CROOMA, complication rates of operatively treated mandibular fractures, paramedian and body

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Introduction. This retrospective study comprises an exploratory analysis of 10 years of surgical treatment of symphysis (S) and parasymphysis/body (P/B). Correlations of complications, as well as dependencies of surgical concepts, are investigated.

Materials and methods. All surgically treated patients in the period of 1995 to 2005 with at least one mandibular fracture mesial to the mandibular angle were included in this study. A total of 63 patients (46 men, 17 women) with 63 symphysis fractures were included and 497 patients (369 men, 128 women) with 553 P/B were included; 99.27% (549) of these fractures were included in the study, 4 had to be dismissed because of inconclusive documentation.

Results. Of patients with P/B, 96.04% were successfully treated with 1 open reduction, 3.76% had 2, and 0.20% had 3 surgeries. Of the surgically treated patients, 75.77% (416) were completely free of complications, whereas the other 24.23% (123) were not. The main complication was mild nerve damage (24.8%).

Osteosynthesis failure rate (OFR) was 2.4% (7 of 298) for 2 miniplates, 5.7% (3 of 53) for 1 tension screw, and 8.4% (9 of 107) for 1 miniplate. Regarding OFR, 2 miniplates showed to be superior in a Fisher exact test (P = .018, adjusted P = .132). Symphysis fractures were completely free of complications in 81.8% and showed 2 major complications, i.e., 1 severe nerve damage and 1 osteosynthesis failure.

Discussion. This study has the limitations of a retrospective study.


Facial trauma is frequently accompanied by fractures of the facial skeleton. Reconstructions of fractures of the frontal bone, the maxilla, and the mandible follow different treatment goals and concepts. Common aims of recovery comprise good occlusion, chewing function, and decompression of sensitive nerves. In contrast to mandibular fractures, reduction of maxillary fractures aims to recover mobility of the eye, eliminate diplopia, and recreate esthetic bony prominences. Fractures of the lower jaw show different problems such as higher mechanical stress along with increased rates of osteosynthesis failure and pseudarthrosis.

Topographic classification of mandibular fractures separates symphysis, parasymphysis, mandibular body, angle, ramus, mandibular neck, and diacapitular fractures. The fracture localization again accounts for diversity in surgical treatment concepts and different complication rates. Surgical treatment of angle and neck fractures is more error prone than parasymphysis and body fractures. A series of scientific publications is dedicated to the previous 2 regions.

In the parasymphysis and mandibular body region (subsequently summarized as P/B), several surgical concepts have been established: rigid osteosynthesis in the base of the mandibular body according to the function stable AO concept (Arbeitsgemeinschaft für Osteosynthesefragen), osteosynthesis with 2 miniplates according to the exercise stable principle of Champy, and tension screws mesial to and below the mental foramen and especially in the symphysis region. In cases of noncomminuted fractures and good reduction, surgeons might even use 1 single miniplate in mandibular body fractures distal to the mental foramen according to Champy (see Figs. 1 and 2).

Postoperative intermaxillary fixation (IMF) is used as a nonrigid treatment alternative or temporary adjuvant therapy.

The preferred surgical approach in our clinic is the marginal incision and thus most of the collected cases.
were treated using this surgical approach. According to the clinic protocol, 3 special cases allow for extraoral approaches larger than step incisions (for transbuccal trochars), such as the submandibular approach, i.e., (1) highly comminuted fractures, (2) fractures of highly atrophic mandibles, and (3) revision surgery owing to nonunion.

Although mandibular angle and neck fractures show different complication rates, lateral mandibular fractures (LMFs) are largely ignored by the scientific community or publications do not address complication rates in the adult patient.  

Ellis and Graham reported about a 2.0-mm locking plate system for mandibular fracture surgery. The 24 body fractures and 19 symphysis fractures did not show any osteosynthesis failure. Bolourian et al. showed equivalent results including 1 symphysis and 11 parasymphysis fractures using a single 2.0-mm miniplate, 4 monocortical screws along Champy’s line of ideal osteosynthesis, plus 2 to 3 weeks of IMF. Chritah et al. confirmed these findings with 1 week of IMF in 17 parasymphysis fractures, 1 body fracture, and 1 symphysis fracture. In a study of Lazow and Tarlow, osteosynthesis failure was found.
in 1 of 159 fractures using 2.0-mm locking miniplates with 1 week IMF.

Nevertheless, a large-scale study regarding P/B is still missing. Our retrospective study comprises an exploratory analysis of 10 years of surgical treatment of P/B. Correlations of complications as well as dependencies of surgical concepts are investigated. It might thus be used for future study planning and sample size calculations.

MATERIALS AND METHODS
The study protocol was approved by the Ethical Committee of the medical university.

Inclusion criteria and data collection
All surgically treated patients in the period of 1995 to 2005 with at least one mandibular body fracture were included in this study and stratified into symphysis fractures and parasymphysis and body fractures (P/B). According to our clinic protocol in cases without complication, standardized follow-up intervals were 10 days (removal of stitches), 5 to 7 weeks, and 5 to 7 months postoperatively. Follow-up intervals were up to weekly in cases of minor complications or those requiring hospital admission. The patients’ electronically documented histories and surgical reports were retrospectively investigated. Data were collected in a newly developed Microsoft Access 2003 database. Because reporting was very heterogeneous using incoherent nomenclature, reclassification tables were built to aggregate complications.

Reclassification of complications
Complications could be classified into 8 major groups: osteosynthesis failure (OF), pseudarthrosis (P), infection (I), mild nerve trauma (MNS), severe nerve trauma (SNS), wound healing disturbance (W), functional impairment (F), and malocclusion (D). Osteosynthesis failure contains fracture of plates or screws and screw loosening. Pseudarthrosis merges fibrous healing and missing osseous healing in the sense of nonunion. Infection combines abscesses and local phlegmona. Local osteomyelitis related to osteosynthesis material was not found in this study. Severe nerve trauma is related only to permanent hypesthesia, dysesthesia, anesthesia, or palsy of the facial nerve. A transient hypesthesia after open reduction is common and was not assessed in this study. Wound healing disturbance is often related to infection, but can also be observed alone with a small inflammatory component. In this study, the term is related to missing soft tissue healing or secondary wound dehiscence. Functional impairment described pathologically limited temporomandibular joint (TMJ) range of motion or joint affection. Despite malocclusion being a functional impairment itself, it was separated to document patients’ complaints of disturbed bites.

Statistical evaluation
Descriptive statistics were programmed as report tables in simple query language (SQL) within Microsoft Access. Hypotheses were tested and statistically evaluated in the open source statistical programming envi-
Table II. Treatment concepts in parasymphysis and body fractures

<table>
<thead>
<tr>
<th>Concept</th>
<th>N =</th>
<th>Osteosynthesis failure</th>
<th>Pseudarthrosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 miniplate</td>
<td>107</td>
<td>8.41 (n = 9)</td>
<td>8.41 (n = 9)</td>
</tr>
<tr>
<td>2 miniplates</td>
<td>298</td>
<td>2.35 (n = 7)</td>
<td>2.68 (n = 8)</td>
</tr>
<tr>
<td>1 tension screw</td>
<td>53</td>
<td>5.66 (n = 3)</td>
<td>0 (n = 0)</td>
</tr>
<tr>
<td>2 tension screws</td>
<td>16</td>
<td>0 (n = 0)</td>
<td>6.25 (n = 9)</td>
</tr>
<tr>
<td>Other</td>
<td>79</td>
<td>3.80 (n = 3)</td>
<td>5.06 (n = 4)</td>
</tr>
</tbody>
</table>

Failures are given in percent and absolute numbers in brackets.

RESULTS

A total of 63 patients (46 men, 17 women) with 66 symphysis fractures were included. Men were 28.37 ± 13.43 years of age, women 25.60 ± 14.84. Symphysis fractures showed 4 wound healing disturbances (6.1%), 1 infection (1.5%), only 1 osteosynthesis failure (1.5%, see Table I), no pseudarthrosis (0%), 6 mild nerve damages (9.1%), 1 severe nerve damage (1.5%), and no malocclusion (0%). A total of 54 patients (81.8%) were completely free of complications, 10 (15.2%) had minor complications, and 2 (3%) had severe complications (OF and SND).

A total of 497 patients (369 men, 128 women) with 553 P/B were included. Men were 30.37 ± 13.69 years of age, women 43.46 ± 23.78 (see Fig. 3). Of these fractures, 99.27% (549) were included in the study; 4 had to be dismissed because the documentation of the surgical treatment was not conclusive. There were 96.04% of fractures successfully treated with 1 open reduction, 3.76% had 2, and 0.20% had 3 surgeries. Of the surgically treated patients, 75.77% (416) were completely free of complications. Treatment concepts are summarized in Tables I (symphysis fractures) and II (P/B). Complication rates and their correlations are given in Table III. Risk factor analysis for osteosynthesis failure and pseudarthrosis is given in Table IV. The 2 largest treatment groups are compared in Table V.

DISCUSSION

Surgical therapy of symphysis mandibular fractures is very safe, reflected by a high success rate. In contrast, P/B show more major complications. Three quarters of environment R using Fisher’s exact test. Accounting for multiple testing, P values were adjusted using Bonferroni correction. Possible risk factors influencing osteosynthesis failure or pseudarthrosis “age above 20 years,” “sex,” “multiple fracturing of the mandible,” and “intermaxillary fixation” were analyzed through multiple Fisher exact tests and Bonferroni correction. The 2 largest treatment groups (with “1 miniplate,” “2 miniplates”) were compared considering osteosynthesis failure and pseudarthrosis.
the patients with P/B showed therapeutic success without any kind of complication. Nevertheless, complications accumulate in the other quarter, thus 1 patient often shows more than 1 complication (see Table III). Thus, the existence of 1 complication increases the probability of a second one.

The crucial complications—regarding their total number—showed to be mild nerve trauma (temporary hyposensitivity) and wound healing disturbances. According to the department’s trauma protocol, every trauma patient routinely receives antibiotics. Wound healing disturbances might be caused by smoking, poor oral hygiene, lacerating wounds, diabetes, undue dissection, or wound closure under tension.

Mild nerve trauma often accompanies P/B. Mostly the trauma itself causes hypoesthesia; other reasons might be undue dissection or nerve damage during reduction.

A variety of treatment concepts were used but only one showed to be sufficient regarding osteosynthesis failure and pseudarthrosis: osteosynthesis using 2 miniplates. Because tension screws are limited in their indication to symphysis and P/B with sufficient bony height between mandibular canal and lower border, only a small number were included in this study.

Two factors were shown to be weakly significant (i.e., highly significant $P$ but no significance after Bonferroni correction) regarding osteosynthesis failure: age and multifracture. One possible reason might be prolonged healing times in older patients accompanied by prolonged stress on osteosynthesis material. This hypothesis is supported by the fact that young patients did not show pseudarthrosis and thus better healing of bone. Single fractures were shown to be more prone to osteosynthesis failure. This compares with investigations of the mandibular neck. The authors believe that single fractures seduce patients to neglect soft diet in the first 6 weeks. Comparable studies with smaller osteosynthesis failure, such as that of Lazow and Tarlow, do use IMF for 1, 2, or 3 weeks. In contrast, no advantage of postsurgical IMF (according to the clinic protocol, IMF is accomplished by 1 hook in each jaw between the central incisors and elastics between the hooks) was found in our study according to Table IV. Nevertheless, a prospective randomized study comparing no postsurgical treatment and postsurgical IMF is missing. Certainly patients treated with IMF do restrict on soft diet.

Another reason of higher OSF in single fractures might be that osteosynthesis of 2 fractures compensates for minor malocclusion owing to the elasticity of titanium.

**CONCLUSION**

A high success rate of open reduction and osteosynthesis with 2 miniplates can be guaranteed.

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**REFERENCES**


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