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Vascularization of the mandibular condylar head with respect to intracapsular fractures of mandible

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ABSTRACT

Background: Causes of mandibular condylar (condylar) head necrosis as a consequence of intracapsular mandibular fractures are still a subject of controversy.
Objectives: To investigate why in some cases of intracapsular fractures condylar head necrosis occurs.
Material: 58 human heads from the collection of Head and Neck Clinical Anatomy Laboratory, from the Institute of Physiology and Pathology of Hearing, Warsaw, Poland, constituted the material.
Study: Head arterial tree injections, anatomical preparation with the use of standard set of microsurgical equipment and an operating microscope.
Results: The main source of condylar head vascularization is the inferior alveolar artery, supplying bone marrow of the whole mandible as well as its cortical layer. Additional arterial blood supplying comes from a various number (2–7) of branches supplying the temporomandibular joint capsule. They originate directly from the maxillary artery or from its primary branches: masseteric artery, external pterygoid artery or superficial temporal artery. Two rare variants of accessory mandibular head vascularization were encountered. The first (2 cases) was an arterial branch from the maxillary artery and the second (1 case) was a branch from the external pterygoid artery. In these cases the arterial supply of lateral part of temporomandibular joint capsule from other sources was reduced.
Conclusion: Fractures resulting in the lateral part of the condylar head in isolation could be potentially threatened by necrosis because of poor vascularization.
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1. Introduction

Mandibular fractures are common. The incidence of condylar damage is high and multiple variants of fractures can be observed (Schneider et al., 2007, Voisin et al., 2008, Zachariades et al., 2006) Intracapsular condylar fractures are rather rare (Eckelt, 2000; Cheynet et al., 1997; De Bont and Bos, 1997). Aseptic osteomyelitis and necrosis of the condylar process or its head are rare complications which may occur several months after an untreated intracapsular fracture (Eckelt, 2000; De Bont and Bos, 1997; Sanders et al., 1977; Wu et al., 1994). Similar pathological changes were observed in an animal model (Long and Goss, 2007). The factors that induce complications subsequent to fractures of the condyle have long been controversial. An anatomical base for these complications is unclear. The present study is an attempt to solve this problem.

2. Material and method

The study was carried out on 58 frozen human heads (27 females and 31 males) from the collection of Laboratory of Clinical Anatomy of Head and Neck, Institute of Physiology and Pathology of Hearing, Warsaw, Poland. The common carotid arteries on both sides were filled with coloured latex and then fixed in 10% formaldehyde for 6 weeks. The specimens were prepared under an operating microscope using standard set of microsurgical equipment. The origins of the blood vessels supplying the condylar head were identified and described. Standard χ squared test was used to analyze the statistical significance of the observed differences between the left and right sides and the sexes.

3. Results

The main and constant source of arterial supply to the mandible as well as the condylar head was the inferior alveolar artery (Fig. 1).

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In every case it penetrated the mandibular canal, and after several milimeters branched off into the bone marrow.

The condylar head also obtained an additional supply from arteries of the temporomandibular joint capsule (Fig. 2). This supply could originate from one of four sources (Table 1): directly from the maxillary artery, from the masseteric artery, from the superficial temporal artery or from the lateral pterygoid artery, without any statistically significant differences regarding sex or side of the body. These arteries penetrated the capsule in various places and branched off in the capsular wall and in periosteum of the condylar head.

In three cases additional sources of arterial supply to the condylar head were encountered. There were small branches (diameter of about 1 mm) stemming directly from the maxillary artery (two male heads, Fig. 3) or as a continuation of the lateral pterygoid artery (one female head, Fig. 4). These arteries penetrated the condylar neck on the border of the temporomandibular joint capsule only form medial side in every case. In these cases the number of arteries supplying the capsule was considerably smaller and amounted to 2 or 3.

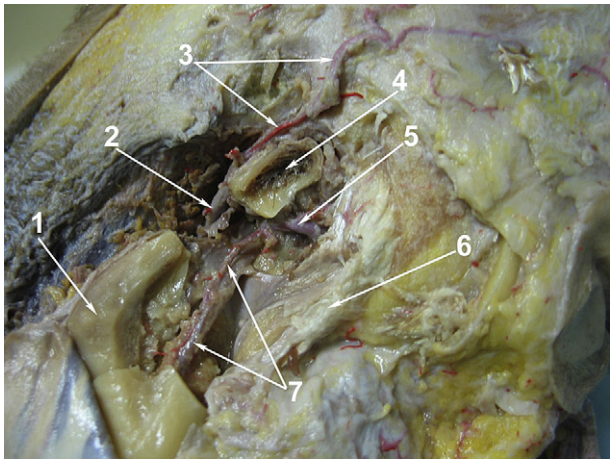

Fig. 1. Human head from right side. Zygomatic arch as well as masseter muscle removed. Mandibular canal opened with inferior alveolar artery visible 1. mandibular angle 2. external carotid artery 3. superficial temporal artery 4. bone marrow of mandibular head 5. maxillary artery 6. temporal muscle 7. inferior alveolar artery.

4. Discussion

Research on foetuses indicates that the vascular pattern of the mandible is developing from the early stages of foetal development until the postnatal period. The vascular pattern of the mandibular body and the alveolar process is invariable and always originates from the inferior alveolar artery. In the foetal period the condylar process and the condylar head blood supply originates from several variable sources forming the dense vascular network in the temporomandibular joint area. During later development one or more vessels emerge from that network, finally making up the blood supply for this part of mandible. The condylar process receives its own numerous and variable sources of vascularization (Mahaczek-Kordowska, 1995).

Until the age of 21 the condylar process cartilage functions in the same way as an epihyseal cartilage in long bones. There are descriptions of numerous small blood vessels penetrating this cartilage and terminating in the distal part of the growing mandible, i.e. its condylar process and head (Blackwood, 1965; Spira et al., 1963; Syvions, 1952). The complex model of the foetal vascular development of the condylar and coronoid processes as opposed to the simple and repetitive one applying to the mandible body may explain considerable variability of the blood supply to the condylar and coronoid processes and the invariable blood supply from the inferior alveolar artery to the mandible body which was observed in this paper.

In the literature there are many studies of mandibular fractures, but even in publications numbering hundreds of cases, intracapsular

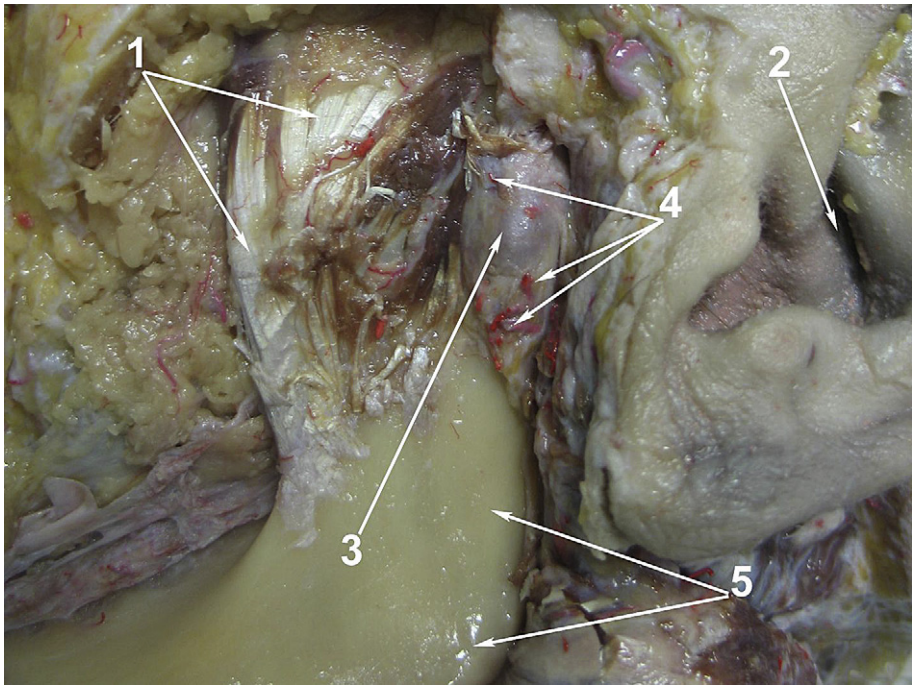

Fig. 2. Human head from left side. Zygomatic arch as well as masseter muscle removed. 1. temporal muscle and coronoid process 2. external auditory meatus 3. capsule of temporomandibular joint 4. arterial branches inserting to capsule of temporomandibular joint 5. mandibular angle.

Table 1
Occurrence of additional vascularization of the condylar head, originating from the capsule of temporomandibular joint.

Source	Females		Males	
	Left side	Right side	Left side	Right side
Maxillary artery	22	26	21	24
Masseteric artery	7	3	8	5
Superficial temporal artery	3	4	2	3
Lateral pterygoid artery	6	8	9	5

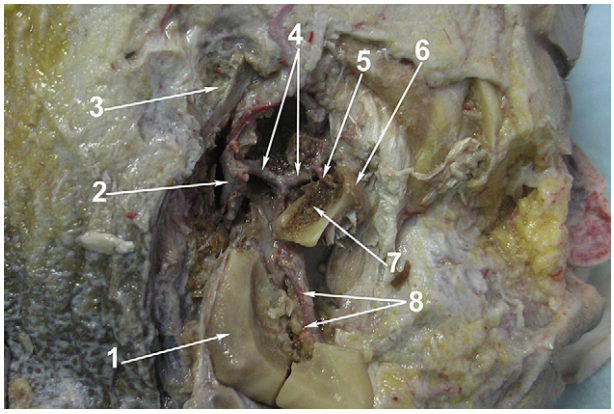

Fig. 3. Human head from right side. Zygomatic arch as well as masseter muscle removed. Mandibular canal opened. Coronoid process removed. Variant of accessory the condylar head supply from maxillary artery 1. mandibular angle 2. external carotid artery 3. external auditory meatus 4. maxillary artery 5. arterial branch to the condylar head 6. surface of the condylar head 7. condylar neck 8. inferior alveolar artery.

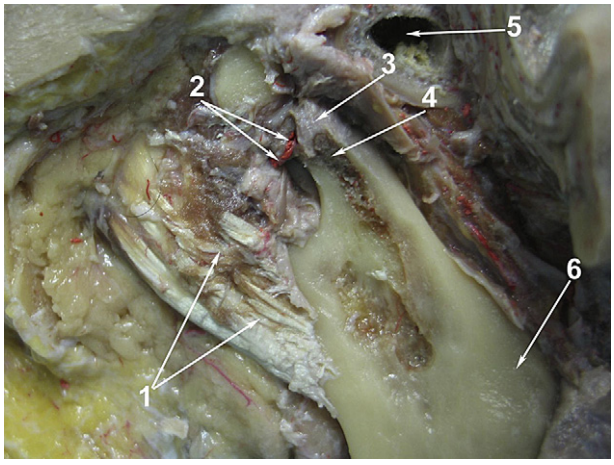

Fig. 4. Human head from left side. Zygomatic arch as well as masseter muscle removed. Variant of accessory mandibular head supply from external pterygoid artery 1. temporal muscle and coronoid process 2. arterial branch to the condylar head 3.condylar head 4. bone marrow of condylar neck 5. external auditory meatus 6. mandibular angle.

fractures constitute a small percentage (Marker et al., 2000, Zachariades et al., 2006).

There are three (Hlawitschka and Eckelt, 2002) or four (He et al., 2009) types of intracapsular fractures described. Some of the fractures, involving small fragments of the mandible head may be difficult to diagnose. Sagittal or vertical fractures of the occipital process and chip fractures of the medial fragment of the condylar head are extremely rare phenomena which may be hard to identify (Antoniades et al., 1993). Isolated condylar head fractures causing separation of its fragment may be more visible if they lead to the necrosis of that fragment.

It seems that the pattern of vascularization determines the clinical course of some of the mandibular fractures. Little data considering arterial vascularization of the mandible could be found (Voy and Fuchs, 1980), and there was no mention of rare anatomical variants. On the base of the results of the present study we suggest that a variable number and diameter of additional arterial branches supplying the mandible may play a role in the clinical course of condylar head fractures. An adequate arterial anastomotic network probably prevents condylar head necrosis in most cases of intracapsular fractures, even in the case of the total detachment of the condylar head from its neck. As shown in this paper, the medial part of the condylar head has a good blood supply as far as the number, the diameter and the invariability of the supplying arteries are concerned. The lateral part of the condylar head generally has a poorer blood supply in the case of its detachment from the condylar neck and, at the same time, from the main arterial vessel i.e. the inferior alveolar artery. In the presence of an additional arterial supply to the condylar head directly from the maxillary artery or from the lateral pterygoid artery there appears to be a decrease in the arterial supply to the capsule. When this pattern is seen there may be an increased risk to the blood supply to the lateral pole of the condylar head. This may explain why in some cases of condylar head fractures all sources of arterial supply are cut off. In these particular cases fractures in the lateral part of the condylar head in isolation could potentially undergo necrosis.

5. Conclusion

Isolated fractures occurring in the lateral part of the condylar head could be potentially threatened by necrosis because of a poor blood supply.

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Conflict of interest

Authors declare they have no conflict of interest in publishing this text.

References

Antoniades K, Karakasis D, Elephtheriades J: Bifid mandibular condyle resulting from a sagittal fracture of the condylar head. Br J Oral Maxillofac Surg 32: 124–126, 1993

Blackwood HJJ: Vascularization of the condylar cartilage of the human mandible. J Anat 99: 551–563, 1965

Cheynet F, Aldegheri A, Chossegros C, Bourezak Z, Blanc JL: The retromandibular approach in fractures of the mandibular condyle. Rev Stomatol Chir Maxillofac 98: 288–294, 1997

De Bont LG, Bos RR: Fractures of the condylar process. Ned Tijdschr Tandheelkd 104: 432–435, 1997

Eckelt U: Fractures of the mandibular condyle. Mund Kiefer Gesichtschir 4(Suppl. 1): 110–117, 2000

He D, Yang C, Chen M, Jiang B, Wang B: Intracapsular condylar fracture of the mandible: our classification and open treatment experience. J Oral Maxillofac Surg 67: 1672–1692, 2009

Hlawitschka M, Eckelt U: Assessment of patients treated for intracapsular fractures of the mandibular condyle by closed techniques. J Oral Maxillofac Surg 60: 784–791, 2002

Long X, Goss AN: A sheep model of intracapsular condylar fracture. J Oral Maxillofac Surg 65: 1102–1108, 2007

Mahaczek-Kordowska A: Development of the mandible and its vascularization in human fetuses in light of morphologic, microangiographic and gnathometric studies. Ann Acad Med Stetin 41: 29–42, 1995 [in Polish]

Marker P, Nielsen A, Lehmann HB: Fractures of the mandibular condyle. Part 1: patterns of distribution of types and causes of fractures in 348 p.tients. Br J Oral Maxillofac Surg 38: 417–421, 2000

Sanders B, McKelvy B, Adams D: Aseptic osteomyelitis and necrosis of the mandibular condylar head after intracapsular fracture. Oral Surg Oral Med Oral Pathol 43: 665–670, 1977

Schneider M, Lauer G, Eckelt E: Surgical treatment of fractures of the mandibular condyle: a comparison of long-term results following different approaches – functional, axiographical and radiological findings. J Craniomaxillofac Surg 35: 151–160, 2007

Spira E, Falin I, Kariplus H: The capillary conducting channels in the distal epiphyses of radius and ulna of the rabbit. J Anat 97: 255–258, 1963

Syvions NBB: The development of the human mandibular joint. J Anat 86: 326–332, 1952

Voisin C, Shahla M, Loeb I, Javadian R: Condylar fractures: a study of 121 cases, a 2 year follow-up. J Craniomaxillofac Surg 36: 161, 2008

Voy ED, Fuchs M: Anatomische Untersuchungen zur Blutgefäßstruktur im Bereich des Kiefergelenkes. In: Schuchardt K (ed.)Fortschritte der Kiefer- und Gesichtschirurgie, Bd. 25. Stuttgart, New York: Georg Thieme Verlag, 2–5, 1980

Wu XG, Hong M, Sun KH: Severe osteoarthrosis after fracture of the mandibular condyle: a clinical and histologic study of seven patients. J Oral Maxillofac Surg 52: 138–142, 1994

Zachariades N, Mezitis M, Mourouzis C, Papadakis D, Spanou A: Fractures of the mandibular condyle: a review of 466 cases. Literature review, reflections on treatment and proposals. J Craniomaxillofac Surg 34: 421–432, 2006