Open reduction and internal fixation of condylar fractures via an extended bicoronal approach with a masseteric myotomy

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SUMMARY. Although condylar fractures of the mandible may be treated by closed reduction and appropriate physiotherapy, open reduction and internal fixation is indicated in specific circumstances. We report 25 cases of a previously unreported method of exposure of condylar fractures using an extended bicoronal approach combined with myotomy of the masseter muscle. Acceptable reduction and fixation was achieved in all cases with an early return to function. The incidence of complications was low, with three mild temporary facial palsies which had resolved by the sixth postoperative week and one haematoma beneath the bicoronal scalp flap. A cosmetically acceptable scar was produced in all cases. The excellent surgical exposure and protection of the facial nerve, combined with cosmetically acceptable scars, commend the use of this technique.

Management of condylar fractures of the mandible remains controversial, chiefly because of uncertainty over the natural history of conservatively managed fractures. A review of the literature reveals that the majority of patients treated by conservative means obtain satisfactory function. There is an ability for the condyle to remodel, particularly in children. Where fracture union was not anatomical, Lindahl noted that asymmetrical movement, clicking and tenderness of the temporomandibular joint (TMJ), although rare in children, were frequent sequelae of conservative management of condylar fractures in adults. In selected cases, open reduction and internal fixation allows for condylar fractures to be accurately reduced and rigidly fixed, resulting in an earlier return to normal function. Operations should only be considered in cases where the displaced fragments are large enough to be reduced and stabilised in three dimensions. An acceptable operative procedure should fulfil the following criteria:

1. There must be no operative morbidity from injury to nerves.
2. The fractures and dislocations must be reduced so that the muscles which act on the condyle regain normal tension and position.
3. Damage to the attachment of the lateral pterygoid muscle to the condylar head must be minimised.
4. Stabilisation must be maintainable until bony union occurs.
5. Restoration of normal function and occlusion should occur within 6–12 weeks.

The central problem in designing an approach to the mandibular condyle is gaining adequate exposure whilst protecting the facial nerves from damage. The condyle may be approached via an intraoral incision or through various skin incisions, including those in the preauricular area, a postauricular incision, vari-}

uous submandibular incisions and a retromandibular incision. We present the use of an extended coronal scalp incision and myotomy of the masseter muscle.

Patients and methods

25 patients underwent open reduction and internal fixation of condylar fractures between June 1989 and October 1994. All patients were treated by the senior author. 17 were male and 8 were female and ranged in age from 5 to 58 years, with a median age of 25 years. There were 21 unilateral condylar fractures and 4 bilateral fractures. 8 patients had associated medial or antero-medial condylar dislocations (Table 1). Subcondylar fracture was the only fracture present in 9 cases. 14 patients had an associated parasymphyseal or symphyseal fracture of the mandible and 2 had contralateral angle fractures. 10 patients had an associated mid-facial or zygomatic fracture. The overall severity of facial fractures was assessed by the coding system described by Cooter and David. Facial fracture scores ranged between 2/50 and 33/50, with an average of 8.4.

Patients were selected for operative treatment of their condylar fractures by criteria similar to those suggested by Zide and Kent in 1983. These indi-
A bicoronal scalp incision is made and extended inferiorly along the natural contours of the helix and tragus to the level of the earlobe (Fig. 1A). The temporal part of the incision is designed to be hidden by the fall of the hair. It is often unnecessary to extend the coronal incision fully on the contralateral side. The scalp is turned down in the subgaleal plane to a level 1–2 cm above the supraorbital rim. From here the dissection continues subperiosteally to the orbital rim on the affected side (Fig. 1B). Lateral to the orbit at about the level of the frontozygomatic suture, the lamina externa of the deep temporal fascia is incised and dissection proceeds inferiorly through the fatty plane in this area to expose the zygomatic arch. Dissection at this level spares the frontal branches of the facial nerve. The masseter muscle is exposed to a distance of 2 cm below the zygomatic arch and the capsule of the temporomandibular joint is identified (Fig. 1C, D). The parotid gland is separated from the cartilaginous external auditory meatus but no attempt is made to dissect formally the trunk of the facial nerve, which is left encased in soft tissue. Starting posteriorly, 1–2 cm below the zygomatic arch the masseter muscle is divided, taking care to avoid damage to the neurovascular structures passing through the sigmoid notch (Fig. 1C). It is now possible to expose the condylar neck, sigmoid notch and upper mandibular ramus. The facial nerve has been reflected inferiorly with the flap, allowing direct vision of the fracture site with minimal traction on the soft tissue about the facial nerve. Reduction of the fracture or fracture dislocation is often aided by the insertion of a 13 mm screw into the proximal fragment to use as a handle, which may be grasped by strong artery forceps.

Further assistance in reduction of the fracture may be gained by the use of a suitably notched instrument applied to the sigmoid notch to produce an inferiorly displacing force on the distal fragment.

The wide exposure obtained by incising the posterior masseter muscle allows assessment of the fracture reduction and condylar relocation achieved against the pull of the lateral pterygoid muscle. Great care is taken to avoid surgical damage to the joint capsule and lateral pterygoid muscle.

Once reduction has been achieved, a 4-hole titanium miniplate is contoured to fit the lateral aspect of the condylar neck and mandibular ramus. Four screws are inserted, two above the fracture and two below the fracture (Figs 1E, F). The screw originally used for manipulation of the proximal fragment is then removed. The masseter muscle and the lamina externa of the deep temporal fascia are repaired with resorbable sutures. The scalp wound is closed in two layers and 6/0 interrupted nylon sutures used to close the preauricular wound. Intermaxillary fixation (IMF) is unnecessary. However, minor occlusal discrepancies may require treatment with elastic traction applied through arch bars placed at the time of operation. In the case of an isolated condylar fracture, postoperative management is initially with a non-chew diet and gentle mobilisation. By the 6th postoperative week, mobilisation is usually complete and the patient may resume a normal diet.

In children, the plates and screws are removed at around the 12th postoperative week via the same bicoronal approach in order to avoid interference with mandibular growth. Plates and screws are left in situ indefinitely in adults.
Results

25 patients underwent open reduction with plate and screw fixation of 29 condylar fractures. Bony union was obtained in each patient. Radiological assessment of fracture reduction revealed excellent reduction in 28 of these fractures (an example is shown in Figure 2). In the remaining fracture, the posterior border of the proximal fragment was noted to be fixed 3 mm posteriorly to the posterior border of the distal fragment. In this patient, who had also suffered a Le Fort I maxillary fracture, the occlusion was noted to be satisfactory and a rapid return to normal function was achieved. 21 of the 25 patients achieved their pre-traumatic occlusion immediately postoperatively. 3 of the remaining patients developed a mild to moderate posterior premature contact of the ipsilateral side. These mild malocclusions resolved within 4 months without the need for further intervention. In the remaining patient, postoperative malocclusion was due to inadequate reduction of a comminuted contralateral parasymphyseal fracture which required further operative intervention. Adequate maximal interincisal opening was achieved by all patients, with a range of 37–50 mm and a mean opening of 43 mm. (Table 2). Immediate postoperative mobilisation
Table 2  Maximum mandibular opening (interincisal distance in mm)

<table>
<thead>
<tr>
<th>Time</th>
<th>1 week</th>
<th>3 weeks</th>
<th>6 weeks</th>
<th>4 months</th>
<th>&gt;1 year</th>
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<tr>
<td>Mean max interincisal distance (range in parenthesis)</td>
<td>25 (16-30)</td>
<td>30 (23-40)</td>
<td>35 (25-40)</td>
<td>41 (30-50)</td>
<td>43 (37-50)</td>
</tr>
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resulted in a mean interincisal distance of 2.5 cm at the end of the first postoperative week, with an increase to 3.5 cm by the 6th week. 5 patients developed a deviation of the mandible to the ipsilateral side on maximal opening. This deviation was mild in all cases, but failed to resolve in 3 patients. There were no cases of permanent facial nerve injuries; however, one mandibular branch and 2 mild frontalis branch palsies were noted, all of which had resolved by the 6th postoperative week. One patient suffered a haematoma under the bicoronal flap which needed reexploration on the night of surgery. The ultimate quality of preauricular and scalp scars at 1 year was judged to be satisfactory by clinician and patient in all cases reviewed. There were no cases of persisting temporomandibular joint dysfunction.

Discussion

Closed reduction of condylar fractures has remained popular because good results are generally obtained and it avoids the possible disadvantages of open reduction, such as facial nerve damage, difficulty in manipulating comminuted fragments and the production of a scar on the face. The larger reviews of closed reduction show that 6-35% of patients suffer short-term problems such as pain, limitation of opening and deformity. The longest reported follow-up of condylar fractures by closed reduction is about 20 years, which, as well as demonstrating early dysfunction, showed an incidence of late arthritic changes in joints not in their appropriate anatomical position. Dahlstrom et al. in their 15-year follow-up of conservatively treated condylar fractures, noted that moderate signs of dysfunction can be expected after condylar displacement in adults. The rationale for open reduction and internal fixation in selected cases is that it allows an earlier return to normal function without the need for IMF or elastic traction and the belief that accurate anatomical reduction will reduce the incidence of late arthritic changes. To date, there have been no studies with sufficient length of follow-up to enable assessment of late changes of the temporomandibular joint following operative management of condylar fractures. Comparison of early outcome between surgically and non-surgically treated groups is difficult, as most studies select patients with more severe injuries for treatment by open reduction and internal fixation. Takenoshita et al. compared functional recovery after surgical and non-surgical treatment of condylar fractures and found that early recovery of movement and opening was better in the conservatively treated group. However, patients for operative treatment were chosen on clinical grounds and both groups were placed in intermaxillary fixation for the first three postoperative weeks, thus negating the potential advantage of early mobilisation in the open reduction group. Konstantinovic and Dimitrijevic demonstrated superior anatomical reduction of surgically reduced fractures in a non-randomised study but showed no clinical benefit over conservative management. Worsaae and Thorn conducted a randomised study of surgical versus non-surgical treatment of unilateral dislocated low subcondylar fractures and concluded that there was significantly less morbidity in the surgically treated group at a median follow-up period of 2 years.

There are many factors influencing the decision to elect for open reduction of condylar fractures. Children and adults need to be considered separately. Lund and Lindahl and Holland showed remodelling of displaced condylar fractures occurring in childhood with associated compensatory growth. Remodelling was incomplete in patients nearing completion of growth and where the condylar head was dislocated from the glenoid fossa. Excessive compensatory growth causing deviation of the chin also occurred in some cases. Lund found no relationship between the degree of compensatory growth and the height of the fracture. Lindahl demonstrated the presence of asymmetrical mandibular movements in conservatively treated children and adults and noted that, whilst these movements had generally resolved
in 2 years in children, they tended to persist in adults. In a long-term follow-up of conservatively treated paediatric condylar fractures, Norholt et al. observed radiological abnormalities of ramus height and condylar morphology on the injured side but noted that these findings did not correlate with clinical or subjective assessments of dysfunction. It was also noted that long-term TMJ dysfunction was less common in patients sustaining injuries at earlier ages. Many authors favour conservative management for the treatment of condylar fractures in childhood. However, we believe that open reduction and internal fixation is indicated in those cases where remodelling is likely to be incomplete and therefore choose operative management where there is medial dislocation of the joint and marked fracture angulation. It is our belief that early restoration of normal anatomical relationships and muscle vectors will encourage normal growth patterns. In adults, the indications suggested by Zide and Kent have found general acceptance in the recent literature. With the growing acceptance of open reduction and internal fixation, the indications for open reduction are expanding. Sargent and Green suggested that open reduction should be considered for bilateral condylar fractures with persistent open bite, subcondylar fractures associated with vertically displaced ramus fractures, severely displaced condylar fractures and unstable fractures in patients who cannot tolerate intermaxillary fixation. These indications are in broad agreement with the criteria used to select operative management in this study.

If open reduction and internal fixation is to be undertaken, accurate and rigid fixation of the fracture is necessary to gain good functional results. Condylar fractures have been classified into intracapsular, and high or low subcondylar fractures. Intracapsular fractures are not amenable to open reduction and internal fixation. For many surgeons, the distinction between high and low subcondylar fractures is of significance in deciding the surgical approach. Sargent and Green suggested that high fractures are best approached by a preauricular incision and low fractures by a retromandibular incision. Intraoral approaches such as that described by Lachner et al. are also popular for low subcondylar fractures. Accurate reduction and adequate fixation rely on good surgical exposure of the fracture and it is our experience that the extended bicoronal approach gives excellent access to almost all subcondylar fractures. Titanium alloy plates with unicortical screws (AusSystem) have provided adequately rigid fixation in all cases. We believe that the consistent production of anatomical reduction shown in this study is primarily due to the excellent exposure provided by the bicoronal approach and myotomy of the masseter muscle. This allows direct rather than oblique visualisation of the temporomandibular joint and fracture site. The approach has been shown to be safe in that no serious complications were produced. Of the three mild facial nerve palsies in this study, all had resolved by the sixth post-operative week. Postoperative functional recovery compares favourably with other studies looking at operative and non-operative treatment in the recent literature. However, long-term follow-up will be needed to determine the incidence of late temporomandibular joint dysfunction and arthritis in these patients with operatively treated fractures and fracture dislocations.

Conclusion

Most condylar fractures may be treated by closed reduction. However, there are a number of fracture patterns and dislocations in which open reduction and internal fixation of condylar fractures is considered to be beneficial. An acceptable operative procedure must give sufficient access to allow anatomical reduction and rigid fixation of the fracture and must avoid damage to the facial nerve and pericondylar structures, particularly the attachment of the lateral pterygoid muscle to the condylar head and articular disc. Any scars produced should be ultimately inconspicuous. We believe that the wide exposure afforded by the extended bicoronal approach and masseteric myotomy, combined with the reflection of the facial nerve away from the operation site and positioning of the skin incision in cosmetically advantageous areas, commend the use of this technique.

References


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