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Experiences with Intraoral Trans-osseous Wiring of Mandibular Fractures

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Summary

After a survey of our indications for the intra-oral approach for placing wires in treating mandibular fractures, our experience with 148 patients, treated with 178 wiring sites, is described. The total number of complications amounted to 7% of the wiring sites. A re-operation was necessary in 4 cases. Middle segment fractures and fractures in the edentulous mandible are especially difficult to treat. Overall, however, the results were good. With an uncomplicated course of healing, the duration of intermaxillary fixation may be reduced to 4 weeks with satisfactory results. Our results may be favourably compared with the results in patients treated with bone plates for fracture reduction.

Key-Words: Mandibular fractures, trans-osseous wiring.

Introduction

Experience has repeatedly shown that there are many types of mandibular fractures that lie outside the range in which conservative treatment is indicated. In these cases, the fractured segments must be surgically repositioned. The segments may then be well adapted and directly wired into the best possible position. In this article, we report our experience in treating mandibular fractures with the direct intra-oral transosseous wiring technique. This method of treatment, in combination with a dental splint, was first proposed by *Morel-Lavallée* in 1861. It was suggested again by *Obwegeser* (1955) and has been used in our clinic for the past 20 years.

Method

The procedure is as follows: In all fractures of the mandible, when an adequate natural dentition is present, dental splints are utilized. With a full natural dentition present, *Obwegeser's* (1953) continuous loop-wiring technique is preferred. In the region of the fracture site the splint is not tightened before the surgical repositioning of the segments is completed. Irrespective of the fracture location – from midline symphysis to low condylar neck fractures – the intra-oral surgical approach is used unless a skin laceration is already present, through which direct intra-osseous wiring can be accomplished. The fracture is exposed through the vestibular mucosa and the fragments are dissected free, repositioned, and wired into proper alignment. The loop of the splint in the region of the fracture is tightened and finally intermaxillary wire fixation is applied. This is the course of the surgical treatment in most of our cases.

With fractures that occur distal to the dentition, i.e. in the angle of the mandible, frequently upper border wiring is used after correct occlusion is secured by intermaxillary fixation. The bur hole must be placed more inferiorly in the anterior fragment than in the posterior fragment.

With fractures of the edentulous mandible, when little or no atrophy of the aveolar ridge is present, in both the upper and lower border of the mandible, two parallel wires are used, perpendicular to the fracture line. Additionally for further stabilization, in certain cases, percutaneous pins have been inserted under direct intra-oral vision *(Obwegeser* 1968). In the case of the extremely atrophied mandible the method described above as well as all other methods proved unsatisfactory.

Sagittal fractures of the ramus and long oblique fractures of the condylar neck are treated by placing one or two circumferential wires percutaneously around the fragments with an awl.

In the case of low horizontal fractures of the condylar neck, intra-osseous wiring is avoided when possible. The approach to this problem is as follows *(Obwegeser* 1970): Initially, intermaxillary fixation is accomplished in the anterior region only. Then, approaching the fracture via the oral route, a strong, large hook is inserted into the sigmoid notch and the ramus is pulled downwards. The condylar neck which is usually medially dislocated,

may then be repositioned. Intermaxillary fixation in the molar region is now completed. If adequate stabilization of the condylar fragment is not secured, a wire suture may be then placed through bur holes in each fragment.

Indications

Generally, trans-osseous wire sutures are indicated in the following cases of mandibular fracture:

1. If conservative repositioning of the fragments is impossible;
2. In fractures where the distal segment is edentulous and an unfavourable fracture line is present;
3. Where there are few or no remaining teeth in the lower jaw;
4. In complex fractures of the mandible;
5. When pseudarthrotic symptoms appear after conservative fracture treatment.

Following the above indications as treatment criteria in our clinic, excluding condylar head fractures, about every fourth patient with a mandibular fracture is treated with direct transosseous wiring.

Case Material

In this study we will only consider those cases in which we have a continuous pre- and postoperative documentation of treatment so as to enable a more accurate evaluation. Our statistics are obtained from the results of 148 patients with a total of 178 transosseous wire sites in the mandible, which were operated on between 1. 1. 1963 and 31. 12. 1972, adhering to the principles stated above. Of the patients treated, 121 had teeth present and 27 were edentulous. Intermaxillary fixation was used additionally in the patients with natural dentition *(Table 1)*. As it may be of interest to know the site of mandibular fractures, this is demonstrated by the number of cases in *Fig. 1*.

Table 1 Number of Patients and Wire Sites.

	Patients	Wire Sites
Natural Dentition	121	145
Edentulous	27	33
Total	148	178

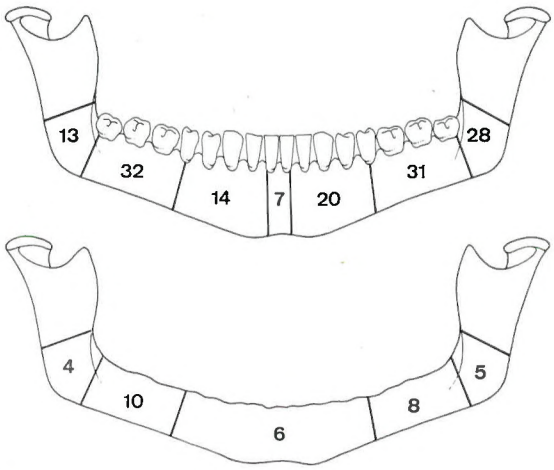


Fig. 1
179 Fracture sites treated with trans-osseus wiring.

Results

Small localized complications, such as suture dehiscence or a rapidly controlled local infection, etc. were observed at 19 wiring sites. They will not be considered further because for the most part these minor complications were primarily due to poor tissue vitality resulting from the injury. In none of the cases did this influence the course of fracture healing and therefore, in our estimation, did not effect the results of this study of intraorally placed trans-osseous bone wires.

Of the 12 significant complications found, there were 5 cases with disturbance in fracture healing, 5 cases of healing in malposition, and two with other healing complications. Of these cases, 4 required re-operation *(Table 2)*. The main group of significant complications consisted of those with delayed bony union and those with occlusal abnormalities, each of which comprised 3% of the total operation sites. Of the 5 cases with delayed bony union, 2 cases were admitted with an abscess present prior to treatment. One case was a severe comminuted fracture. In the 4th case, disturbed healing was caused by complications in the patients

Table 2 Complications in 178 Wire Sites.

Occlusal Abnormalities	5 (3.0%)
Delayed Bony Union	5 (3.0%)
Pseudarthrosis	1 (0.5%)
Osteomyelitis of fracture line	1 (0.5%)
Total	12 (7.0%)

general medical condition. However, these 4 fractures were united after 4 months' treatment. Intermaxillary fixation was continued for between 4 and 12 weeks. In the 5th case, with extensive soft tissue damage, adequate tissue to cover the fracture site completely was not present. Here, after 7 weeks of intermaxillary fixation, a year elapsed before the fracture was clinically consolidated. In these five cases with complicated healing none had disturbance of occlusion.

In the 5 cases with discrepancies in occlusion, consolidation of the fracture was complete within 6 weeks, occlusal discrepancies were caused by malposition of the fragments. In 3 of the 5 cases, the occlusal discrepancy was so small that correction was obtained by grinding. The remaining 2 cases required re-operation for correction.

In one case, in spite of early trans-osseous wiring, a fracture-line osteomyelitis occurred. Pre-existing abscess had been present, however, at the time of surgical repositioning of the fragments. Of the cases cited in Table 2, one developed a pseudarthrosis. This was a fracture in an edentulous mandible which was treated with direct wires and bank bone. It is presumed that the cause of one case of marginal mandibular nerve paresis was due to the extra-oral insertion of Roger-Anderson pins, which were utilized in addition to intra-oral intra-osseous wiring of a fractured edentulous mandible.

The duration of intermaxillary fixation was generally between 4 and 6 weeks. In tabulating the different durations of immobilization to compare the duration of fixation with disturbances of fracture healing and discrepancies in occlusion, as we have done in Tab. 4, no difference in results was found. The percentage of complications were equally high in both groups.

Table 3 Reoperations.

Malunions	2
Osteomyelitis of fracture line	1
Pseudarthrosis	1
Total	4 (2.5%)

Table 4 Duration of Intermaxillary Fixation in Jaws with Teeth.

	Wire Sites	Healing Complications Occlusal Disturbances
4 weeks or less	28	2 (7%)
more than 4 weeks	120	8 (7%)

Discussion

The method of application of intra-oral trans-osseous wiring was proposed by many authors (*Kazanjian* 1933, *Bradley* and *Hildreth* 1954, *Obwegeser* 1955, *Marlette* 1963, *Neuner* 1971 and others). Nevertheless, none have published their results in respect of complications in a large series, in detail. The results presented show that complications were present in 7% of the total number of patients treated. Difficulties are obvious in the treatment of middle segment fractures ("Mittelstückfraktur", i.e. bilateral fractures in the canine region) and 4 of the 5 cases of occlusal abnormalities belonged to this group of fractures (*Table 2*). We must, therefore, ask ourselves whether another method of stabilization can be found to treat this type of case. Another area in which treatment is problematical is in the surgical care of the edentulous atrophic mandible (*Table 5*). Here the rate of complications is nearly double that of the mandible with natural dentition. For this reason another method of treatment was recently adopted (*Obwegeser* and *Sailer* 1973).

An important factor in the occurrence of complications is the time scale in which surgical treatment

Table 5 Therapy for Fractured Edentulous Mandibles.

	Wire Sites	Complications
Wiring alone	6	1
Wiring + IMF with acrylic splints	9	0
Wiring + Extraoral Pins	15	2
Wiring + Bank Rib Grafts	3	1
Total	33	4 (12%)

Table 6 Time Scale from Fracture Until Operation.

Operation	Wire Sites	Complications
until the 4th day	86	2 (2.3%)
until the 10th day	53	3 (5.7%)
later	39	7 (18%)

is established *(Table 6)*. About 1/5 of the fractures were operated on more than 10 days after injury; half the complications occurred in this group. The complication rate is about 3 times higher than in the group that had early treatment. In our clinic, the number of patients treated long after the accident has clearly decreased in recent years.

In discussing the duration of intermaxillary fixation *(Table 4)* we can conclude, from our results, that with a normal postoperative course the duration of fixation may be reduced from 6 to 4 weeks. However, the number of cases in our study is comparatively small and we cannot prove this statement statistically.

Bradley and *Hildreth* (1954) describe 21 cases of intra-orally placed trans-osseous wires. As far as we know, this is the largest published series. In their series, they state that there were no infections present; however, they did not mention the problem of delayed healing. It is our belief that the criteria for treatment of these two authors and *Marlette* (1963) differ from our own which parallel those of *Neuner* (1971). In comparing our results with the results obtained from those authors using bone plates, as in the study by *Schmitz* et al. (1973), they reported a somewhat smaller complication rate in respect of discrepancies in occlusion, and few segment displacements in a study with a comparable number of cases to our own. The number of infections and re-operations occurring in both groups was the same. In the patient study published by *Scharf* and *Reuter* (1973), a somewhat smaller number of cases was presented with a somewhat higher percentage of complications. The number of complications, particularly in fracture healing, was relatively high. In our opinion, an extra-oral incision in itself might be called a complication, as it is not caused by the trauma and particularly if an incision in the facial region can be avoided in treating a facial fracture. In most cases bone plates applied to the mandible require an extra-oral incision.

All publications covering the field of bone plates agree that the main problem encountered is in obtaining perfect cuspal interdigitation *(Spiessl* and *Schargus* 1971, *Luhr* 1972, *Schilli* and *Niederdellmann* 1973 and others). *Spiessl* and *Schargus* (1971) believe that when using bone plates without intermaxillary fixation, a malocclusion may be avoided only when the principle of orthopaedic plating with a tension-band is utilized. *Ewers, Niederdellmann* and *Schilli* (1973), by utilizing a special scheme of placing the screw holes achieve a pre-compression of the bone segments in the area above to the plate. In our field, this means the area of occlusion. Unfortunately, there are no results reported in the literature to date about this important problem.

Whereas in cases of trans-osseous wiring the removal of the wires is unnecessary, as previously mentioned by *Grasser* (1972), bone plates must be removed thereby necessitating another surgical procedure. On the other hand, we cannot forego intermaxillary fixation because we consider trans-osseous wires alone to be generally not stable enough to secure perfect occlusion – in contrast to *Neuner* (1971). The only acceptable exception to this rule, in our opinion, is in the edentulous, not too highly atrophic mandible. *Schwenzer* (1966), from his studies on the most mechanically favourable configuration of the wires, also believes that inter-maxillary fixation is necessary.

Although the intra-oral technique of placing the wire is somewhat more demanding, this difficulty has to be accepted to avoid the disadvantages of an external incision with its possible accompanying complications of visible scarring and damage to the mandibular branch of the facial nerve.

Conclusions

Based on the experience of the series presented the following conclusions can be drawn:

1. The intra-oral trans-osseous wiring technique has been well proven for us. Yet, one problem that is apparent is in the treatment of middle-segment fractures.
2. In spite of the exclusive use of oral access to the fracture site, the postoperative infection rate causing delayed fracture healing is small.
3. The final results after treatment with intra-orally placed wires appear, on the whole, at least as good as those treated with bone plates.
4. The treatment of fractures in the edentulous extremely atrophic mandible is subject to an especially high complication rate. For these cases an alternative method of treatment has recently been reported by *Obwegeser* and *Sailer* (1973).

5. Surgical treatment should be accomplished as early as possible following trauma, that is, as soon as life-threatening conditions are alleviated.
6. Intermaxillary fixation for 6 weeks is usually sufficient in all cases. A reduction of fixation to 4 weeks in uncomplicated cases appears to be justified.

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