The Treatment of Fractures of the Mandible

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■ *One hundred and eleven cases of mandibular fracture in 67 patients who were seen at the San Francisco General Hospital from 1960 to 1962 were reviewed.*

With the exception of two cases in which displaced fragments interfered with the mandibular range of motion, condylar fractures were successfully treated with closed reduction. Undisplaced fractures of the angle were treated successfully by intermaxillary fixation alone, but the significantly displaced fractures were treated by open reduction and interosseous wire fixation. Fractures of the anterior body and midbody were usually treated with closed reduction if adequate teeth were present for satisfactory intermaxillary fixation. Some fractures of the anterior body, particularly those in the region of the symphysis require open reduction because of the strong pull of the muscles in that area.

In this series of patients, clinical infection and non-union were most commonly associated with fractures communicating with teeth. If open reduction is necessary, the results in this series suggest that it should be delayed until the oral tract left by extraction is healed.

Prophylactic antibiotics did not appear to be of value in preventing infection or non-union in this small series of patients, although sufficient data were not available for a statistical conclusion.

THIS PRESENTATION is a review of experience with 111 mandibular fractures in 67 patients with regard to the indications for open reduction, the use of antibiotics, and the management of teeth in the line of fracture. The material of the study was drawn from 260 patients with acute maxillo-facial fractures who were admitted during the past three years at the San Francisco General Hospital — 260 with acute maxillo-facial fractures. One hundred and forty-six of these patients were treated on the University of California Plastic Surgery Service (Table 1). In this latter group, there were 78 patients with fractures of the mandible. Eleven of these 78 patients were deleted from the study, seven because they were lost to follow-up before treatment could be evaluated and

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Submitted December 16, 1963.

four because medical contra-indications prevented procedures to immobilize the fractures.

Thirty-five of the 67 patients in this study had bilateral fractures. Five patients had two fractures on the same side and two patients had three separate fractures. Fifty of the patients were male; 17 were female. The average age of the patients was 34 years. Forty patients were injured in fights, 13 in automobile accidents, three in falls, and 11 in miscellaneous or unknown incidents. Concomitant injuries are shown in Table 2.

Condylar Fractures

There were 20 condylar fractures in 20 patients (Table 3). Eighteen of these patients were treated with closed reduction by intermaxillary fixation which brought and held the teeth in normal occlusion for four weeks. Early guided motion was allowed to prevent ankylosis at the temporomandibular joint. Satisfactory functional results were obtained in all of these 18 patients, supporting the belief that condylar fractures (with the exception of those that lock the temporomandibular joint) can be effectively treated by intermaxillary traction alone.[1,5] Two patients were treated with open reduction. In both cases the condylar head was greatly displaced, in one patient to the extent that it prevented movement of the jaw. In the latter case the condylar head was resected. Results were satisfactory in both patients.

Fractures of the Mandibular Angle

Thirty-two patients had a total of 36 fractures of the angle of the mandible. Seventeen of these fractures were treated with closed reduction utilizing intermaxillary fixation for six weeks. These 17 fractures healed. Nineteen fractures were treated by open reduction with interosseous wiring in addition to intermaxillary fixation. In 16 of these 19 fractures there was displacement of the bones. In the three cases in which the bones were not displaced, the patients were edentulous. In one of the 19 cases in which open reduction was used, non-union developed. The remaining fractures healed satisfactorily (Table 3).

Our approach to fractures of the angle is governed by whether or not there is a significantly displaced posterior fragment that canot be controlled by closed reduction. In the majority of displaced fractures of the angle, no tooth is present in the posterior fragment and muscle is interposed in the fracture. These displaced fractures are treated with open reduction.

Midbody Fractures

There were 25 midbody fractures in 19 patients. Four fractures were treated with closed reduction and these healed. Twenty-one fractures were treated with open reduction and interosseous wiring. Nineteen of these fractures were in edentulous patients and the two remaining were in patients with multiple, displaced mandibular fractures that were not otherwise reducible. In two of the patients treated with open reduction infection developed and the fractures did not unite. The remaining 19 fractures healed satisfactorily (Table 3).

The most important factor in determining the treatment of fractures of the midbody of the mandible is the presence of teeth. If one segment of the fractured jaw is edentulous, significant displacement may be difficult to reduce and the reduction may be difficult to maintain. On the other hand, considerable displacement of a midbody fracture in a patient with teeth can usually be reduced by closed manipulation and intermaxillary fixation.

Fractures of the Anterior Body

Thirty fractures of the anterior body occurred in 30 patients. Twenty-four of these fractures were

TABLE 1.—*Incidence of Maxillo-Facial Fractures Seen in the San Francisco General Hospital,* 1960-1962*

Location of Fracture	*Number of Patients*
Mandible	65
Mandible, maxilla-zygoma	8
Mandible, maxilla-zygoma, nose	3
Mandible, nose	2
Maxilla-zygoma	52
Maxilla-zygoma, nose	7
Nose	8
Frontal bone	1
Total	146

*Plastic Surgery Service, University of California Medical School.

TABLE 2.—*Incidence of Associated Injuries in Patients with Mandibular Fractures*

Associated Injuries	*Number of Patients*
Other facial fracture	12
Fracture of the skull	5
Fracture of an extremity	10
Laceration	22

TABLE 3.—*Results of Closed and Open Reductions of Mandibular Fractures*

Location of Fracture	*Number of Fractures*				
	Total	*Closed Reduction*	*Open Reduction*	*Healed*	*Non-Union*
Condylar	20	18	2	20	0
Angle	36	17	19	35	1
Midbody	25	4	21	23	2
Anterior body	30	24	6	26	4
Total	111	63	48	104	7

treated with closed reduction and non-union developend in three instances. Six of the fractures of the anterior body were treated with open reduction and interosseous wiring; non-union developed in one. The remaining fractures healed satisfactorily (Table 3).

It is our belief that healing of the anterior mandible is adversely affected by the relatively poor blood supply to that area and that achievement of exact occlusion and bony apposition is essential. Fractures of the anterior body, even when displaced, can usually be treated with closed reduction if teeth are present for adequate intermaxillary fixation. Open reduction is reserved for cases in which displacement cannot be overcome and and proper occlusion cannot be obtained with closed reduction. This occurs most commonly in fractures of the symphysis menti because of the strong pull of the geniohyoideus muscles.

TABLE 4.—*Relationship of Teeth in the Line of Fracture to the Incidence of Infection and Non-Union*

Location of Fracture	Number of Fractures			
	Total	Infection	Non-Union	Healed
Condyle	20	0	0	20
Angle				
With teeth	6	2	1	5
Without teeth	30	1	0	30
Midbody				
With teeth	5	2	1	4
Without teeth	20	3	1	19
Anterior body				
With teeth	11	3	4	7
Without teeth	19	0	0	19

TABLE 5.—*Relationship of the Type of Treatment to the Incidence of Infection and Non-Union*

Treatment	Number of Fractures			
	Total	Teeth in the Line of Fracture	Infection	Non-Union
Closed reduction				
Without extraction	59	9	2	2
With extraction	4	4	1	1
Open reduction				
Without extraction	39	0	3	1
With extraction	9	9	5	3
Total	111	22	11	7

TABLE 6.—*Relationship of Prophylactic Antibiotics to the Incidence of Infection and Non-Union*

Treatment	Number of Patients			
	Total	Developing Infection	Developing Non-Union	Healed
Prophylactic antibiotics	38	8	4	34
No prophylactic antibiotics	29	3	3	26

TABLE 7.—*Relationship of Prophylactic Antibiotics to the Incidence of Infection and Non-Union in Patients with Teeth in the Line of Fracture*

Treatment	Number of Patients		
	Total	Infection	Non-Union
Prophylactic antibiotics	11	4	3
No prophylactic antibiotics	11	3	3
Total	22	7	6

Teeth in the Line of Fracture

In 22 patients wtih 22 fractures, teeth were present in the line of fracture (Table 4). Six fractures of the angle communicated with teeth; two of these fractures became infected and one did not heal. Five midbody fractures communicated with teeth; of these, two became infected and one did not heal. Eleven fractures of the anterior body communicated with teeth; three of these became clinically infected and four did not heal.

In the group of 63 fractures that were treated with closed reduction, there were 13 fractures with teeth in the line of fracture. In nine of these fractures the involved teeth were not extracted. In two fractures infection with non-union developed. One fracture healed after clinical infection. Teeth were extracted from the line of fracture in four fractures that were treated with closed reduction. One of these fractures became infected and did not heal.

Of 48 fractures treated by open reduction, nine had teeth in the line of fracture. These teeth were extracted at the time of open reduction. Clinical infection developed in five of these fractures with subsequent non-union occurring in three (Table 5). There were no teeth in the line of the remaining 39 fractures treated by open reduction. In three of these 39 fractures infection developed and in one the fragments did not unite.

The study of this series of patients suggests that extraction before open reduction is less likely to result in infection if the tract left by extraction is allowed to seal before manipulation and interosseus wiring of the fragments are undertaken.

Clinical Infection

Clinical infection occurred in 11 of 111 fractures. In seven of the infected cases there were teeth in the line of fracture. Five of these seven were treated with simultaneous extraction and open reduction; two were treated with closed reduction, accompanied in one instance by simultaneous tooth extraction. In all four of the cases of infection that did not involve teeth, the fractures were compounded into the mouth. One of these four were infected by a splint wire which was passed through the open reduction site. Two others were grossly contaminated and one had gone untreated for ten days. The fourth case was in a child with an associated severe head injury. He

remained comatose, constantly grinding his teeth, and it was impossible to obtain adequate immobilization of the fracture of the jaw.

In the cases in which infection developed, the average time elapsing between fracture and hospitalization was seven days, as compared with 36 hours for the entire group. Perhaps this time factor, associated with poor oral hygiene, contributed to the incidence of infection in these patients.

Antibiotics

Thirty-eight patients in this series were treated with prophylactic antibiotics. Clinical infection in the line of fracture developed in eight, and in four there was non-union. Of 29 patients who received no prophylactic antibiotics, three had clinical infection in the line of fracture and three had non-union at the fracture site (Table 6).

Eleven of the 22 patients with teeth in the line of fracture were given antibiotics prophylactically. In four of these patients clinical infection developed, and in three non-union. Of 11 patients with teeth in the line of fracture who did not receive prophylactic antibiotics, three had clinical infection and three had non-union (Table 7).

Antibiotics were given for various reasons. In some cases administartion was started in the emergency room as a matter of routine by the attending staff. In others they were given primarily because of an associated injury. Patients with severely compounded and contaminated fractures generally were given antibiotics early.

It is apparent that the use of prophylactic antibiotics did not significantly reduce the incidence of infection or non-union in this series of patients. Although it is common practice to treat all patients with mandibular fracture with antibiotics, it is our belief that the use of these agents should be restricted to those cases in which there is massive wound contamination or an abscessed tooth in the line of fracture.

Non-Union

There were seven cases of non-union. Clinical infection preceded non-union in five cases, in four of which there were teeth in the line of fracture and in one there was gross contamination orally. The two cases of non-union without clinical infection were in patients with teeth that were left in the line of fracture. Thus, of the seven cases of non-union in this series, six were associated with teeth in the line of fracture. It is perhaps significant that four of the seven cases of non-union occurred in the anterior portion of the mandible where the circulation is less adequate than in the ramus and body of the mandible.

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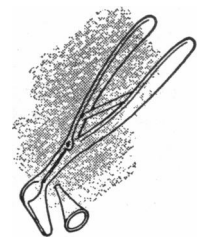
6. Wilhelm: "Proxeos Totius Medicinae," 1275.