various internal fixation techniques such as wire and titanium miniplate (Martin-Champy®; Medicon®),

Leibinger<sup>®</sup>; Normed<sup>®</sup>, all of Germany and Osteomed<sup>®</sup>; USA), circumosseous skeletal fixation, reconstruction plates, and titanium mesh. Internal fixation was analysed according to the technique chosen, the facial bones involved, and complications encountered. Of the internal fixation techniques using miniplates, the following methods were noted: intraoral approach, together with transbuccal approach where necessary; plus lateral eyebrow and infraorbital rim approach for zygomatic, orbital and maxillary fractures.

Furthermore, in order to determine whether there was any change in the internal fixation techniques applied over the years, the 25 year study period was divided into 5-year intervals (1978–1982, 1983–1987, 1988–1992, 1993–1997, and 1998–2002), and the number of internal fixation cases in each period was analysed separately.

## RESULTS

### Demographic Distribution

Two thousand nine hundred and one patients received treatment for maxillofacial trauma from 1978 to 2002. The majority of facial fracture patients were male (77.5%, female: 22.5%). The age decades in which fractures were most common were, in decreasing order of frequency, 0–10 (801 patients, 27.6%), 21–30 (750 patients, 25.8%), and 11–20 (555 patients, 19.1%; Table 1).

Analysis of seasons revealed that trauma occurred most frequently in summer (1054 cases, 36.3%), followed by autumn (752 patients, 25.9%) and spring (644 patients, 22.2%). Trauma occurred least during winter (451 patients, 15.5%).

The most common aetiological factor was traffic accidents (1104 patients, 38%), followed closely by falls (1065 patients, 36.7%); the least common was sports accidents (33 patients, 1.1%; Table 2).

Regarding facial bones involved and fracture types, it was found that the great majority of cases were isolated injuries (2608 cases, 89.9%). Mandibular fractures were most common (2111 cases, 72.8%), while mandible–maxilla fractures were the most common type of combined injuries (112 cases, 3.9%; Table 3).

**Table 1** – Age distribution of 2901 maxillofacial fracture patients

Age	Number of cases	%
0–10	801	27.6
11–20	555	19.1
21–30	750	25.8
31–40	424	14.6
41–50	196	6.7
51–60	120	4.1
<60	55	1.9
Total	2901	99.8

**Table 2** – Aetiology of maxillofacial fractures in 2901 patients

Aetiology	Number of cases	%
Traffic accident	1104	38
Fall	1065	36.7
Assault	299	10
Gunshot wound	178	6.1
Kick by animal	142	4.9
Work accident	48	1.6
Sports accident	33	1.1
Others	32	1.1
Total	2901	99.5

**Table 3** – Distribution of 2901 cases with maxillofacial fractures according to facial bones and types of fracture

Facial bones and types of fracture	Number of cases	%
Isolated fractures	2608	89.9
Mandible	2111	72.8
Maxilla	267	9.2
Zygoma	230	7.9
Combined fractures	293	10.1
Mandible + maxilla	112	3.9
Mandible + zygoma	47	1.6
Maxilla + zygoma	46	1.6
Mandible + maxilla + zygoma	88	3
Total	2901	100

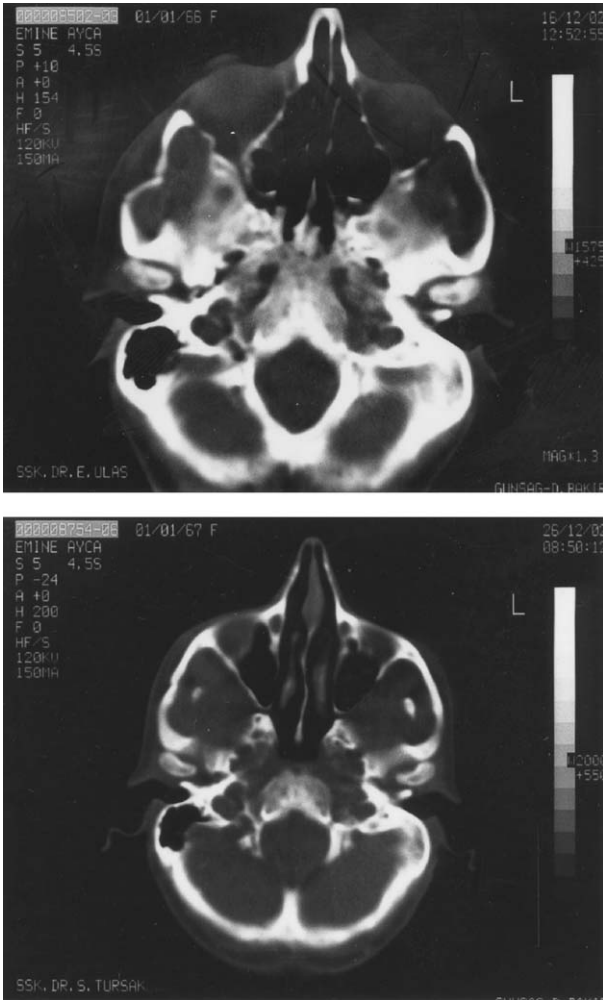
### Treatment

Six hundred and forty-two cases (22.1%) were treated with internal fixation techniques. The great majority of the remaining 2259 cases (77.9%) were treated with arch bars, while in some cases, intermaxillary fixation was used with figure of 8 ligatures. In stable zygomatic fractures or isolated zygomatic arch fractures, hook traction and elevation by Gillies' (Gillies *et al.*, 1927) or Keen's (Keen, 1909) methods were used (Fig. 1). In a small number of cases, no surgical treatment was carried out, and patients were given advice (oral fluid diet, periodic reviews) and followed-up.

The treatment modality chosen in 44.5% of the 642 cases treated with internal fixation was miniplate osteosynthesis, followed by wire osteosynthesis in 133 cases (20.7%) and skeletal wire fixation (circummandibular, circumzygomatic, or zygomatico-frontal process) in 124 cases (19.3%; Table 4; Fig. 2).

The treatment criteria in children were: (1) to avoid open reduction and rigid fixation as much as possible, (2) using only short-term immobilisation if possible, (3) giving priority to circumzygomatic and circummandibular suspensions in acrylic splint support.

The distribution of internal fixation techniques according to the facial bones affected was as follows: mandibula (380 cases, 59.2%), zygoma (121 cases, 18.8% maxilla (56 cases, 8.7%), and combined facial bones (84 cases, 13.1%; Table 5; Fig. 3).



**Fig. 1** – Pre- and postoperative CT of patient with zygomatic arch fracture treated by intraoral approach.

**Table 4** – Distribution of 642 cases treated by internal fixation according to treatment modalities

Methods of internal fixation	Number of cases	%
Miniplate	286	44.5
Wire osteosynthesis	133	20.7
Circum-osseous skeletal fixation	124	19.3
Combined internal fixation	85	13.2
Reconstruction plate	9	1.4
Titanium mesh	5	0.8
<b>Total</b>	<b>642</b>	<b>99.9</b>

In long-term follow-up of miniplate techniques (286 cases), it was found that the plate came out in 5 cases, broke in 4, and allergic reactions developed in 2 cases (total 11 cases; [Table 6](#)).

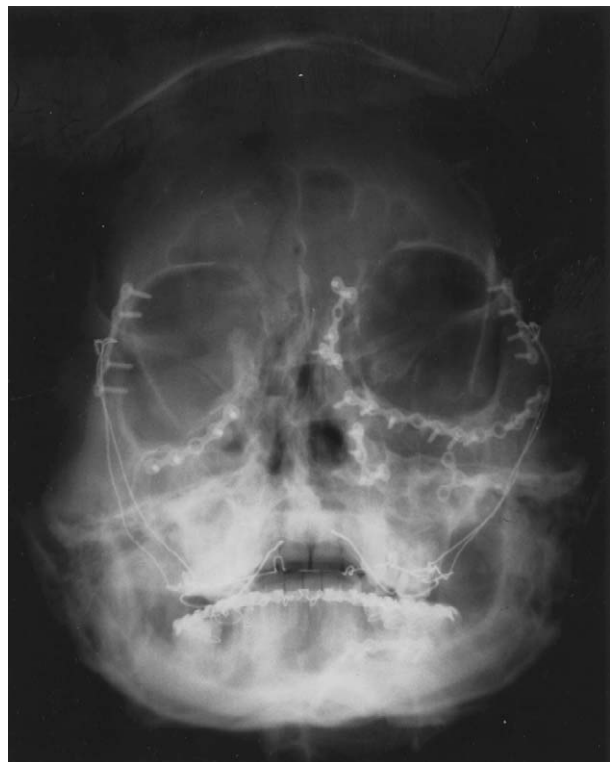
Other complications were associated with special aetiological factors (gunshot and traffic accidents in particular) or delayed treatment for any reasons (neurological injury, economic problems, etc.). They included a wide range, from mild residual deformity



**Fig. 2** – Radiograph of patient treated with circummandibular and circumzygomatic wires.

**Table 5** – Distribution of 642 cases treated by internal fixation according to facial bones

Facial bones	Number of cases	%
Mandible	380	59.2
Maxilla	56	8.7
Zygoma	121	18.8
Combined	84	13.1
<b>Total</b>	<b>642</b>	<b>99.8</b>

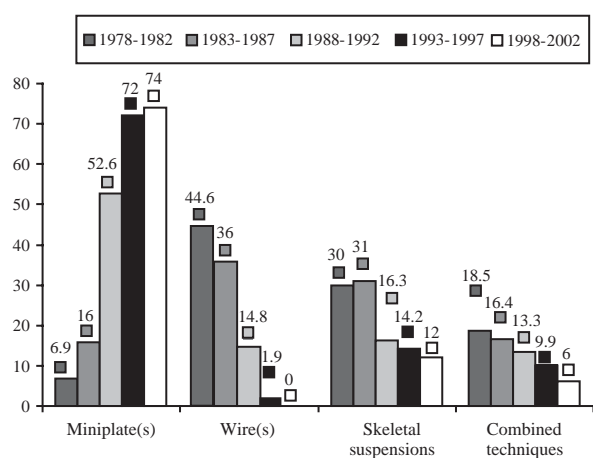


**Fig. 3** – Radiograph of patient with panfacial fractures treated with combined internal fixation modalities.

**Table 6** – Distribution of 37 cases with complications following internal fixation (642 cases)

Complications	Number of cases	% (n = 642)
Plate came out by itself	5	0.8
Plate broke	4	0.6
Allergy	2	0.3
Mild residual deformity	5	0.8
Telecanthus	3	0.5
Lower eyelid emphysema	4	0.6
Stenson's duct fistula	1	0.1
Infections and opening soft-tissue flaps	7	1.1
Cold feeling	6	0.9
Total	37	5.7

n: Patients with internal fixation

**Fig. 4** – Comparison of internal fixation methods applied during each 5 year period.

of the zygoma (5 cases), telecanthus (3 cases) to lower eyelid emphysema (4 cases), Stenson's duct fistula (1 case), and postoperative infection and soft-tissue flaps dehiscence (7 cases). In addition, 6 of the zygomatico-orbital fracture patients who underwent miniplate osteosynthesis described a 'cold feeling' associated with the miniplates lateral to the eye in cold weather in the late postoperative period. The overall incidence of complications associated with internal fixation techniques was 5.7% (37 cases; Table 6).

Evaluation of internal fixation techniques in 5-year periods revealed that the use of miniplate osteosynthesis increased markedly (from 6.9% in 1978–1982 to 74% in 1998–2002). In contrast, wire osteosynthesis rapidly decreased over the years. (44.6% in 1978–1982 and 0% in 1998–2002; Fig. 4).

## DISCUSSION

A large number of studies have been done on the aetiology of maxillofacial trauma (Adekeye, 1980; Brown and Cowpe, 1985; Abiose, 1986; Adi et al.,

1990; Torgersen and Tornes, 1992; Erol and Ozer, 1996; Anwar, 1998; Bo et al., 1998; Erol et al., 1998; Ugboko et al., 1998; Gassner et al., 2003). Studies performed worldwide show that traffic accidents are the prime cause of facial trauma (Adekeye, 1980; Abiose, 1986; Erol and Ozer, 1996; Anwar, 1998; Bo et al., 1998; Erol et al., 1998; Iida et al., 2001). In some developed countries, traffic accidents occupy a lower rank in aetiological frequency (Nakamura and Gross, 1973; Brown and Cowpe, 1985; Adi et al., 1990; Torgersen and Tornes, 1992). Abiose (1986) found that 81.4% of his cases were from traffic accidents, whereas Nakamura and Gross (1973) found this cause to be only 17% in facial trauma. Komisar et al. (1991) and Tanaka et al. (1994) attributed the different rates of facial trauma from traffic accidents to the use of seatbelts. However, there may be other factors involved in developed countries such as safer construction of roads, more effective law enforcement (especially for speeding and drunk driving), and the development of subways.

In another study carried out in this department including 1172 patients from 1978 to 1990, the incidence of traffic accidents in the aetiology of facial trauma was found to be 40% (Erol and Ozer, 1996). In the present study, it was noted that their incidence whilst decreasing is still a the most common factor.

Another significant aetiological factor was falls (36.7%). In survey of the literature, we did not find such high rates in other studies (Anwar, 1998; Bo et al., 1998; Iida et al., 2001). The great majority of this 36.7% comprised falls from housetops. In the rural district of Southeast Anatolia, it is common for people to sleep on the flat housetops (resembling a terrace) during summer and autumn because of the extreme heat. Falls from housetops during the night caused a number of injuries in addition to facial trauma, especially in children. In many studies, it has been reported that the age group in which fractures were most common was 21–30 years (Nakamura and Gross, 1973; Adekeye, 1980; Tanaka et al., 1994). In contrast, the most common age group for facial trauma in the present study was 0–10 years (27.6%), and it is believed that this difference can be explained by the habit of sleeping on housetops.

Of the 2901 patients in this study, only 642 (22.1%) were treated with one or more internal fixation techniques, while the great majority of the remaining 2259 cases were treated conservatively.

Arch bar fixation is a simple, economical method used for treating maxillary and mandibular fractures, can be performed in 15–20 min without creating stress for the patient, and yields satisfactory clinical results provided that it is indicated. On the other hand, disadvantages include significant weight loss due to IMF. Adverse effects are obvious on the patient's social and professional life due to speech difficulty and it is considered to be a contributing factor in the development of pulmonary atelectasis. Lastly dental and periodontal complications may be caused by difficulties in maintaining dental hygiene (Hayter and Cawood, 1993; Aframian-Farnad et al., 2002). One

study shared that periodontal disease following arch bar use had healed after 1 year at the latest (*Thor and Andersson, 2001*).

Over a 25-year period, approximately 2000 patients were treated conservatively by arch bars (intermaxillary fixation) in this department. No complications concerning fracture healing were encountered in any of these patients. However, this method was not used for comminuted fractures and cases with extreme dislocation. In addition, internal fixation techniques tended to be favoured for mandibular angle fractures in which displacement of the posterior fragment occurred due to muscle action (*Passeri et al., 1993; Uglesic et al., 1993*) and to avoid dislocation, malocclusion and possible facial asymmetry. In fractures resulting from gunshot injuries causing minute fragmentations in the bone, open reduction was avoided if possible (in cases without defects or in which bone continuity was not entirely disrupted). In cases with bone defects and in whom internal fixation was unavoidable, periosteal dissection was avoided as much as possible in fragmented areas in order to prevent further ischaemia and osteomyelitis. Other fractures not internally fixed were those of the zygoma and its arch. In such cases, hook traction or elevation with an oral or temporal approach were chosen. These techniques are quite quick, comfortable, and generally satisfactory. However, in one case with an isolated, comminuted fracture of the zygomatic arch, trismus persisted for 3 months post-operatively, but resolved with exercises.

Miniplates were the most favoured osteosynthesis method (44.5%). Their advantages are both technical and functional (*Hayter and Cawood, 1993*). Functional advantages include rapid improvement of jaw opening and biting strength, in addition to benefits already listed (*Hayter and Cawood, 1993*). Technical advantages include ease of application, stability and biomechanical compatibility, monocortical and transoral application (*Hayter and Cawood, 1993*). Miniplate fixation is also effective in minimizing complications following zygomatic fractures (*Passeri et al., 1993; Uglesic et al., 1993; Rohrich and Watumull, 1995*).

However, there are also certain disadvantages, such as loosening of plates and screws, and the inability to use orthopaedic forces postoperatively with intermaxillary fixation (*Hobar, 1992*). As post-operative compensation with maxillo-mandibular elastics is extremely difficult, it is important to achieve an ideal occlusion when applying rigid fixation, since the incidence of malocclusion is higher after miniplate application than when only using arch bars (*Lidqvist et al., 1986; Dodson et al., 1990; Hobar, 1992*). In this 2901-patient series, miniplate osteosynthesis was performed in a total of 286 cases, and complications were seen in 11 of these cases.

Another noteworthy point is the progressive abandonment of wire osteosynthesis, (44.6% in 1978–1982, 0% in 1998–2002), whilst the use of miniplate osteosynthesis increased markedly (6.9% in 1978–1982, compared with 74% in 1998–2002).

However, despite the great professional and commercial interest in miniplate osteosynthesis we think that conservative treatment should not be forgotten and other skeletal fixation techniques should not be overlooked when indicated. For example, in cases of maxillary and orbital fractures, circumzygomatic or frontozygomatic fixation applied to the maxilla is a valuable treatment modality in addition to miniplate fixation applied to the zygoma and mandible, for ideal restoration of facial aesthetics and, in particular, occlusion.

## CONCLUSION

Traffic accidents were the most common aetiological factor in maxillofacial trauma, isolated fractures were the fracture type encountered most often (89.9%), and the mandible was involved most frequently (72.8%). The great majority of fractures (77.5%) occurred in males and in the 0–10 age group. Miniplate osteosynthesis was the most widespread of the internal fixation techniques.

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