Edited by
Robert M. Goldwyn, M.D.

Clinical Professor of Surgery, Harvard Medical School; Head, Division of Plastic Surgery, Beth Israel Hospital; Surgeon, Beth Israel Hospital and Peter Bent Brigham Hospital, Boston; Editor, Plastic and Reconstructive Surgery

LONG-TERM RESULTS IN PLASTIC AND RECONSTRUCTIVE SURGERY

Little, Brown and Company, Boston

First Edition

Library of Congress Catalog Card No. 80-80589
Vol. I ISBN 0-316-31972-4
Vol. II ISBN 0-316-31973-2
Printed in the United States of America
HAL
Slipcase and binding design by Betsy Hacker

LONG-TERM RESULTS IN PLASTIC AND RECONSTRUCTIVE SURGERY

VOLUME II

The Physician: dealing with the present but with an eye to the past and future

Sculpture in Wood by Jacob Goldwyn, M.D.

To Roberta
With gratitude for the short-term, full-term, and long-term results

CONTENTS

VOLUME II

LONG-TERM RESULTS IN PLASTIC AND RECONSTRUCTIVE SURGERY

25

THE treatment of fractures of the facial skeleton in the years prior to 1950 was characterized by a "noninvasive" approach, and the manipulation of displaced fragments was usually done blindly and by remote or percutaneous approaches. Gillies, Kilner, Stone, and others developed methods of approach from the temporal area, intraorally and by direct application of hooks, tenaculum forceps, and other means to move displaced fragments. Zaydon and Brown [9] reported fixation with K-wires, which again did not require direct visualization of fracture fragments. Blind antral packing was a commonly used method of reducing and supporting fractures of the orbital floor.

To those who were seeing large numbers of facial fractures, it became evident that the late results were frequently less than satisfactory, and displacement of the eye downward and backward was a common sequela to fracture dislocations of the orbit.

A more aggressive surgical approach to these and other fractures of the facial skeleton appeared to be indicated and is now well established as standard procedure by many of those most active in this field [5]. In order to analyze the merits of this method, 3,002 cases have been reviewed with special emphasis on late results (Table 25-1). Fifty-three of these patients who had had middle-third facial fractures involving the orbit were examined 4 to 24 years after treatment. On the basis of these findings, as well as the total experience gained over the past 28 years, several conclusions emerge.

As is shown in Tables 25-3 and 25-4, the total number of serious disfiguring or disabling complications was small, even after the most critical analysis. In retrospect, this is attributed

Frederick J. McCoy

LATE RESULTS IN FACIAL FRACTURES

to the methods utilized in diagnosis as well as treatment.

Diagnosis

Fractures and dislocations occurring in the mandible as well as the frontal area present little difficulty in recognition and diagnosis. Radiographs of good quality can be relied upon to demonstrate both the location of the fracture lines and the amount and direction of displacement of bone fragments. The diagnosis of fractures of the middle third of the face, particularly in the orbital floor, is frequently more difficult.

Under the best of circumstances, x-rays cannot be considered infallible, and in the severely injured patient they can be technically compromised to a serious degree.

Experience has shown that the maximum information can be obtained from the following views:

Stereoscopic Waters
Caldwell
Towne
Oblique mandibular views
Planography

Panoramic-tomographic radiograph views, when available, are helpful but not necessary.

The computerized axial tomography scanner is useful in special instances to demonstrate soft tissues of the orbit as well as bone, but it is far too expensive to be utilized routinely in fractures of the facial skeleton.

X-rays in this study have again been shown indispensable as a diagnostic tool and as a record. Unfortunately, however, they cannot be regarded as a completely reliable guide to treatment, particularly in fractures of the middle third of the face. Here clinical judgment must prevail. This is based on a thorough understanding of the mechanisms of these fractures and a careful analysis of the trauma history and physical findings.

Mechanism of Fractures

One of the greatest obstacles to a sound concept of fractures is a misunderstanding of the physical characteristics of living bone. Although commonly thought of as brittle, similar to the study skulls one is accustomed to seeing, facial bones in reality have a remarkable amount of elasticity. They are capable of a surprising amount of deformation on impact before disruption occurs along the lines of stress. The infraorbital rim, for example, can be demonstrated to move at least 6 mm posteriorly and still return to its normal position without evidence of fracture. In so doing, of course, it may compress the thin orbital floor in end-on fashion, causing it to fragment and telescope, compromising the integrity of the support for the orbital contents [8]. This is believed to be the invariable mechanism of orbital floor fracture rather than the "blowout" principle [2].

A special effort was made throughout this study to determine the nature of the impinging force and the point of impact, and in no instance was it possible to confirm a blow to the soft tissue contents of the orbit which could possibly have produced the theoretical hy-

TABLE 25-1. *Fractures of the Facial Skeleton*

Type	Number of Patients	Percent of Total
Frontal	90	3
Middle third	1,179	39
Mandible (alone and associated)	1,389	47
Others	344	11
Total of all fractures of facial skeleton	3,002	100

TABLE 25-2. *Fractures of the Middle Third of the Face*

Subdivisional Involvement	Number of Patients	Percent of Total (1,179)
Zygomatic arch (only)	83	7
Zygomatic maxillary complex	836	71
Orbit		
Infraorbital margin (only)	83	7
Infraorbital margin and floor	718	61
Orbital floor (only)	83	7
Lateral wall	67	6
Supraorbital margin and roof	42	4
Nasoethmoid pyramid	79	7
LeFort II	103	9
Upper jaw		
Transverse separation (LeFort I)	84	7
Midline	26	2
Alveolar segment	40	3
LeFort III (craniofacial disjunction)	71	6

drodynamic forces necessary to produce a blowout of the orbital floor. The explanation for a floor fracture in the absence of rim disruption is believed to lie in the inherent elasticity of bone. Of course, in the majority of cases (61 percent of all middle-third fractures), both the floor and rim are demonstrably broken (Table 25-2).*

*This figure should probably be significantly higher and is low probably because of inaccurate recording in some of the clinical records.

Diagnosis by Physical Signs and Symptoms

The following signs and symptoms were the ones most frequently present in this series:

Swelling and discoloration
Visible or palpable deformity
Abnormal mobility
Diplopia and entrapment
Malocclusion
Trismus
Crepitus (bony or air in tissues)
Bleeding in the auditory meatus
Infraorbital nerve anesthesia

The value of diplopia and entrapment as a diagnostic sign has not been borne out in this study. Diplopia in forward gaze may rarely be present when the floor has ruptured and swelling is minimal. It can frequently be elicited by careful history as having been present transiently immediately following injury but disappearing rapidly as edema developed, creating false intraorbital support. Its absence, therefore, is not diagnostically significant (Fig. 25-1). When it is present in upward gaze, it indicates possible entrapment of the inferior rectus muscle and should be proved by the forced duction test [2]. Since this sign was present in only 16 percent of proven orbital floor fractures in this series, however, it cannot be considered a reliable indicator of the necessity for surgical intervention (Fig. 25-2 A and B). Occasional additional causes of diplopia may be abducens dysfunction or intraocular pathology.

It was also found that external auditory canal bleeding requires careful analysis. While this has traditionally been regarded as positive evidence of basal skull fracture—and occasionally is, to be sure—close inspection is warranted. It will usually be found to be due to a small laceration of the anterior wall, 10 to 12 mm deep to the tragus, resulting from perforating fracture fragments from the posterior wall of the glenoid fossa driven back by a blow on the chin transmitted through the mandibular condyle.

Repeatedly, the finding of infraorbital nerve

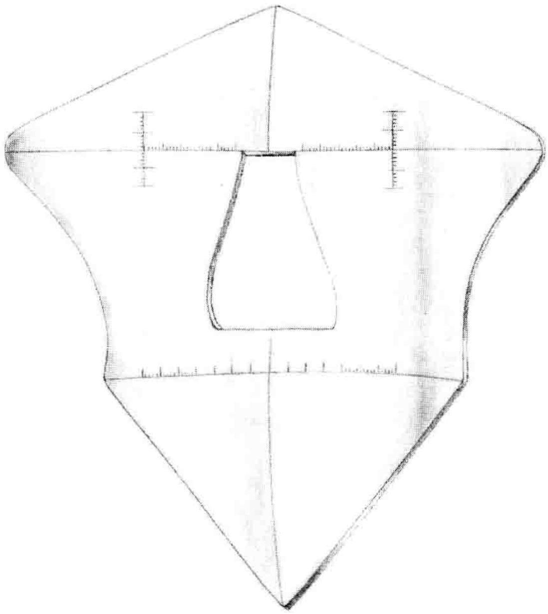
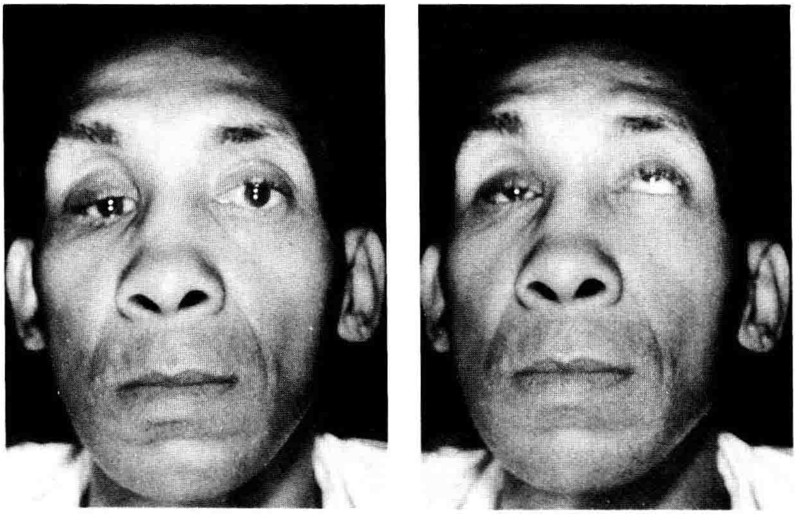


FIGURE 25-1. *A Plexiglas tri-square useful in measuring for globe or canthal displacement in vertical or horizontal planes. The scale is in millimeters.*

anesthesia proved its reliability. *The most constant single finding in fractures of the orbital floor is anesthesia of the infraorbital nerve.*

This terminal branch of the maxillary division of the fifth nerve traverses the infraorbital fissure or canal. The latter structure weakens the bone so that most zygomaticomaxillary fractures separate along this fault. The impinging force on the malar prominence drives the bone backward and downward, and a shearing action occurs which affects first the cutaneous branches to the lip and cheek, then the anterior, middle, and posterior superior alveolar branches in turn, depending in part at least on the amount of force applied (Fig. 25-3).

This is diagnostically helpful in that the more profound the anesthesia, the more extensive the dislocation has been, and therefore the greater the likelihood of damage to the floor. It is necessary in assessing this sign to rule out direct contusion to the cutaneous portion at or distal to the foramen by compression or shearing force. Obvious evidence of severe soft-tissue trauma is usually present in such cases.



A B

FIGURE 25-2. *Result of an unrecognized and untreated orbital floor fracture with inferior and posterior displacement of the right globe as well as entrapment limiting upward gaze.*

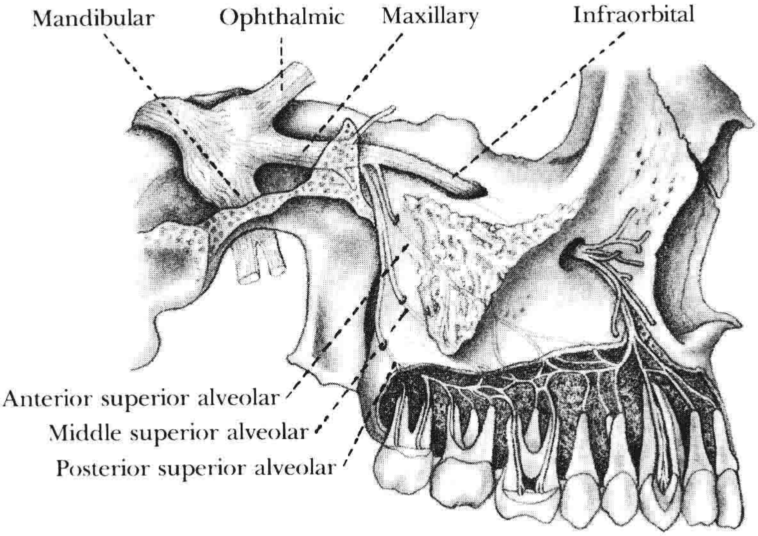


FIGURE 25-3. *The anatomical relationships of the terminal branches of the infraorbital nerve and the maxilla, explaining the reason that minor dislocations of the orbital floor may involve anesthesia to the lip and cheek, while more severe backward displacement may involve the gingiva and teeth.*

The significance of infraorbital anesthesia lies in the fact that for nerve injury to have occurred involving the lip, cheek, and gingiva, there must have been a major movement of the fragments with fracture of the orbital floor along the fissure. Under these circumstances, a defect in the orbital floor must be ruled out. In this series the rule was established that *when infraorbital nerve anesthesia persists unimproved for 48 hours or more, orbital exploration must be carried out.* In every instance (636 patients), fractures were found in the orbital floor, although not all had defects requiring repair.

Reconstruction of significant defects in the floor was required in 539 patients. Of these repairs, 478 were rib grafts (Fig. 25-4), 25 were simple rotation of bone fragments for small defects (Fig. 25-5), and 36 were allografts. The conclusion from this would seem to indicate that until some better diagnostic method can be found to determine the presence and size of orbital floor defects, all patients with floor fractures will need to be explored if one aspires to attain a 100 percent discovery rate. Moreover, at this time, it appears that infraorbital nerve anesthesia is the most reliable indicator available.

Treatment

The methods used in the treatment of this series of patients differs in certain important respects from those frequently reported. The low incidence of late complications is believed to be attributable to the observance of the details of the following methods of management.

ZYGOMATIC ARCH

The simplest of all facial fractures to treat are those limited to the zygomatic arch. Introduction of a cervical sound through a Gillies approach and carried down deep to the temporalis fascia leads to the depressed segments. Prying outward, the fragments usually snap into place with good stability. Occasionally, in cases of extensive comminution or where seen late, there may be a tendency for the deformity to recur. In these cases, a Kirschner wire drilled

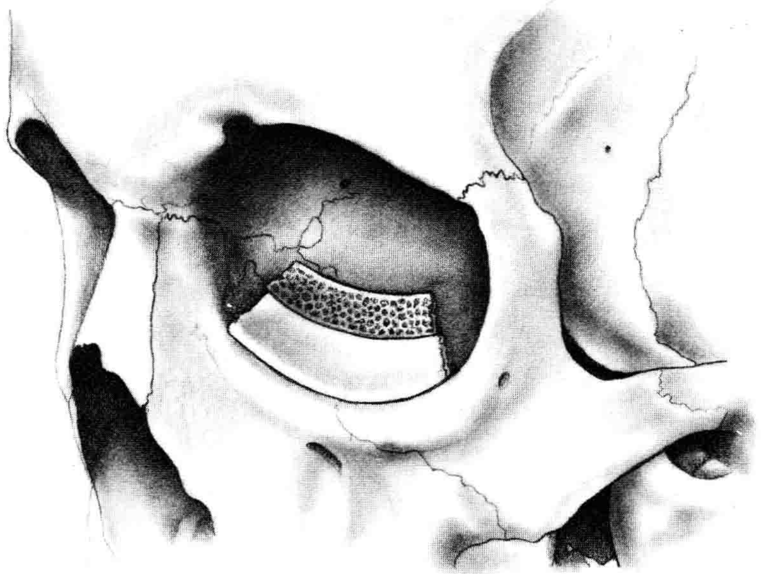


FIGURE 25-4. *Split-rib graft in place in the floor of the orbit. Multiple partial fractures are used to crimp the graft to conform to the natural curvature of the floor.*

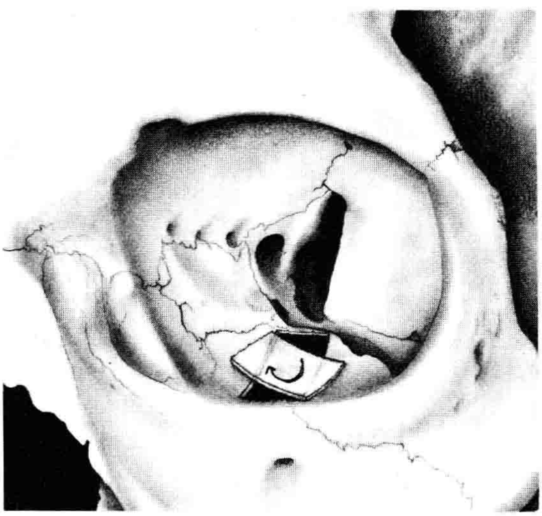


FIGURE 25-5. *Diagrammatic representation of the utilization of a rectangular segment by 90 degree rotation. When used it should be combined with a repair of any rent in the periorbita to guarantee containment of orbital fat.*

through the arch and deep to the reduced fragments (simultaneously held in place with the sound) and into the maxilla will stabilize the structure [9]. Open reduction with packing or wiring has been recommended [4], but has not been found necessary in this series.

ZYGOMATICOMAXILLARY (ZM) COMPLEX (ORBIT)

In most ZM fractures, the Waters x-ray views and the planograms will show positive or highly suggestive evidence of fracture dislocation. This is an indication for open reduction. The initial incision is made in the lower eyelid 5 mm above the *normal* level of the inferior orbital rim. The muscle fibers are split to expose the rim and the fracture line, which is most commonly found between the middle and medial thirds of the rim. The periosteum is cut and carefully elevated along the floor for 3 cm and from the medial wall to the inferior orbital fissure laterally. Retracting the orbital contents upward gently with a malleable ribbon retractor permits inspection of the entire floor constituting the roof of the antrum (Fig. 25-6). At this point it is necessary to determine whether there is backward displacement of the rim, and