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Fracture and Diastasis of the Superior Maxillæ and Upper Bones of the Face,

TREATED BY THE AID OF THE INTER-DENTAL SPLINT; WITH TWO CASES.

BY

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FRACTURE AND DIASTASIS OF THE
SUPERIOR MAXILLÆ AND UPPER
BONES OF THE FACE,
TREATED BY THE AID OF THE INTER-DENTAL SPLINT.
WITH TWO CASES.

Fractures of the superior maxillary bones are, from their protected location, quite rarely met with except in the alveolar process. The causes of such injuries are usually the result of the extraction of the teeth, or blows or falls upon the chin which separate or split open the walls of the alveoli. This is accomplished in the one case by the lateral force applied in breaking up the attachments of the roots of the teeth, and in the other by driving the teeth upwards and through their alveoli.

Such injuries, however, are never very serious, and rarely require special apparatus to maintain the fractured bones in their normal positions. I shall therefore lay aside all consideration of this class of accidents, and confine my remarks to the more serious injuries of this location, viz.: *Fractures and Diastasis of the Superior Maxillaæ and Upper Bones of the Face.*

This class of injuries (which I present for your consideration) have elicited very little attention either by the general surgeon or the oral specialist, and several of the most noted works on surgery make no mention of them whatever. This, I think, is due to the fact that such cases are of very rare occurrence.

Two cases have recently come under my care at St. Luke's Free Hospital, and have led me to



make a somewhat careful examination of the text-books and periodical literature bearing upon this subject, and so far, I have been able to gather together but nineteen cases which can be fairly classed as similar to those which form the inspiration of this essay.

Injuries to the bones of the face which cause comminuted fractures and separation from the bones of the cranium, are always the result of great violence; like the passage of the wheel of a carriage over the face, falling from a great height, the kick of a horse, a blow in the face by some heavy missile thrown with great force, or a gunshot wound; crushing of the head between a moving elevator and the floor, the overturning of a carriage upon the occupant, or other heavy crushing force.

Such injuries are always serious and often prove fatal, either from shock, hæmorrhage, direct injury to the brain, or later complications.

In such cases as survive the shock of injury and escape immediately serious complications of the brain, a favorable termination may be looked for, and in many cases with very little deformity. This, however, will depend very much upon the character and location of the particular injury, the success obtained in readjusting the fractured and dislocated bones, and maintaining them in their proper positions.

For the purpose of reference I have grouped together the various published cases which I have found in my search, but shall only mention, very briefly, the extent of the injury and the percentage of fatality.

In speaking of this class of injury, Erichsen¹ says, "In some cases all the bones of the face ap-

¹Erichsen's Science and Art of Surgery, 8th ed., 1884, vol. i, p. 545.

pear to have been smashed and separated from the skull by the infliction of great violence." He mentions four cases of this form of injury: one reported by South, one by Vidal, and two which came under his own notice.

The injury in South's case was caused by the man being "struck in the face by the handle of a rapidly revolving crank," all the bones of the face were "separated and loosened" and so comminuted as to "feel like beans in a bag."

Vidal's case, also a man, was injured by "a fall from a great height and separated all the facial bones."

Erichsen's cases were both the result of falls from a considerable elevation and striking upon the face. The two former recovered, the two latter died in a few hours.

Packard² mentions three cases: one by Cotting, in which the face was crushed by a cart wheel passing over it; another, brought to the Pennsylvania Hospital, in which the injury was received by the head being caught between the platform of a steam hoisting machine and the floor; and the last one, a case reported by Heath in his "Injuries and Diseases of the Jaws," which was under the care of Dr. Fyffe. The first and last cases recovered, but in the other death ensued in a few hours.

Heath³ describes two cases: The first came under his personal notice, and was "caused by the passage of a wagon wheel over the face, the bones were completely crushed and separated one from another, and death was instantaneous." The second one is that reported by Dr. Fyffe, and is the same case referred to by Packard, and will be described later.

² Ashurst's Inta'l Encyclopedia of Surgery, vol. iv, p. 67.

³ Heath's Injuries and Diseases of the Jaws, 3d ed., p. 59.

Tiffany⁴ mentions a single case which was reported by Professor Christopher Johnston. The patient, a gentleman, was struck in the face by the walking beam of a steamboat. All the bones of the face were crushed and "seemed literally to consist of a bag of bones moving freely with inspiration and expiration, so extensive was the comminution." This case made a good recovery and an excellent result was obtained by supporting the superior maxillæ, by means of a silver wire passed through the cheeks and under the teeth, and uniting the ends of the wire over the top of the head by a rubber band.

Richard Wiseman⁵ published the report of the first case on record, and described the method of treatment. The patient was a little boy 8 years of age, who was, kicked by a horse and the whole upper jaw driven in, so that the finger could not be passed behind the palate. A flattened hook was constructed which could be inserted behind the palate and by extension constantly maintained by the hand of the patient and assistants, the bones were held in place and a good recovery followed.

Dr. Fyffe,⁶ of Westminster Hospital, London, has published the report of one case. This patient was thrown from a cab, the vehicle turning over upon him. The superior and inferior maxillæ were fractured, and the bones of the face detached from the skull so that the former "moved up and down in the act of swallowing." This patient also recovered.

Holmes⁷ describes a single case, in which the bones of the face were crushed and dislocated by a carriage wheel passing over the face, and in

⁴American System of Dentistry, p. 568.

⁵Treatise on Surgery, 1734, by Richard Wiseman.

⁶London Lancet, July, 1860.

⁷Holmes' Principles and Practice of Surgery, p. 197.

which, after recovery, there "was a disagreeable lengthening of the face" as a result of the injury; but more likely the result of the treatment. Among the methods of treatment suggested are gutta-percha moulds, cork disks placed between the teeth, wiring of fragments and carefully adjusted pressure by the Hanesby truss.

Hamilton⁸ refers to one case which came under his own care, in which the upper bones of the face were fractured and torn from their attachments to the cranium, and had to be supported to keep them in place. The patient died on the twelfth day after the injury.

Mason⁹ reports a case which was under the care of Mr. Bickersteth, of Liverpool. A gentleman standing upon the deck of a steamer was struck upon the side of the face by an iron hook attached to the hawser, which had parted under a heavy strain. On examination "immediately after the accident, the mouth seemed to be filled by a piece of bloody meat, but on further examination, this proved to be the muscles attached to the upper jaw; the orbital plate of the superior maxilla of the injured side was found beneath the cheek, whilst the palate process with the alveolar ridge and teeth were, for the time, situated in the upper part of the pharynx, looking towards the bodies of the upper cervical vertebræ. The facial surface of the bone took the place of the roof of the mouth, jamming the jaws open. The soft palate was not torn, but considerably stretched. The superior maxilla of the injured side was turned completely upon its axis.

"The detached mass was replaced, the lower jaw firmly closed upon it for support, and the whole rapidly united with scarcely any deformity."

⁸ Hamilton's Fractures and Dislocations, p. 102.

⁹ Mason's Surgery of the Face, p. 71.

Mr. John Salter¹⁰ reported a case in which the superior maxillæ and malar bones were separated from their attachments with the skull, and so crushed as to feel like a mass of "loose bones."

Dr. Harris,¹¹ of New York, also reported a case of a little child only 2 years of age, who fell a distance of fifty feet to the pavement, striking upon the face and sustaining fractures and separation upon the median line of both superior maxillæ and palate bones. "Union had not taken place six weeks after the injury."

Mr. Houghton¹² describes a case in which the "superior maxillæ were so fractured and displaced as to make it impossible for the patient to protrude the tongue until after the bones had been adjusted to their normal position."

Bryant¹³ mentions one case in which "the superior maxillary bones were completely detached from the skull, and could be moved about in any direction, yet a good recovery ensued."

Agnew¹⁴ mentions the cases of Wiseman, Fyffe and Packard, but describes no new cases.

Garretson¹⁵ reports two cases. The history of the first was furnished him by Prof. Agnew, in which a lad was crushed between the bumpers of two railroad cars, and sustained diastasis of all the bones of the face from the skull, comminuted fracture of the superior maxillæ, and four fractures of the lower jaw. The patient recovered, but with considerable deformity.

The second case, a painter, came under his own care. The injury was caused by falling from the

¹⁰ Medical Times and Gazette, June 5, 1869, p. 600, from Mason's Surgery of the Face, p. 70.

¹¹ New York Medical Journal, vol. xiii, 2d Series, p. 214.

¹² British Medical Journal, Jan. 2, 1858, p. 15, from Mason's Surgery of the Face, p. 71.

¹³ Bryant's Practice of Surgery, p. 397.

¹⁴ Agnew's System of Surgery.

¹⁵ Garretson's Oral Surgery, 4th ed., p. 805.

roof of a house and striking upon the pavement below. He sustained severe comminuted fractures of the superior and inferior maxillæ and fracture of both arms and legs. Several splinters of bone were removed from the anterior portion of the lower jaw, this allowed the parts to fall together "the symphysis of junction being midway between its former position and the hyoid bone." The patient made a good recovery, but with considerable deformity.

SUMMARY OF CASES.

Operator.	No. of Cases	Cause of Injury.	Recovered.	Died.
Wiseman . . .	1	Kicked by a horse	1	
South	1	Struck by a revolving crank	1	
Vidal	1	Fall from a great height	1	
Erichsen . . .	2	" " " " " " " " " " " " " " " "		2
Cotting	1	Crushed by cart wheel	1	
Packard	1	Crushed by hoisting machine		1
Heath	1	Crushed by wagon wheel		1
Johnston . . .	1	Blow from walking-beam of steamboat	1	
Fyffe	1	Crushed by overturned cab	1	
Holmes	1	Crushed by carriage wheel	1	
Hamilton . . .	1	Not stated		1
Bickersteth . .	1	Struck by iron hook	1	
Salter (John) .	1		1	
Harris	1	Falling from a window	1	
Houghton . . .	1		1	
Bryant	1	Fall from a great height	1	
Agnew	1	Crushed between car bumpers	1	
Garretson . . .	1	Falling from a housetop	1	
Total,	19		14	5

Per cent. of mortality, 26.34.

With regard to gunshot fractures of the bones of the face, the Surgeon-General¹⁰ of the United States reports that from the beginning of the Civil War to October, 1864, there were reported 4,167 cases of gunshot wounds of the face of all kinds.

¹⁰ Surgeon-General's Reports, vol. 1, p. 289.

Of this number 1,579 were fractures of the various bones of the face; 891 recovered, 107 died, and in 581 cases the results had not been ascertained. The greatest cause of fatality in these cases was secondary hæmorrhage.

In the Medical and Surgical History of the War of the Rebellion¹⁷ the whole number of gunshot fractures of the various bones of the face is stated as being 4,502; recoveries 3,700, deaths 404, undetermined results 398, and the percentage of fatality 9.8. "The results of shot injuries of the face confirm the opinion that these wounds commonly do well, notwithstanding the amount of destruction apparent at the time of the injury."

The reasons for the apparent lower rate of mortality in this class of injuries is doubtless due to the fact that all forms of fractures of bones of the face have been included in this table. If, however, the more serious cases (similar to those covered by the title of this essay) could be grouped together, I should expect to find the percentage of fatality considerably higher.

With this brief summary of the history and results of the various cases which I have been able to find on record, I will present those which have lately come under my own observation, with the hope that they may prove interesting, and that the means used in their treatment will be helpful and suggestive to others who may be called upon to treat this class of injuries.

*Case 1.*¹⁸—Mr. Conrad A., Swede, æt. 28 years, occupation, sawyer, employed at the Pullman Palace Car Works, Pullman, Ill., was brought into St. Luke's Free Hospital on March 15, 1887, in an unconscious condition, with an incised wound of the right cheek, starting from a point

¹⁷ Part iii, vol. ii, p. 688.

¹⁸ St. Luke's Free Hospital Reports.

just below the inner canthus of the eye and extending obliquely backwards and downwards a distance of four inches, exposing the superior maxillary bone and completely penetrating the cheek, leaving a considerable external opening into the mouth.

This wound had been sewed up by the surgeon at the Works. The right malar was crushed, both nasal bones were fractured and separated at the naso-frontal suture. The left zygomatic process was fractured near its union with the malar bone, both superior maxillæ were torn loose from the bones of the cranium, so that the whole mass was loose and freely movable in any direction, and suspended by the soft tissues. When the mouth was opened to its fullest extent the teeth of the upper jaw rested upon those of the lower. Both superior maxillary bones were also fractured on a nearly perpendicular line; on the right side between the first and the second molar teeth; on the left, between the second bicuspid and first molar teeth. Openings existed in both antræ. The right could be entered with the probe through the wound in the cheek and also through the alveolar process on the buccal aspect between the roots of the first and second molars, while the left could be penetrated through the buccal surface of the alveolar process on the line of the fracture between the second bicuspid and the first molar teeth.

The palate process and palate bones were also badly crushed, forming a compound comminuted fracture, with loss of bone tissue, leaving an opening in the hard palate on the right side near its posterior edge and the median line, through which the index finger could be freely passed. The bones of the internal nose were badly comminuted and several pieces which were loose were removed.

The left side of the face was completely anæst-

thetic over the whole region supplied by the infra-orbital nerve, while upon the right side the upper lip and the wing of the nose only had lost sensation. The inferior maxilla was not injured and none of the teeth lost by the injury in either jaw.

The accident occurred by the patient being struck in the face by a piece of oak timber 12 inches long and 9 x 8 inches in diameter, which was thrown by a circular saw 18 inches in diameter, and revolving at the rate of about 3,000 revolutions per minute.



Case No. 1. Cut. No. 1.—Three years before the injury.

When the patient was admitted the chances for

recovery seemed very small. Cold applications were ordered over the face, and stimulants hypodermically, if the temperature should fall below normal and the pulse below 60. Nourishment to be given if possible, and $\frac{1}{4}$ grain of morphia to allay pain.

March 16th.—Swelling of parts very great, both eyes closed and nasal passages completely plugged. Pulse 84, temperature 101.8° . Would arouse when spoken to.

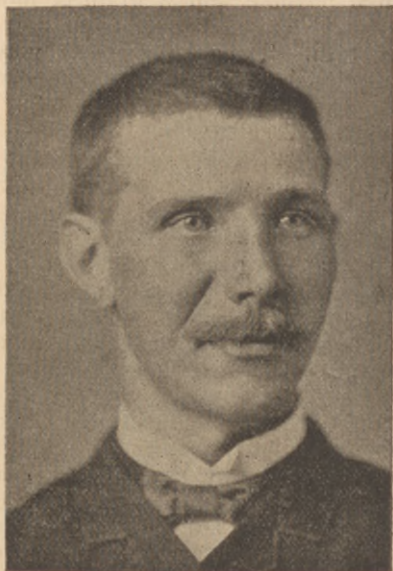
May 17th.—Patient has rallied. Pulse 74, temperature 100° . Seems to be conscious. Swelling less.

On the 18th his temperature was normal and did not rise again above that point, and he rapidly improved in general condition from this date.

The treatment of the jaws was begun on the 17th, and consisted of first wiring the posterior fragments of both superior maxillæ to the anterior or middle portion by means of silver wire passed around the teeth on either side of the fractures. The fractured palate bones and the palatine processes were then moulded into place as nearly as possible with the fingers, and the nasal bones lifted into position by means of the handle of an instrument. The lower jaw was then closed upon the superior teeth, care being taken to get a correct occlusion, and held in position by means of an occipito-frontal and occipito-mental bandage.

The following night the patient tore off the bandages several times. The nasal passages being closed he had great difficulty in breathing when the jaws were held tightly together. The bandages were therefore reapplied more loosely, but this allowed the injured bones to fall out of place, and defeated the object in view. This is the plan of treatment usually recommended by such authors as mention this class of injuries, but in my hands

it has proved a signal failure, from the fact that the nose was so injured and the parts so badly swollen as to close the nasal passages for several



Case No. 1. Cut No. 2.—Shows condition after union of the fractured bones.

days, and therefore making it impossible to breathe with any degree of comfort except through the open mouth.

There must be considerable difficulty in any severe case in maintaining the position of the fractured and dislocated bones when this plan is adopted, and nearly impossible in those cases in which all the teeth were lost prior to the accident, for it is a well-known fact that as

a rule endentulous jaws do not come in contact, and if they should, a normal occlusion would not be obtained, nor the injured parts prevented from slipping out of position. The plan of treatment adopted by Prof. Johnston is also objectionable by reason of the wounds made in the cheeks. In this



Case No. 1. Cut No. 3.—Shows the apparatus in position.

case I was compelled to devise some other means, one which would maintain the position of the fractured bone and at the same time leave the lower jaw free, so that the mouth could be open for the purpose of breathing. This was accomplished by adapting the principle of the Kingsley

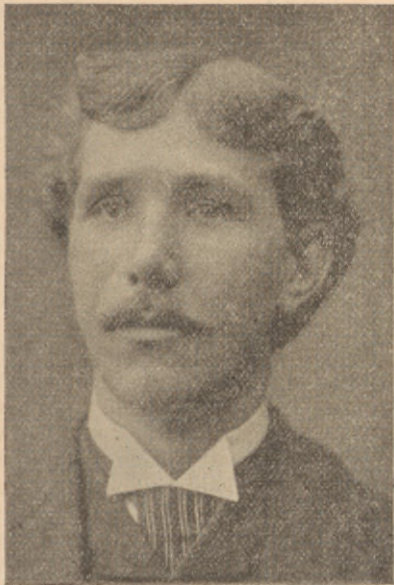
interdental splint to the upper jaw. Impressions of the upper and lower teeth were taken in modeling compound, by first moulding it on the upper teeth and while it was yet soft forcing the lower jaw upward till a correct occlusion of the teeth was obtained. This impression was trimmed to the desired shape and a one-eighth inch steel wire was imbedded in the sides upon a line with the ends of the teeth and then bent backwards upon itself opposite the cuspid teeth, and allowed to extend outside the cheek nearly to the lower border of the ear. From this was constructed a hard rubber splint with the wires attached. The splint was held in position by means of double straps attached to the wire upon each side and buckled to a close-fitting leather cap laced firmly upon the head. This proved to be a very successful appliance, as it held the bones in their proper position, permitted comfortable breathing and free movement of the lower jaw, which enabled him to talk and after a few days to masticate soft food.

Deep indentations were left in the under side of the splint in which the lower teeth fitted accurately when the mouth was closed. The object of this was to furnish a sure guide to the normal position of the upper maxillæ. Without this the correctness of the adjustment of the bones could not have been verified. The importance of this cannot be overestimated. The only other treatment was good feeding and thorough irrigation of the wounds, antræ and the mouth, with a 2 per cent. solution of carbolic acid every two or three hours until the discharges ceased, and the removal of a few spiculæ of bone from the nose and the wall of the right antrum.

The patient was discharged on May 14th, with small fistulous openings through the gums leading into both antræ at the points of fracture, and

a small opening in the hard palate which was gradually growing less. There was also a slight deflection to the left of the nasal septum. The opening into the right antrum soon closed, as did that in the hard palate.

June 22.—Patient returned for the removal of the cicatrix in the right cheek, which was adherent to the maxillary bone.



Case No. 1. Cut No. 4.—Shows final result after the operation on the cheek.

June 25th.—Stitches removed and the patient discharged.

The opening into the left antrum remained patulous for some months, with slight discharge into

the mouth, but finally closed. Sensation has been entirely restored in both sides of the face.

*Case 2.*¹⁰—Henry S., German, æt. 35, occupation laborer, employed at Armour Packing House. Was admitted Oct. 7, 1887, one hour after the accident, which was caused by being struck across the bridge of the nose by a descending elevator while he was looking up the shaft. Was suffering from concussion of the brain when admitted. Examination disclosed the fact of a lacerated wound over the left eye and extending across the nose to the right eye, the finger could be introduced and readily passed down into each orbit and against the fractured edges of the nasal and sphenoid bones. By taking hold of the upper teeth all the bones of the upper face were found to be movable, and when the mouth was open the the upper teeth rested upon the lower and there was a peculiar and disagreeable elongation of the face. A later examination revealed the fact that the frontal sinus was crushed in, the nasal and lachrymal bones comminuted, and that all the bones of the face were torn loose from the skull on a line passing through the orbits; and that the superior maxillæ were separated from the other bones of the face. The inferior maxilla was not injured. Several loose pieces of bone were removed from the region of the inner canthus of each eye by the house surgeon. The wound was stitched, drainage tubes inserted, the lower jaw bandaged tightly against the upper teeth, and iced cloths ordered over the face and head. Pulse 60, temperature 97.4°. Stimulants administered freely. Profuse hæmorrhage occurred during the night, and vomiting of blood every few hours until two o'clock on the following day. He became conscious during the night, but the other symp-

¹⁰St. Luke's Free Hospital Reports.

toms seemed to give but little hope of a final recovery.

The temperature reached 102.2° on the 8th, at 4 P.M., and fell to normal on the 9th. No brain symptoms developed and the patient rapidly improved in general condition from this time. Swelling and suppuration were so extensive for several days as to render the adjustment of a splint impossible. The treatment consisted of stimulants



Case No. 2. Cut No. 1.—Six years before the injury.

and thorough irrigation of the wounds. The old method of bandaging was resorted to but proved a failure, for the reason that the lower jaw could

not be held sufficiently closed to support the fractured bones in their proper position without obstructing breathing by the mouth. This was necessary as nasal breathing was at the time impossible.

Oct. 24th.—Inserted an interdental splint, constructed after the plan of the one used in the preceding case, and supported it from the head by the same means. The case progressed favorably and was discharged on Dec. 3d, the bones having all united.



Case No. 2. Cut No. 2.—Final result.

Dec. 24th.—Patient returned complaining of

double vision. The lens of the left eye looked cloudy and traumatic cataract was feared.

April 1, 1888.—Patient seems entirely well. The double vision complained of has passed away and the lens has cleared up.

From the casts of the jaws in Case 1, it will be seen that the occlusion of the teeth is nearly, if not quite, normal. And by the photographs taken before the accident occurred (which I have been so fortunate as to obtain in both cases) and those taken since the patients were discharged, that in Case 1 the only deformity visible is a slight flattening of the right superior maxilla and the faint line of the cicatrix resulting from the incised wound in the cheek.

In Case 2 the occlusion of the jaw is equally good but the deformity is greater. This is the result of the loss of portions of the nasal bones and the external wall of the frontal sinus, and the adhesion and contraction of the cicatricial tissue over these places.

No. 9 Jackson Street.

DR. E. S. TALBOT, of Chicago: We have all listened to Dr. Marshall's paper with unusual interest, as it treats of cases which demand prompt and positive treatment. Great force is required to produce an injury of this nature. Other complications, such as shocks, inflammation and secondary hæmorrhage are liable to ensue on account of the locality. If nature or treatment can overcome these difficulties another serious one presents itself in devising a means to hold the parts in place after putting them in proper position, until they have united.

A few years ago I was requested to assist Dr. Powell, of Chicago, in a case somewhat similar to one mentioned by Dr. Marshall. A girl, about 8

years of age, was leaning over an opening in an elevator shaft, head down, when she was struck on the back of the head by the elevator, the face forced to the sill of the building. She sustained a compound fracture of both superior and inferior maxillary bones. The parts were put in their natural position, the teeth being the guide. The jaws were bandaged together in the usual manner. The next morning we found the bandage off, with the bones slightly displaced. This is the point I wish to make: that where a bandage is used it is not certain it will remain in position twenty-four hours. After a little study we concluded upon the following plan, which I believe to be an infallible method of treatment: A skull-cap was made of cotton cloth to fit the head as far as the eyebrows and occipital protuberance. A splint for the inferior maxilla was made of gutta-percha (card-board, tin, or anything that can be moulded to the jaws will do as well). Having placed the pieces of bone in position and brought the jaws together so that the teeth occluded properly, adhesive strips were cut one inch in width, wound and fastened not only to the splint and the skull-cap, but also to the cheeks. The strips were applied in such a manner as to exert the proper force in the right direction. Three or four were then applied. One or two strips fastened to the splint, the cheeks and back of the neck, held all firmly in position.

The patient can be fed with liquids through a rubber tube. Should the teeth be missing, or but a few in position, occlusion would be impossible and the dental splint must be used. The adhesive strips can then be used in the manner described.

