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Non-shortening fracture of the mandibular head resulting in severe mouth opening disorder operated on via the retroauricular approach – a case report

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ABSTRACT

This report describes a case of a non-shortening fracture of the mandibular head resulting in severe mouth opening disorder operated on via a retroauricular approach (RA). We published this report because there is a very limited number of English-language articles on the RA. The second reason that prompted us to publish this report was the uniqueness of the case, i.e., there was an almost complete limitation of mandibular abduction in the fracture which did not shorten the vertical dimension of the mandible branch. The case described by us is an example of the effective use of the RA for the open treatment of a fracture of the mandibular head. Papers on the RA, including this report, indicate the satisfactory results of this method – a strong alternative to pre- and transauricular approaches. A non-shortening fracture of the mandibular head in the form of a significant persistent limitation of mandibular abduction is atypical and may be treated as another indication for open treatment.

Keywords: retroauricular approach; mandibular condyle fracture; mandibular head fracture; retro-auricular transmeatal approach.

INTRODUCTION

The bone that forms the lower part of the facial skeleton and supports the bottom teeth is called the mandible. The mandible is connected to the skull by geminate temporomandibular joints. Each temporomandibular joint consists of an acetabulum on the temporal bone and an articular head, which is the head of the mandible. The head of the mandible is the top of the condylar process of this bone and, like the entire condylar process, it is mainly injured by an indirect mechanism. It occurs when the forces applied to the main part of the mandible, known as the mandible base, are partially transferred to the condyle, which may result in a fracture of the mandible head.

Studies report that mandible fractures account for more than 4 out of 10 of all maxillofacial fractures in the European population. Eight percent of mandibular fractures, i.e., 3.4% of all maxillofacial fractures among Europeans, are articular head fractures [1]. Some of them are fractures of the mandibular head which do not shorten the vertical dimension of the mandibular branch. No change in the height of the mandibular branches generally means that no occlusive disorders are present. This is an indication that conservative treatment can be applied [2]. Despite the fact that the proper height of the mandible branch was preserved, surgery was necessary in this case as the patient presented a severe mouth opening disorder that could not be managed by conservative methods.

The retroauricular approach (RA) was used to provide surgical access to the mandibular head [3]. This approach was chosen due to an expected good insight into the arrangement of the bone fragments and the possibility of keeping the attachment of the joint capsule on the lateral part of the mandibular head [4, 5]. In addition, the RA was chosen because of a low risk of damage to the facial nerve and a more aesthetic scar placement [3]. The head of the mandible was fixed using small fragment screw osteosynthesis [4]. Uncomplicated healing, a good therapeutic effect in terms of mandibular mobility and an uneventful period of postoperative follow-up confirmed this to be the correct approach.

We decided to describe this case because of a very limited number of English-language articles on the RA [3]. The second reason that prompted us to publish this report was its uniqueness, i.e., an almost complete limitation of mandibular abduction in a fracture which did not shorten the vertical dimension of the mandible branch.

CASE REPORT

We present the case of a 29-year-old man who suffered a fracture in his right mandibular head. The patient reported to the Maxillofacial Surgery Department of the Hospital of the Ministry of Interior and Administration in Kielce, 10 days post-injury. In the course of the interview, the patient reported that the injury was

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a result of getting beaten by another person, including a blow to the face. In the 10-day time-period prior to hospital admission, the patient suffered from a pain in the right preauricular region, which he considered to be a mere tissue injury caused by the impact. The pain itself did not alarm the patient but the limitation of the mandible abduction was a clear inconvenience to him. In the first few days after the injury, the patient assumed that the limitation in the ability to open his mouth was a result of contusion and that it would pass spontaneously. About a week after the beating, the patient decided to see a general practitioner who referred the patient to a maxillofacial surgery clinic. Thus, the immediate cause of admission to the hospital was a significant disorder in the abduction of the mandible.

Upon hospital admission, the maximum interincisal distance was found to be 6 mm without manual assistance. Additional tests, including imaging diagnostics, were ordered. The initial X-ray screening showed a type VI fracture of the mandibular condyle in accordance with the Spiessl and Schroll classification. Type VI of this classification represents any intracapsular fracture [6]. Further diagnostics using computed tomography revealed that the mandibular branch had not shortened vertically. The fracture line was singular and medial to the pole zone (Fig. 1, 2). Therefore, the diagnosis was specified as a mandibular head fracture type M according to the AOCMF classification published in 2014 by Neff et al. [7]. However, according to a newer classification proposal by Kozakiewicz in 2019, which is in line with the older classification of Neff et al. from 2004, a type A head fracture was diagnosed [8, 9].

FIGURE 1. Fracture of the right mandibular head. Computed tomography – frontal reconstruction, anterior view

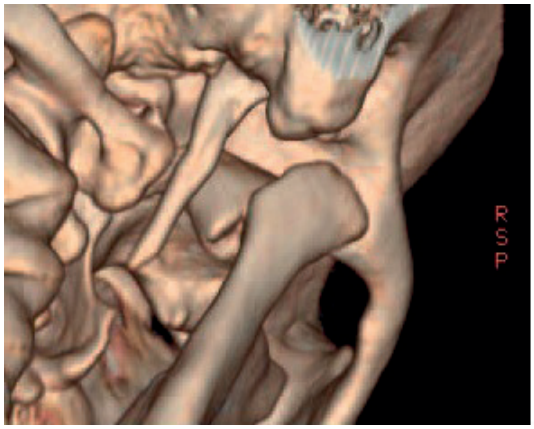

FIGURE 2. Fracture of the right mandibular head. Computed tomography – 3D reconstruction, posterolateral view

There was no shortening of the mandibular branch height, but the lack of any improvement in mouth opening prompted surgical treatment. We assumed that the limited mandibular abduction must be the result of a rearrangement of the elements of the temporomandibular joint, i.e., part of the mandibular head and the articular disc. Surgical intervention offered the potential for repositioning these structures. In our opinion, the operation could improve or even completely restore the range of mandibular mobility, which was why we discussed this type of treatment in detail with the patient. The patient, aware of the natural consequences and possible complications of the surgical intervention, agreed to the proposed therapy plan.

The patient underwent surgery for open reposition and internal fixation of the mandibular head fracture via the RA. The treatment was performed in antibiotic prophylaxis compliant with recommendation 1.9 of the PTS/NPOA guidelines which are currently obligatory in Poland [10]. Due to the lack of contraindications, 45 min before the operation, ampicillin with sulbactam was administered intravenously at a dose of 1500 mg. No further doses of the antibiotic were administered during the operation or in the postoperative period. Perioperative premedication and analgesic pharmacotherapy did not differ from generally accepted standards. Endotracheal intubation through the right nasal passage was performed. Thus, there was no endotracheal tube between the dental arches which allowed for intraoperative control of the occlusion. Due to the extraoral operating field, the area of the oral cavity was sterile and protected against any possible contamination from within it.

In the 1st step of the operation, a standard preparation was performed according to the protocol described by Neff [11]. First an incision line within the sulcus of the retroauricular crease was marked on the skin (Fig. 3). After the incision of the skin, preparation was carried out on the surface of the mastoid and temporal fascias. The external auditory canal was prepared above the perichondrium and cut in a plane distant from the bone by about 3–4 mm (Fig. 4). Cutting the cartilaginous part of the ear canal away from the bone is of key importance for its future positioning and avoiding complications in the form of postoperative auricular canal stenosis [11, 12].

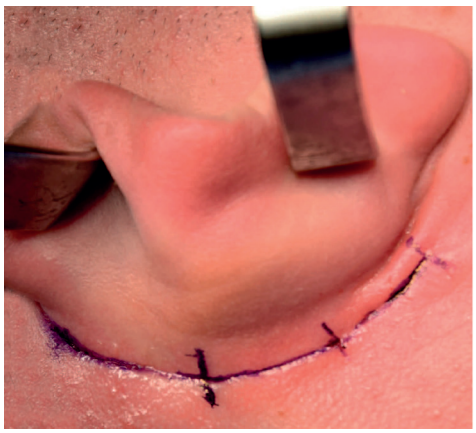

FIGURE 3. Planning for the incision line. The skin is marked with the incision line and several perpendicular guide-lines are marked for future positioning of the flap

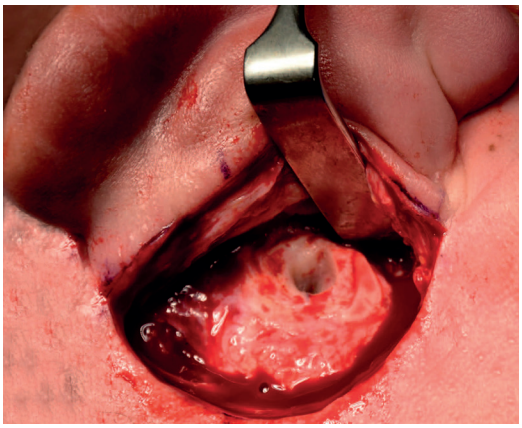

FIGURE 4. Cutting off the ear canal

After cutting off the external auditory canal, a posterolateral view of the mandibular head was revealed. Due to the type of preparation, most of the lateral ligament of the temporomandibular joint was preserved, but had already been partially torn by the sharp edge of the distal bone fracture (condylar stump). In the next stage, the proximal fraction of the mandibular head was repositioned. HexaDrive (Medartis) screws, each 1.8 mm in diameter and 13 mm long, were used to achieve stable fixation (Fig. 5). The screw heads were embedded in the bone to avoid injury to the ligaments by any protruding osteosynthetic material [13]. Correct occlusion and restoration of the mandibular abduction were confirmed.

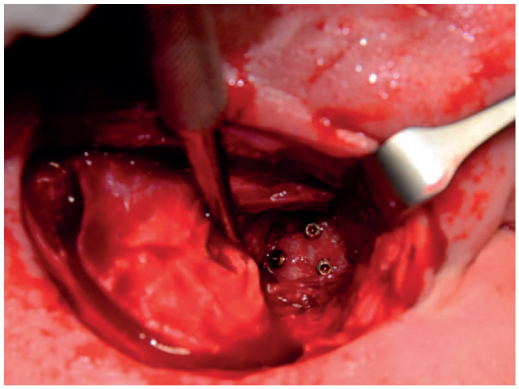

FIGURE 5. The mandible head fixed with 3 screws of 1.8 mm diameter

To avoid auricular canal stenosis, deep positioning sutures, which are referred to in the protocol of Neff as basal sutures, were placed (Fig. 6). In the next stage, the joint capsule and the individual wound layers were sutured. A special type of suture was placed over the skin of the external ear canal. These were non-absorbable sutures led out through the ear canal outside the auricle, referred to in the Neff protocol as pre-laid sutures (Fig. 7) [11].

On the 1st day after surgery, a control computed tomography was performed (Fig. 8). The 3D scan showed that the proximal bone fragment and the osteosynthetic material were in the correct position. The patient was equipped with a flexible intermaxillary fixation on 4 screws located vestibularly between

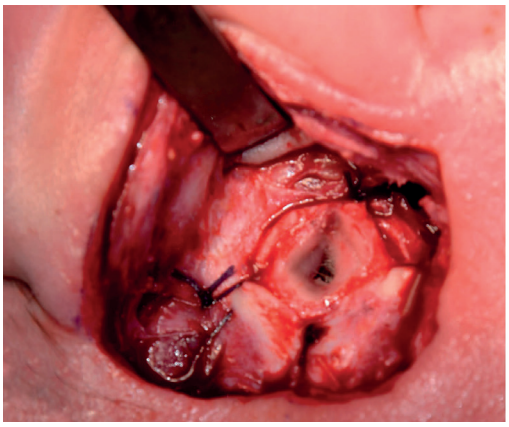

FIGURE 6. Basal sutures positioning the auditory canal and preventing its stenosis

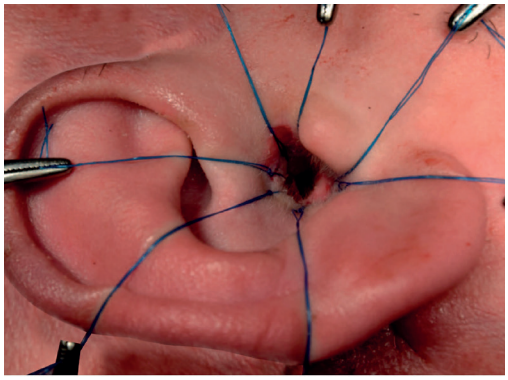

FIGURE 7. Cutaneous sutures of the external auditory canal

the roots of the premolars, with a tension allowing for a wide opening of the mouth whilst retaining the positioning of the mandible at rest in correct occlusion. Functional therapy was implemented as part of the stay in the hospital ward and training was conducted for the continuation of mechanotherapy at home. The patient was discharged home on the 3rd day after surgery with the recommendation of systematic exercises for the mobility of the mandible in 3 planes.

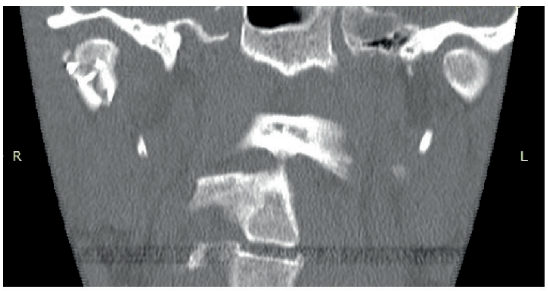

FIGURE 8. Control computed tomography performed the day after surgery. Visible osteosynthetic material in the right mandibular head. Frontal reconstruction, anterior view

On discharge day, the extent of the mandibular abduction was 29 mm interincisally without manual mobilization. During the discharge examination, hypoesthesia of the skin in the preauricular and temporal areas was noted. The hypoesthesia was gradually self-limiting and completely resolved after 6 weeks

as observed during routine outpatient checks. We suspect that the cause of the hypoesthesia was the intraoperative pressure of the hooks on the auriculotemporal nerve [4]. During patient care, there were no other neurological disorders including no damage to the facial nerve which was carefully examined.

The skin sutures in the ear canal and retroauricular crease were removed 5 days after their insertion during surgery. From the moment the sutures were removed, the patient used earplugs for the right external ear canal for 10 weeks. Additionally, in accordance with the recommendations of Kozakiewicz, the patient was not allowed to use spectacles for 3 months after the operation [12]. In our case, the patient did not require corrective lenses and the recommendation was respected without difficulty. There were no changes in the pre- and postoperative diameter of the external auditory canal. The measurements of the canal diameter were checked immediately before the operation, after the removal of the skin sutures and during subsequent follow-up visits.

The mandibular abduction 3 months after the operation was 42 mm between the incisors without manual support. A routine orthopantomogram showed no abnormalities (Fig. 9). Four months after the operation, the osteosynthetic material was removed. The operation to remove the osteosynthetic screws was carried out in the same antibiotic prophylaxis as the 1st operation. The patient was discharged on the 2nd day after the operation. This time, intermaxillary fixation was not used, however, due to surgical intervention in the articular capsule, functional therapy was reintroduced until the 1st follow-up visit 7 days after the surgery.

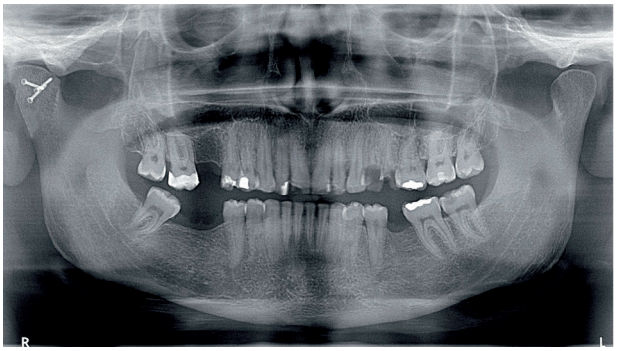

FIGURE 9. Control orthopantomogram made 3 months after fixation

After discharge, the patient was included in postoperative follow-ups during which no postoperative complications were observed. Particular attention was paid to examining possible paralysis of the facial nerve branches, which did not occur. The protocol of recommendations and follow-up visits, including the removal of sutures, did not differ from that for the 1st operation. The patient used earplugs for 10 weeks after the operation and did not use spectacles for 3 months, as with the 1st operation. The follow-up visits were uneventful and were completed 6 months after the 2nd operation. During this time, there was no reduction in the cross-section of the external auditory canal. During the treatment period, both before and after each operation and at the end of the observation period, no occlusion disorders occurred. The last recorded value of mandibular abduction measured between the incisal edges of the upper medial incisors and lower medial incisors was 43 mm.

DISCUSSION

The current knowledge on managing the fractures of the mandibular condyle head does not indicate one universal therapy [14, 15, 16, 17, 18]. Choosing an appropriate method for treating mandibular head injuries is made on a case-by-case basis and depends on many factors [15, 16]. The key factors for choosing between the 2 extremely different therapeutic strategies, i.e., closed or open treatment, include: (a) the course of the fracture line; (b) the arrangement of bone fragments in relation to one another; (c) the presence of intermediate fracture fragments; (d) the height of the mandibular branch, if shortened [2, 14]. Compared to closed treatment, surgical interventions into the articular capsule are associated with the risk of temporary or permanent paralysis of facial and auriculotemporal nerves [4, 14]. Other disadvantages of open access surgery on any condylar fracture of the mandible are a high cost, visible scarring and the risk of bleeding [19].

Despite being more low risk than surgical intervention, closed methods are not free from disadvantages. Numerous complications of closed methods include: (a) deformation of the mandibular head; (b) persistent dislocation of the articular head; (c) loss of vertical height of the mandibular condyle; (d) permanent displacement of the articular disc; (e) reduced mobility of the mandible, such as limited mouth opening and deviation in the abduction path; (f) occlusal disorders [14]. Attempts to reduce the incidence of the above-mentioned complications lead to the repositioning of displaced fractures under visual control and a stable fixation of bone fragments [14, 16, 17, 19, 20]. Thus, the main indication for the conservative treatment of mandibular head fractures is a small amount of displacement in the bone fragments [7, 16, 21].

In turn, fractures that qualify for surgical treatment are those that shorten the vertical dimension of the mandibular branch by a certain amount [14]. These values are often consistently determined for all types of fractures of the mandibular condyle and, depending on the case, range 2–5 mm [12]. This means that a shortening of the height of the mandibular branch which exceeds this qualifies for surgery. Usually, patients with condylar head fractures without a shortening of the mandible branch are not eligible for open treatment [7, 21]; however, the loss of height of the condyle is not the only indication for surgical intervention in the case of head fractures. Some authors point to the necessity of surgical treatment where there is a dislocation of the condylar stump lateral to the glenoid fossa [5, 22, 23]. Chen et al. specify that surgical treatment in such cases should be implemented only when non-surgical methods do not allow for the reduction of dislocation [5]. In our case, neither of these 2 generally accepted indications for open treatment occurred. Nevertheless, the arrangement of

the proximal bone fragment, i.e., a part of the mandibular head, significantly limited mandibular abduction in our patient ruled out any attempts at conservative management.

The direct cause of the significantly limited mandibular abduction in the described case is difficult to define. We suspect this may have been caused by a mechanical blockage of the sliding movement in the upper part of the temporomandibular joint. This was based on the possibility of the mouth opening a small amount, which may correspond to a rotational movement in the lower part of the joint. This rotational movement does not require the distal fracture (condyle stump) to move forward. Further abduction may have been limited by the presence of a mechanical obstacle in the forward sliding movement. The same happens when the intentional Dautrey's procedure is performed [24]. In our case, the element limiting the sliding movement had to be the loose part of the mandible head.

Taking the growing range of indications for surgical intervention within the temporomandibular joint capsule into account, it should be noted that, as well as instances were surgery is appropriate, the most appropriate surgical approach must also be discussed [3, 15, 18]. Thus, the supra-auricular (coronal, semicoronal and temporal), preauricular (with possible perilobular modification), transauricular (or endaural) and finally retroauricular (or postauricular; with possible temporal modification) approaches are considered [12, 25]. Commonly used and widely modified techniques for accessing the mandibular head are the preauricular and transauricular approaches [11, 20, 26]. Supra-auricular approaches are reserved for multiple skull fractures, in which the necessity to visualize the mandibular head is only one of many stages of the operation [12]. The retroauricular transmeatal approach is a significant alternative to the above-mentioned approaches due to a reduced risk to the facial nerve and a different vantage point of the exposed mandible head [3, 4]. An additional advantage of the RA is the location of the scar within the sulcus of the retroauricular crease, which provides a better aesthetic outcome [27, 28].

Although the RA technique has been known for over a century, literature reports are limited [3, 29]. Nonetheless, RA cannot be treated as an experimental method, though recognized medical authorities have been using it for years, and professional textbooks mention it on a par with approaches from the preauricular group [4, 11, 12, 27]. The benefit of using the RA is the effective bypassing and undermining of the facial nerve branches, which significantly reduces the risk of facial paralysis [3, 28]. Retroauricular approach also allows for the preservation of the temporomandibular joint capsule in the lateral pole of the head, which is a clear difference to the approaches proceeded anterior from the auricle [4, 5].

The correct type and number of screws for the fixation of the mandibular head allowing a fast induction of functional therapy have been analyzed by numerous authors [30, 31, 32, 33, 34, 35]. Currently, it is assumed that the optimal technique for fixing a broken mandibular head is the use of long screws [31, 35]. This is a result of the structure of the mandibular head itself, which mostly consists of a spongy bone and does not allow for the short screws to correctly anchor themselves, as is the case with fractures, for example, of the mandibular body [31]. Therefore, it is most advantageous to insert screws with a length slightly smaller than the given cross section of the mandibular head transverse to the fracture plane [12, 36]. The number of screws used largely depends on the technical possibilities resulting from the size and shape of the proximal fracture or the possible presence of intermediate fragments. The development of surgical techniques means that the latest scientific works analyze the shape of the condylar process in more detail in terms of the possibility of fixing fractures of its head and neck [12, 34, 37]. It has been calculated that the use of 2 or 3 screws provides mobility in the gap of a high fracture of the mandibular neck at the level of about 0.2 mm, which is about 3 times less than in the case of fixation with 1 screw [34]. However, it should be remembered that this is an assessment carried out for a different type of fracture, which is closer to the head fracture with condylar shortening (type P according to AOCMF) [7, 34]. Nevertheless, it is assumed that condylar head fractures also require 2–3 screws to perform stable osteosynthesis [4]. Pavlychuk et al. suggest that the additional use of a patient specific mini-plate improves the stabilization of P-type fractures according to the AOCMF classification [38].

In cases of comminuted fractures, it is sometimes necessary to use microplates in addition to long screws [4]. Microplates can also be helpful in the stage of initial stabilization of the fragments before the final fixation [12]. Some authors even allow the use of miniplates for the final fixation of the mandibular head [27, 28]. On the other hand, other authors point out that minimizing the osteosynthetic material protruding from the bone reduces irritation of the surrounding ligaments [4, 13, 39]. In our case, fracture stability was achieved without the need to insert micro- or mini-plates and only fully embedded non-resorbable screws made of grade 5 titanium alloy were used. The use of long titanium screws is the conventional procedure for fixation of the mandibular head [30, 32, 33]. However, these must be removed [4, 13, 39]. Therefore, research is being conducted on the possibility of using resorbable materials for this purpose [26, 33, 40]. So far, it has been revealed that polymeric materials exhibit much lower mechanical resistance than titanium alloys [33, 40]. For this reason, the greatest hopes for the fixation of the mandibular head with a resorbable material are currently placed in long screws made of magnesium alloys [40, 41].

CONCLUSION

The case described here is an example of the effective use of the RA for the open treatment of a fracture of the mandibular head. Papers on the RA, including this report, indicate a satisfactory outcome of this method – a strong alternative to pre- and transauricular approaches. The atypical consequence of a non-shortening fracture of the mandibular head in the form of a significant persistent limitation of mandibular abduction may be treated as another indication for open treatment.

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