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Case Report

Transosseous Wire Fixation: An Obsolete, Yet Valuable Method For Surgical Management Of Facial Fractures

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A R T I C L E I N F O

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A B S T R A C T

Facial fracture sometimes is associated with complications which influence its prognosis. Aspects of the complications of facial fracture investigated are those emanating from the methods of treatment employed in its management. Such methods of treatment include conservative, closed reduction with maxillomandibular fixation (MMF) and open reduction with inter-maxillary fixation and rigid internal fixation. It is expected that with improvement in the knowledge of this condition and its management protocols complications will be reduced to the barest minimum. But, this is not so as there are many confounding variables that influence treatment outcome. This paper examined those complications associated with the various treatment methods and recommends that the older methods of treatment like closed reduction technique and transosseous wire osteosynthesis are still relevant in the current day practice.

Introduction

Facial fractures precludes accurate reduction and stable fixation because their displacement and malocclusion results in functional and morphological consequences. The best way to achieve it, is by open reduction and internal fixation. Plates and screws technology is the gold standard in the modern treatment and widely used in developed countries but the significance of wire fixation cannot be overlooked. However, in the third world where facial fractures comprise a significant proportion of trauma, lack of resources precludes the use of plating technology in most of countries and wire osteosynthesis is still widely used. However, there are few data published on the results of wire osteosynthesis from developing countries. The aim of this literature is to evaluate the effectiveness and complications of this traditional method of treatment and to discuss some of its other benefits and disadvantages.

Transosseous Wiring: About 1847 Fauchard in France and Buck in the United States commenced the use of transosseous wiring with silver wires. Results were variable owing to the development of sepsis but the scope of surgery was considerably enlarged with the discovery of general anaesthesia, ether, by Morton in Massachusetts and chloroform by Simson, the following year in England. An interesting variation of transosseous wiring was that the holes were drilled through the mandibular fragments and flat headed silver pins drawn through from the lingual to the labial surfaces until the heads were in contact with bone. The ends of the pins were then bent and the fragments approximated by winding silk ligature to and fro under the pins[2].

Direct wiring across the fracture line is an effective method of fixation of jaw bone fractures. Transosseous wiring can be done through intraoral or extraoral approach.

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Holes are drilled in the bony fragments on either side of the fracture line, after which a length of 26 gauge stain-less steel wire is passed into the holes and across the fracture. The fracture must be reduced independently with the teeth in occlusion before the free ends of the wire are lightened and twisted. The twisted ends are cut short and lucked into the nearest drill hole. The single strand wire fixation in this horizontal manner is the simplest form of fixation with intraosseous wiring. It can be modified in various ways depending on the following:

- Position of fracture.
- Muscle forces acting on the fragments.
- Number of fragments to be fixed. Nature of the fracture line—oblique, straight, etc.
- The variations can be two-hole, four-hole, and three-hole technique.
- Obwegeser's figure of eight wiring, Hayton-William's modification of figure of eight wiring, etc. These variations arc mainly used at the inferior border of the mandible through extraoral incision[5].

Indications for Extraoral Incision with Transosseous Wiring at the Inferior Border:

1. Unfavorable and grossly displaced fracture at the angle of the mandible.
2. Severe overriding of the fragments.
3. Triangular comminuted fracture at the inferior border associated with angle fracture.
4. fracture of edentulous mandible.
5. Malunited fractures.
6. Non-union of the fracture.
7. Fractures with large extra oral lacerations.

The intraoral incision for fixation of trans osseous wiring at the upper border is chosen for the fractures at the angle with minimum displacement or for the edentulous areas of the body fracture.

Intraoral Transalveolar or Upper Border (Superior Border) Wiring

It was first advocated by Sir William Kelsey Fry to control the posterior fragment by drilling a hole through the alveolar process of each fragment. Here, the wire is passed through the extraction socket of the third molar tooth, which is invariably involved in the fracture line. Many times, simple loop through only the buccal plate may be adequate. But for better fixation both buccal as well as lingual plates of the alveolar process should be involved and the horizontal mattress type of wiring provides optimum stability. While drilling the holes on either side of the fractured fragments at the alveolar crest, one has to select the site for drilling the holes carefully, so that during final twisting, the thin alveolar bone should not get crumbled down. While drilling the hole on the lingual plate, protection of the lingual nerve should be done by placing periosteal elevator. This type of wiling is always combined with some form of intermaxillary fixation (IMF)[3].

Extraoral Lower Border (Inferior Border) Transosseous Wiring

Fractured fragmenls are exposed under direct vision through Risdon's incision. After culling through the plerygomasseteric sling and periosteal layer, the bony fragments are located. The periosteum and tissues on the medial surface are also stripped from the bone for a distance of one centimeter. The end of each fragment is secured with bone holding forceps {Crocodile bone holding forceps, or Kocher's forceps, or Rowe's modified forceps, or Harrison's bone holding forceps) and fractured fragments are brought into approximation by manipulating the bone holding forceps. If some soft tissue is entrapped between the fragments or any other debris should be separated or removed. A Hal ribbon retractor or tongue depressor is placed under the medial side at the inferior border to protect the underlying soft tissue structures. The entire area should be well exposed by using L-shaped retractors at the upper edge of the incision. The holes should be drilled using small round bur with electrical engine and hand piece with constant irrigation of saline solution. The first hole should be drilled in the anterior fragment slightly away from the inferior border and at least 0.5 cm from the fracture site. Another hole should be made through the buccal and lingual cortex. Care should be taken that the hole should be drilled away from inferior alveolar nerve. If four hole technique is to be used, then another hole (No. 2) is drilled above the first hole in the anterior fragment[6].

The ribbon retractor is then repositioned under the posterior fragment. One hole is placed near the inferior border 0.5 cm from the fracture site. Another hole is placed as high as possible above the first one and just below the inferior alveolar canal. Two separate double wires of 26 gauge are cut and one wire is passed from No. 1 hole from buccal cortex to lingual cortex and passed at the posterior fragment to lingual cortex and brought out over buccal cortex from hole No. 4. Then another wire is passed from hole No. 2 and brought Out from hole Mo. 3. Both these wire's ends -are twisted individually in criss cross manner after approximating the fragments and ends nit and finished.

Before final tightening of the wires, the assistant should check the occlusion or temporary IML should be carried out. The wires are checked for their tightness and bone holding forceps removed and fracture reduction is inspected. Wound closure is done in layers.

Temporary IML should be removed prior to extubation, if the procedure is done under GA. In the immediate postoperative period, no IML should be given. Next day IML can be done. The sutures should be removed on 5th-7th day. The stainless steel wires remain within the bone permanently and their removal is not necessary, since it is an inert substance and does not give rise to inflammation or irritation of the tissues, unless sepsis has been introduced[2].

Detached fragments of bone:

During Surgical procedure, detached portions of the cortical bone may be occasionally encountered, which was not obvious clinically as well as radiological. Provided that they are attached to periosteum or muscle, they may be wired back into position. On the other hand, small portions of bone devoid of such attachments with loss of blood supply should not be retained, because they may lead to sequestration at a later date. Such pieces should be therefore removed. However, if a segment of bone removal will lead to a big defect between the bone ends which would lead to nonunion, then in such cases the bone should be replaced back and wired in position as a free graft.

The surgery was performed according to the theatre schedule, usually within 6 to 10 days after the fracture occurrence. The patient was subjected to assessment of the general condition and general anaesthesia. Intraoral, external, or combined approaches were used. A 0.5mm-diameter soft stainless steel wire was used for the fixation. At each fracture focus of the mandible body or angle, two points of fixation were performed, on the base of mandible and the oblique line.

In Le Fort II fractures, osteosynthesis was performed on the nasal cavity lateral rim and the maxillozygomatic buttress. In Le Fort III fractures, it was performed on the infra orbital rim and on the frontozygomatic suture. In the zygoma fractures, a 3-point fixation across zygomaticomaxillary buttress, frontozygomatic suture,

Fig-1,2 fractured mandible and fixed with semi rigid plates and trans osseous wiring

and inferior orbital rim or a 2-point fixation across zygomaticomaxillary buttress and frontozygomatic buttress were performed after evaluation of reduction of the fracture at these three regions; temporozygomatic suture displaced fractures were subjected to closed reduction[7].

The transosseous wiring was always combined with the jaws immobilization in mandibular or Le fort fracture patients. This immobilization was recommended for six weeks in adult patients and three weeks in children. It consisted in maxillomandibular fixation (MMF) using arch bars in patients with mandibular fractures and fixation with wires from the zygomatic process of the frontal bone to the lower arch bar in patients with maxillary fractures. Antibiotics were given preoperatively and continued for 7 to 10 days after surgery. A steroid anti inflammatory was given for 3 days preoperatively and continued for 3 to 4 days postoperatively. Chlorhexidine mouth rinse was given when intraoral approach was used. Liquid and soft diet was recommended in patients with jaws immobilization.

Patients were followed-up postoperatively for at least, 3 weeks in the zygoma osteosynthesis and 6 weeks in the mandible and Le Fort osteosynthesis. At follow-up, patients with mandibular or Le Fort fractures were assessed for occlusion. Those with zygoma fractures were checked for diplopia, enopthalmos and face asymmetry. All the patients were checked for face nervous impairment, operative site infection, and bone union impairment. Operative site infection was defined by a painful swelling or abscess formation with or without drainage from the fracture site. Delayed bone union referred to persistent mobility at the fracture site 8 weeks after osteosynthesis.

Fig-3, Multiple mandibular angle fracture treated with mini bone plates and trans osseous wiring

Discussion

Open reduction and internal fixation of facial fracture has the multiple challenges of restoring the face anatomy and functions impaired by the displacement of the fracture segments and avoiding the treatment-related complications. In this study, these goals are achieved in more than 90% of the patients who had a satisfactory outcome after wire osteosynthesis. Internal wire fixation ensures alignment and contact of the fracture fragments. In a Le Fort or a mandible fracture, these actions are secured by the jaws immobilization. In the zygomatic complex fracture management Gandi et al. declare wire as efficient as miniplate.

Transosseous wiring osteosynthesis is an economical method of internal fixation. Wire and arch bars are more easily affordable than plates and screws. Unlike in the plate and screw system, there is no need of calibrated drill. Moreover, wire is a well tolerated and non-cumbersome material which does not require removal. In this study, no patient complained of wire intolerance as frequently encountered with plates. Erol et al. report complaint of “cold feeling” in cold weather in patients after zygomatico-orbital fracture treatment by miniplate osteosynthesis. Chakranarayan et al. report plates removal in two patients warranted by complaint of palpable implant at the frontozygomatic region and implant rejection. some of wire internal fixation disadvantages include the facts that it is not strong enough to prevent interfragmentary motion across the fracture, and lack of directional control. Jaws fixation required for stability enforcement in the mandibular or Le Fort fracture treatment may result in a significant weight loss due difficulties of feeding, adverse effects on the patient’s social and professional life due to speech difficulty. Additionally, difficulties in maintaining dental hygiene result lastly in dental and periodontal diseases and development of pulmonary atelectasis is reported. Lack of stability may result in bone non-union as any mobility of the fracture fragments impedes the bony healing. Challenge of passing the wire through the drill holes especially in case of limited exposure of the fracture focus and the wire break during its tightening are other concerns which make wire internal fixation time consuming. Additionally, there is a risk of iatrogenic bone substance loss when passing the wire or during itstightening, particularly on the upper jaw bones or in case of comminuted fracture.

Postoperative complications of facial fracture are broad and include occlusion, mouth opening, vision, face sensory and bone union impairments, infections, and face asymmetry. Post operative infections, the most common complication in this study are a usual concern in facial fracture surgery, irrespective to the facial bone. Their spectrum varies from the surgical wound infection to osteomyelitis. Their rates in literature are diverse and the variability may be due to lack of clear definition of post operative infection, differences of study designs and reporting bias. Although the operative site infection rates according to the fracture location do not reach significant differences in this study, mandible fractures are reported to be the most common provider of infectious complications. Postoperative extended regimen prophylactic antibiotics as routinely performed in this study is reported to have no significant beneficial effect. Several studies report compound fracture and delay in treatment being the most determinant risk factors. Maloclusion may result from inadequate reduction and fixation of a Le Fort or a mandible fracture.

However, a restored occlusion may be compromised by a non-compliant patient releasing prematurely himself the jaws immobilization. Delayed bone union observed in two patients with mandible fracture in this study can be due to lack of stability of the fixation as loss of substance or communition of the fracture focus can not be bridged effectively by wire. Face asymmetry and enophtalmos after zygomatic complex fracture repair are likely due to improper treatment. The zygoma provides the prominence of the cheek by its convex external surface and forms a part of the bony orbit. Its fractures are commonly quadripod, at the four processes attached to the frontal, maxillary, temporal and sphenoid bones resulting to the bone displacement inferiorly, medially and rotation. Any inaccurate repositioning of the bone at its different wrists may result in the cheek depression or flattening as well as enophtalmos. In all the patients in this study, fixation of zygomatic complex at more than one point is performed as recommended to achieve a definite stability. However, initial proper reduction in some patients may have been compromised postoperatively by masticatory forces as a rigid and stable fixation could be hardly achieved with wire osteosynthesis. Enophtalmos is a surgical challenge with a fracture of the inferior wall or the medial wall of the orbit reported to be the most common factors. Enophthalmos in the patient in this study could be due the defect of the inferior orbital as well as an outward displacement of the zygomatic bone and loss of substance of the greater wing of the sphenoid bone at the lateral wall of the orbit as reported by some authors. Such treatment of enophtalmos could be hardly achieved as the patient did not have preoperative computed tomography.

Conclusion

Since the plating technology is not easily affordable in developing countries, wire internal fixation may be a reasonable alternative for the surgical treatment of non-comminuted facial fractures and those without bone substance loss, in such setting. However, efforts should be directed to adopt the modern technology of plating system because of its better results.

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