Endoscope-Assisted Fixation of Mandibular Condylar Process Fractures

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Purpose: Reduction and plate osteosynthesis of condylar fractures often require a wide extraoral approach with the risk of aesthetic impairment and possible facial nerve palsy. To avoid complications, the purpose of this pilot study was to use an endoscopic device for the treatment of condylar fractures also allowing for endoscopically assisted plate application.

Patients and Methods: Seven condylar fractures were operated under endoscopic control. In three patients, a newly developed device for endoscopically controlled plate application was clinically tested. The new device and the application technique is described in detail.

Results: In two of three cases using this approach, fracture healing was achieved with the condyle in the anatomically correct position. In the third case the plate had to be removed early because of insufficient screw fixation.

Conclusion: This technique may be helpful to further minimize surgical trauma in head and neck fracture treatment. The newly developed plate application device may also be used to approach other regions of the skull eg, the skull base, the zygoma, or the orbit.

Condylar process fractures of the mandible are frequent, accounting for 25% to 45% of all mandibular fractures.1-3 In the literature, the indications for open reduction or closed treatment are controversial.4-7 With the increasing use of rigid internal fixation, the indications for open reduction and plate osteosynthesis of condylar fractures have increased, avoiding maxillomandibular fixation and possibly mandibular deviation during rehabilitation.4

Established techniques for fixation of the condylar fragment are plate and screw fixation.8-10 The surgical access to the fracture site is performed typically through an extraoral submandibular or preauricular incision, allowing for good exposure, in contrast to the transoral approach.4,11-12 Despite an adequate exposure, repositioning of medially dislocated or rotated proximal fracture fragments, as well as temporary fixation of the condyle, is demanding. The application of an osteosynthesis plate and insertion of screws via a transbuccal trochar is difficult. The inherent risk of damaging the facial nerve is the most severe complication and depends on the type of extraoral approach.5

To overcome these problems and to simplify fracture repositioning and plate application, a prototype of an endoscope combined with a plate application device was developed in collaboration with the technical research and development laboratory of the Hannover Medical School.

ENDOSCOPIC PLATE APPLICATION DEVICE

The device consists of a 3.5-mm endoscope (Fa. Wolf, Knittlingen, Germany) attached to a special channel for the application of 2.0 osteosynthesis plates (Synthes USA, Paoli, PA) (Fig 1). A miniplate can be moved forward stepwise in this channel so that at each step the next plate hole is visible in the focus of the optical system. The curved tip of the endoscope is shaped like a periosteal elevator to enable preparation of the proximal fragment. At the tip of the instrument is a standardized threaded hole to insert the transbuccal drill guide for drilling of the screw holes and placement of the osteosynthesis screws under visual control (Fig 2). Through additional channels, the field of vision of the endoscope can be flushed and suctioned.

DEVELOPMENT OF THE ENDOSCOPIC TECHNIQUE

In a preliminary anatomic study, the reduction of osteotomized condylar processes was performed. Modified forehead lift instruments, special angulated condyle forceps, and a flexible fixator were used for
repositioning the condylar segment under endoscopic vision. The cadaver studies served as a basis for further modification of the endoscopic plate application prototype. To gain additional experience, endoscopic-supported repositioning and fixation of condylar process fractures was performed in four patients. These clinical skills and the experience of the cadaver studies were prerequisites to use the plate application prototype in three other cases.

SURGICAL TECHNIQUE

The ascending ramus of the mandible was approached through 2- to 3-cm submandibular incision. Then the endoscope was inserted subperiosteally and advanced cranially on the ascending mandibular ramus toward the fracture. The elevator-like tip of the endoscope facilitated preparation of the fractured condylar process by removing the periosteum and the soft tissue in the vicinity. When the fracture gap became visible in the endoscope (Fig 3), the angle of the mandible was distracted inferiorly using the reduction forceps, allowing for the repositioning of the condylar process.

Modified forehead lift instruments or Kirschner wires were inserted transcutaneously for mobilization and reduction of the proximal fragment (Fig 4). Usually, two small incisions were made in the condylar region. The fragment was temporary held in place either by a special angulated reduction forceps, which was inserted via the submandibular approach, or by the transcutaneously inserted Kirschner wires. Then, the plate osteosynthesis was performed. After repositioning of the condylar process, the tip of the instrument was positioned on the lateral surface of the condyle to allow the transbuccal insertion of the first screw in the proximal fragment.

Slowly delivering the osteosynthesis plate out of the channel, while pulling back the endoscope, the next hole in the plate for screw insertion became visible (Fig 2). Fixation of the plate and stabilization of the fracture was achieved, while observing the posterior mandibular border for the correct anatomic realignment of the fracture.

Preliminary Results

Endoscopically assisted reduction of fractures of the condylar process was performed in four patients using a standard preauricular/submandibular approach. In all cases, the procedure, and especially fixation of the plate on the condylar fragment, was facilitated using the endoscope. However, the plate and screws were
inserted through the transfacial access. Healing of the fracture in an anatomically correct position was uneventful in all four patients.

The prototype instrument for inserting osteosynthesis plates endoscopically as previously described was used in three cases. In two patients, the fractures were repositioned and stabilized in anatomic position. In the third patient, in whom there was delayed repositioning of a 2-week-old condylar process fracture, loosening of the two screws in the proximal fragment occurred, necessitating plate removal after 2 weeks. Disturbance of the facial nerve was not observed in any patient. In the pilot study, the operation time was 3.5 hours, compared with 2 to 2.5 hours in the standard extroral approach.

Discussion

Minimally invasive techniques using endoscopes, for example, the forehead lift, have been introduced into soft tissue surgery to avoid extensive tissue damage and to minimize blood loss.\textsuperscript{15} Endoscopic procedures have also been used for the fixation of fractures of the extremities, such as the tibial plateau, the distal radius, and wrist fractures.\textsuperscript{14,16} In the head and neck region, the repositioning and grafting of medial orbital wall fractures, screw compression osteosynthesis of dens axis fractures, and the reduction and plate osteosynthesis of a comminuted malar fracture using endoscopic assistance have been reported.\textsuperscript{17-19}

Accordingly, the endoscope-assisted reduction and rigid internal fixation of condylar process fractures by plate osteosynthesis using the newly developed special plate application device, may be considered a first step in the minimally invasive treatment of mandibular fractures. It is encouraging that the prototype facilitates an easier and more controlled insertion of miniplates, with transcutaneous screw insertion via a trochar.

An advantage of this technique is the reduced tissue trauma attributable to the limited exposure of the bone in the condylar region. The risk of facial nerve palsy or other neurologic complications, which are reported as occurring relatively frequently during the open reduction of condylar process fractures via an extroral approach, is theoretically diminished.\textsuperscript{5,20}

A disadvantage of the device is that it allows the application of straight plates only. In the chosen area—the mandibular condyle region—the use of an unbent plate is sufficient because the lateral aspect of the condyle is nearly flat and the 2.0 plate adapts to the bone surface. Other disadvantages arise from the restricted overall view and the difficulty in the handling of the condylar fragments with the rigid endoscope. Although using modified forehead lift instruments, the angulated forceps, or transcutaneously inserted Kirschner wires for the manipulation of the condylar fragment was helpful, this method is not recommended for the less experienced surgeon. Severely dislocated or comminuted fractures, which are difficult to diagnose, should not be treated using this device.\textsuperscript{21}

Additional uses of this prototype include other mandibular fractures, for example, placing a plate at the inferior border of the mandibular body beneath the mental nerve or at the inferior border in mandibular angle fractures. Although no prebent plates can be inserted, the use of less stiff plates that will adapt to the bone surface is possible. Furthermore, the development of different inserts for the application of smaller plates, as well as resorbable plates, are future aims.

The use of the endoscopic device in the midface also might be promising, for example, in treatment of orbital and skullbase fractures. Similar to the endoscopic techniques in facial aesthetic soft tissue surgery, access incisions for trauma surgery can be located in less obvious facial areas such as the hairline and skinfolds, thus possibly avoiding further disfigurement. In this respect, the endoscopic prototype may be regarded as a favorable tool for reconstructive and aesthetic surgery.

References

Discussion

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This article reflects a current trend toward soft tissue surgery and treatment of fractures with the use of endoscopic techniques. The authors are to be commended for the development and preliminary testing of innovative instrumentation that combines an endoscope, periosteal elevator, plate-holding forceps, and transbuccal trochar. The real question to be answered is whether this technique will lead to improved patient care, or is this yet another example of a technique looking for an indication? To attempt to answer this question, we must briefly review current thinking regarding the treatment of condylar process fractures.

Two major factors need to be considered concerning the management of condylar fractures: the age of the patient and the degree of displacement or dislocation of the condylar segment. Although there is general agreement that the appropriate treatment of condylar process and subcondylar fractures in the young child is closed reduction for a short time, followed by the use of training elastics, physical therapy, and close follow-up to evaluate growth, there is still controversy concerning the appropriate treatment for adolescent and adult patients with the same injury. The controversy involves whether these fractures should be treated by closed techniques or with open techniques and rigid fixation. General suggestions for treatment have been developed. For these patients, absolute indications include condylar displacement into the middle cranial fossa or external auditory canal, lateral extracapsular displacement, inability to obtain an adequate occlusion, and an open wound of the joint with presence of a foreign body or gross contamination. Relative indications include bilateral fractures in the edentulous patient when splinting of the arches is not possible, medical conditions that necessitate immediate jaw function, bilateral condylar process fractures with associated midfacial fractures and loss of posterior height, bilateral condylar process fractures with an associated open bite, and anteromedial fracture-dislocation with condylar angulation of 90° or more.


5. Zide MF: Indications for open reduction of mandibular condy- 1


