Stability of the osteotomy site following bilateral sagittal split osteotomy: screw fixation v IMF


Department of Maxillofacial Surgery, Newcastle General Hospital, Newcastle-upon-Tyne; Department of Maxillofacial Surgery, Free University Hospital, Amsterdam, The Netherlands

SUMMARY. In a group of patients with mandibular deficiency with a low to normal mandibular plane angle (mean 20.7°, range 10–28°) and deep bite, the position of the condylar segment relative to the mandibular body, following bilateral sagittal split osteotomy (BSSO) for mandibular advancement was assessed. Ten patients in whom intermaxillary fixation (IMF) was used for a 5-week period were compared to 10 patients where 2 mm diameter Wurzburg™ positional screws were used as internal fixation. Six patients who were known bruxists and underwent BSSO were also reviewed. No clinically significant changes were seen in any patient group and no significant differences were found in the relationship with time between the condylar and body segments, irrespective of the fixation method used.

INTRODUCTION

Since Obwegeser and Trauner’s description of the sagittal split osteotomy in 1957 this operation has been used to advance the mandible in cases of mandibular retrognathia with increasing frequency. A number of technical modifications of the procedure are in common use today and have improved the reliability and stability of the procedure (Dal Pont, 1961; Hunsuck, 1968). However, postoperative relapse of both dental and skeletal elements still occurs (Epker & Wessberg, 1982; Van Sickels et al., 1986). Factors contributing to skeletal relapse have been considered by many authors, and have included the surgeon’s level of experience (Epker & Wessberg, 1982), the degree of mandibular advancement (Van Sickels & Flanary, 1985), the postsurgical position of the condyle (Will et al., 1984) and the presurgical mandibular plane angle (Greebe & Tuinzing, 1984).

The recent trend towards the increased use of internal fixation for the management of mandibular osteotomies has enabled a comparison of the techniques of intermaxillary fixation with a variety of internal fixation methods. In this study, patients in whom intermaxillary fixation (IMF) was used for a 5-week period following bilateral sagittal split osteotomy (BSSO) mandibular advancement were compared to patients where 2 mm diameter Wurzburg™ positional screws were used as an internal fixation method. Six patients who were known bruxists and underwent BSSO for mandibular advancement were also assessed as there was a clinical impression that in the bruxist patients, the proximal segment rotated superiorly during the healing phase.

Patients in the screw fixation and IMF groups were selected randomly from an operative database. Patients who had IMF were selected from 1989 when this was the commonest method of fixation. The screw fixation group were operated on in 1990. During this period the planning and indications for surgery remained constant.

Patients were defined as bruxists using a number of criteria. These were: temporomandibular joint dysfunction with a myogenic component associated with marked attrition and faceting of tooth surfaces. Splint therapy had been used pre-operatively and a high incidence of splint fracture and/or wear was recorded.

Dento-facial deformities may be divided into five categories to enable accurate diagnosis and treatment planning (Tuinzing et al., 1990). These categories also enable predictions regarding stability and temporomandibular joint behaviour postoperatively (Kerstens et al., 1989). The groups are summarised in Table 1.

MATERIAL AND METHOD

A group of 20 patients who had surgical orthodontics in the Department of Oral and Maxillofacial Surgery at the Free University of Amsterdam were retrospectively assessed for changes at the osteotomy site following BSSO. The mean age was 30.2 years with a range of 17–59 years. Seventeen were female and 3 were male. All patients were of a C category, with

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<th>Table 1 - Classification of dento-facial deformity</th>
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<tr>
<td>GROUP A</td>
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low to normal preoperative mandibular plane angles, mean 20.7° (range 10°-28°). Assessment was carried out using standardised lateral cephalograms taken pre-operatively (T1); 1-3 days postoperatively (T2); 6 weeks (T3); and 1 year postoperatively (T4). An additional group of 6 bruxist patients, 5 male and 1 female, with a mean age of 42.1 years (range 35-48 years) were also studied. T4 films were not available for three of this group.

Ten patients had intermaxillary fixation applied for a period of 5 weeks, and 10 had screw fixation: 5 of the bruxism patients were treated with IMF and in 1 patient screw fixation was used. After presurgical orthodontics, all operations were carried out using a standardised technique with one of the authors as the main operating surgeon. A Hunsuck-modified BSSO was carried out in all of the patients (Hunsuck, 1968).

Prefabricated acrylic and wire splints were used to determine the degree of mandibular advancement according to the preoperative plan, and in the IMF group these were left in situ for the 5-week period of fixation. A simple loop wire was used at the upper border of the mandible between the proximal and distal fragments to prevent gross displacement of the segments. Additional skeletal fixation was also used in this group with mental and anterior nasal spine wires for IMF.

Positional screw fixation was achieved with the patient in IMF and an acrylic and wire splint in situ. Three 2 mm diameter Wurzburg™ screws were placed at the upper border of the mandible via a transbuccal approach. The proximal segment was positioned and held by an assistant during fixation.

Tracings were carried out by one author using a superimposed SN line. Ramus to body, ramus to SN and mandibular body to SN values were calculated on all postoperative radiographs. T1 films were used to determine the preoperative mandibular plane angle (Fig. 1).

RESULTS

Summation of the changes in each group, IMF, screw fixation and bruxists are shown in Figures 2-4. Changes are shown relative to the T2 film and are the mean changes for different groups at each measurement site. In the screw fixation group the ramus to mandibular body angle increased slightly from period T2-T4. The range of change was -3° to +5°, mean change 126.7°-128.8°, ramus to SN values decreased with a range of change recorded from -3° to +2°, mean 80.3°-79.9°, mandibular body to SN increased slightly, range -1° to +5°, mean change 26.9°-28.9°.

Ramus to body values in the IMF group also increased slightly from T2-T4 radiographs. The range of values was from -2° to +10°, and the mean change was from 130.6°-133.7°. In the ramus to SN

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Fig. 1 - Reference planes for cephalometric assessment.
calculations a small average decrease was seen, range
$-6^\circ$ to $+4^\circ$, mean change $79.0^\circ$ to $78.2^\circ$. Meanwhile
body to SN measurements increased slightly, range
$-2^\circ$ to $+8^\circ$, mean change $29.3^\circ$ to $31.6^\circ$. In the bruxism
group a similar pattern of change was seen with
ramus body values again increasing slightly, range
$+1^\circ$ to $-4^\circ$, mean change $132.2^\circ$ to $135.8^\circ$. Ramus to
SN angles decreased slightly from a mean of
$78.8^\circ$ to $76.5^\circ$, the range of change $-2^\circ$ to $+1^\circ$.
Mandibular plane angles remained relatively constant
changing from $31.2^\circ$ to $31.3^\circ$, range $-1^\circ$ to $+3^\circ$.
The results were subjected to a statistical analysis
using a Students t test. No values reached a level of
significance for the method of fixation used. 95%
confidence limits were calculated for the different
fixation groups. Statistical results are shown in Tables
2 and 3.
All patients had a clinically acceptable result. As
mentioned above this study was in part stimulated by the clinical impression that in patients known to
be bruxists who underwent BSSO the proximal seg-
ment had a tendency to rotate superiorly postoper-
atively. However, no significant change in the
angle of body to ramus, ramus to SN, or
mandibular plane to SN was seen between T2 and
T4 films.

**DISCUSSION**

In recent years various techniques of internal fixation
have been introduced for the BSSO in an attempt to
reduce skeletal relapse and improve patient comfort
(Souyris, 1976; Spiessl, 1976; Jeter et al., 1986). Van
Sickels et al. (1986) demonstrated a markedly reduced
horizontal movement during the first 6 weeks post-
operatively at point B, and pogonion, followed by a
slight advancement at 6 months in patients where
rigid internal screw fixation was used. More recent
work by Watzke et al. (1990) has not confirmed the short term benefits of rigid internal fixation when compared to IMF long term, with regard to relapse.
In Watzke's patients, rotation of the proximal seg-
ment in the wire group was greater than in the screw
group, but greater remodelling occurred in the screw
group. The net result was that the screw group
maintained a presurgical gonial position better than
the wire group, but no other measure attained a level of
statistical significance.
Watzke's study found that in the IMF group the
ramus tended to incline forwards immediately after
surgery with the gonion moving forward an average
of nearly 3 mm. In the screw group ramus position
was much better maintained initially, but underwent
greater proximal segment remodelling. Watzke and
his co-workers did not consider these changes to be
of clinical significance. In this present study the ramus
appeared to rotate posteriorly at period T3 in the
screw and IMF groups whilst the bruxist group
showed a slight anterior rotation from the T3 film.
In all groups slight anterior rotation had occurred on
the T4 film.
The impact of positional change at the osteotomy
site not only needs to be considered for skeletal
relapse but may influence the relationships of the
temporomandibular joint and thus the incidence of
postoperative temporomandibular joint dysfunction
(Will et al., 1984; Hackney et al., 1989). Kerstens
(1989) looked at the incidence of pre and postoper-
ative TMJ symptoms following orthognathic surgery
for different groups of dento-facial deformity. In his
study 66% of the preoperatively symptomatic patients
reported fewer TMJ symptoms 1 year after corrective
surgery. The best results were found in patients
operated on because of low or normal angle mandibular
retrognathism. Although not of statistical signifi-
cance, the chance of developing TMJ symptoms in
high angle absolute mandibular retrognathism
patients operated on by means of bimaxillary surgery
was found to be considerable.

**Table 2 - Statistical analysis: 95% confidence limits**

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<th>IMF-Screw group</th>
<th>IMF-Bruxist group</th>
<th>Screw-Bruxist group</th>
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<tr>
<td>Ramus-Body</td>
<td>$-2.19^\circ$ &lt; $4.19^\circ$</td>
<td>$-3.95^\circ$ &lt; $4.65^\circ$</td>
<td>$-4.05^\circ$ &lt; $2.75^\circ$</td>
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<tr>
<td>Ramus SN</td>
<td>$-1.53^\circ$ &lt; $2.33^\circ$</td>
<td>$-3.14^\circ$ &lt; $2.55^\circ$</td>
<td>$-1.85^\circ$ &lt; $2.05^\circ$</td>
</tr>
<tr>
<td>Body-SN</td>
<td>$-2.06^\circ$ &lt; $2.86^\circ$</td>
<td>$-2.15^\circ$ &lt; $4.75^\circ$</td>
<td>$-1.91^\circ$ &lt; $3.71^\circ$</td>
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**Table 3 - Statistical analysis: P. values**

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<th>IMF-Screw group</th>
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<th>Screw-Bruxist group</th>
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<tbody>
<tr>
<td>Ramus-Body</td>
<td>0.5</td>
<td>0.9</td>
<td>0.7</td>
</tr>
<tr>
<td>Ramus-SN</td>
<td>0.7</td>
<td>0.8</td>
<td>0.9</td>
</tr>
<tr>
<td>Body-SN</td>
<td>0.7</td>
<td>0.4</td>
<td>0.5</td>
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techniques of internal fixation. Van Sickels et al. (1985), Kierl et al. (1990), and Kirkpatrick et al. (1987) have all commented on the stability of various techniques of rigid internal fixation. Recent comparisons between IMF and internal fixation have cast doubt on the theory that increased stability at the osteotomy site results in decreased relapse (Watzke et al., 1990).

By clinically defining the type of dento-facial deformity as described in Figure 1, it is possible to compare similar types of deformity with operative technique and method of fixation. In this study measurements were made at the osteotomy site in an attempt to define the relative stability of IMF and screw fixation. Minor changes occurred in all patients postoperatively but were of a small degree and did not affect the clinical outcome. The ramus to body angle had a tendency to increase from T2 to T4 in all groups, but there was no significant difference between the fixation groups. It was noted that in SN changes were negative over time, but again there was no significant difference between the groups.

In the IMF group, the mandibular plane angle increased slightly from period T2 to T4. These changes indicated a slight clockwise rotation of the mandible as previously demonstrated by Greebe and Tuinzing (1984). Whether these movements represent compensatory dento-alveolar changes or plasticity at the osteotomy site, is not clear. All patients had both pre- and postoperative orthodontics, and most required the closure of lateral open bites. However, these changes were not prevented by the use of internal fixation and appeared to be of a comparable level to those seen in the IMF group.

There are many apparent benefits of internal fixation following orthognathic surgery. Patient acceptance is high as there is less disturbance of function and it is more comfortable than a period of IMF. Postoperative airway management is made easier as it is patient feeding and speech. Numerous workers have demonstrated that the various techniques of screw fixation are stable.

Postoperative changes do still occur, however, and in the region of the osteotomy site appear to be small but predictable and do not seem to affect the clinical outcome. There does not appear to be a significant difference between IMF and screw fixation, in either normal patients or patients known to have a bruxism habit.

This study supports the view that the category of dento-facial deformity is the determining factor in successful surgical outcome, rather than the fixation method used.

References


The Authors

G. D. Putnam FDSRCS, FRCS
Registrar
Department of Maxillofacial Surgery
Newcastle General Hospital
Westgate Road
Newcastle-upon-Tyne NE4 6BE
J. P. B. Bouwman DMD
Oral Surgeon
D. B. Tuinzing DMD, PhD
Professor
Department of Maxillofacial Surgery
Free University Hospital
Amsterdam
The Netherlands

Correspondence and requests for offprints to Mr G. D. Putnam
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