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The study of arterial anastomoses in the region of the alveolar process and the anterior maxilla wall in foetuses

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The anterior maxilla wall and alveolar process are covered by the arterial network. Procedures in this region can cause heavy bleeding. Knowledge of the anatomical course of a particular artery is essential for performing surgery in this area. The aim of this study was to search for and then analyse anastomoses between the infraorbital and posterior superior alveolar artery.

In the study, 19 maxillas of foetuses were analysed. The arteries were injected with coloured latex. The dissection was carried out using a surgical microscope and microsurgical equipment. The lower eyelid with cheek skin was separated and the facial muscles were cut to expose the maxilla and arteries of the alveolar process.

The study revealed that in 10 out of 19 of the specimens there was an arterial connection between the infraorbital and posterior superior alveolar artery. The course of the analysed anastomosis was diverse. In all cases we observed an anterior superior alveolar artery. In all specimens the alveolar process was vascularised by many arteries originating from the analysed anastomosis.

The location of the analysed anastomosis can be stated before operation, on the line between the medial eye angle and the sixth tooth of the same side.

The anastomosis described in the study means that caudally running arteries are important in choosing incisions in procedures performed at the alveolar process. (Folia Morphol 2009; 68, 2: 65–69)

Key words: posterior superior alveolar artery, infraorbital artery, anterior superior alveolar artery

INTRODUCTION

Surgical procedures in the region of the alveolar process and the body of the maxilla can cause profuse bleeding due to the rich network of arteries supplying this region. The facial artery, infraorbital artery (IOA), buccal artery, transverse facial artery, and posterior superior alveolar artery (PSAA) are the vessels running between the facial muscles and at the surface of the body of the maxilla. Knowledge of the anatomical course of a particular artery is essential for conducting dental surgery procedures such as root resection, maxillo-facial operations (LeFort I osteotomy, alveolar process augmentation), or laryngological operations (Caldwell-Luc with its modifications) [5, 8].

A variety of widespread surgical procedures in the region of the maxilla body and the alveolar process forced us to precisely analyse the vessel anastomoses in this region because their descriptions in anatomical textbooks [1, 6, 10] are incomplete. There

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Figure 1. Foetus during preparation.

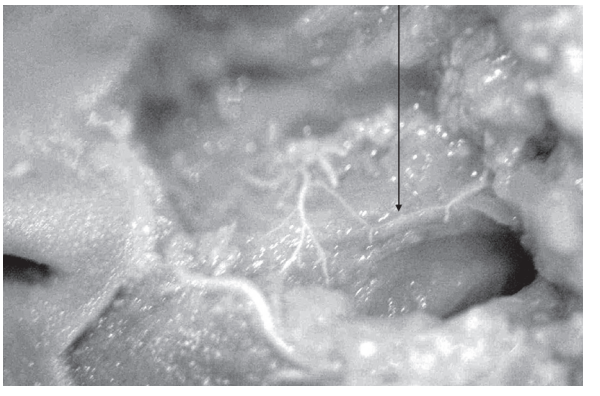

Figure 2. Anastomosis running parallel to the alveolar process ridge.

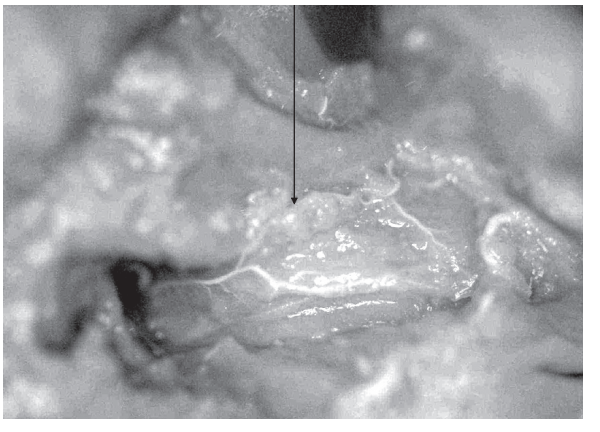

Figure 3. Anastomosis running above the incisive fosse.

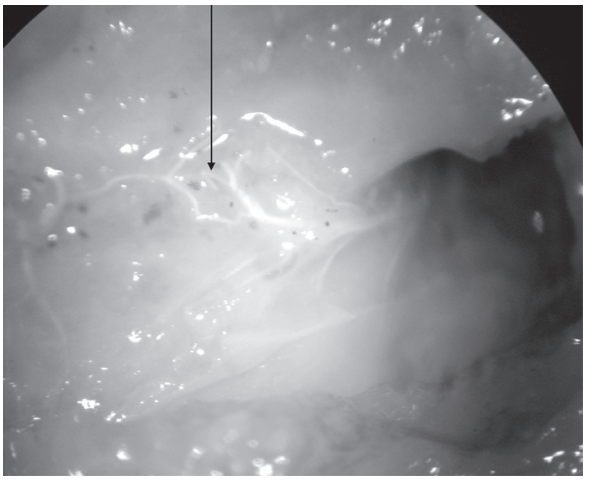

Figure 4. Artery is dividing and then unites into one vessel.

are descriptions of the anastomosis between IOA and PSAA in publications focusing on the problem. Knowledge of the location of this artery enables the avoidance of bleeding during surgical procedures. Moreover, keeping this anastomosis with its branches secures the appropriate blood supply to the alveolar process [9].

Anatomical studies of the arterial network at the maxilla body in foetuses are also made to analyse the ontogenetic development of the maxilla and incisive bone [3, 7].

The aim of this study was to search for and then analyse anastomoses between the IOA and PSAA with their branches.

MATERIAL AND METHODS

The study was based on 10 formalin-fixed foetuses of both sexes aged from 20 to 26 weeks — 19 maxilla were analysed. The material came from the collection of the Anatomy Department of the Centre for Biostructure Research of Medical University in Warsaw.

The arteries were injected with coloured latex via the umbilical vain, from 5 to 10 mL depending on the age of the foetus. Dissection was carried out using a surgical microscope and microsurgical equipment. The skin cut was the same as that used in a maxillectomy operation (Fig. 1). The lower eyelid with cheek skin was separated and the facial muscles were cut to expose the maxilla body and arteries of the alveolar process. All specimens were measured and photographed.

RESULTS

In 10 out of 19 of the specimens there was an arterial connection between the IOA and PSAA. This vessel was on the surface of the maxilla body, under the facial muscles. The course of the analysed anastomosis was varied — parallel to the alveolar process ridge (Fig. 2), above the incisive fosse (Fig. 3), or with ramifications on its course (Fig. 4).

In all cases (19/19) there was a posterior part of the analysed anastomosis — the lengthening of

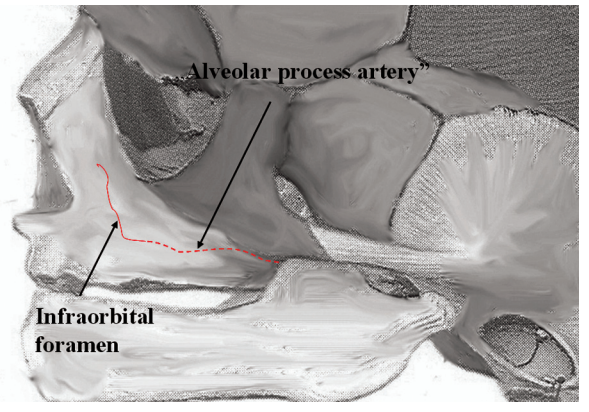

Figure 5. Anastomosis marked with a solid line; "alveolar process artery" marked with spotted line.

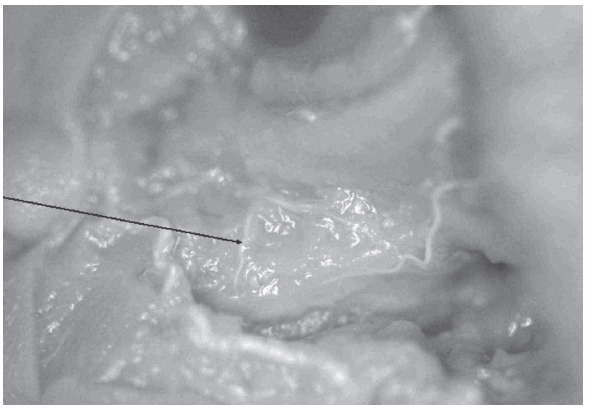

Figure 7. Anterior superior alveolar artery — marked with arrow.

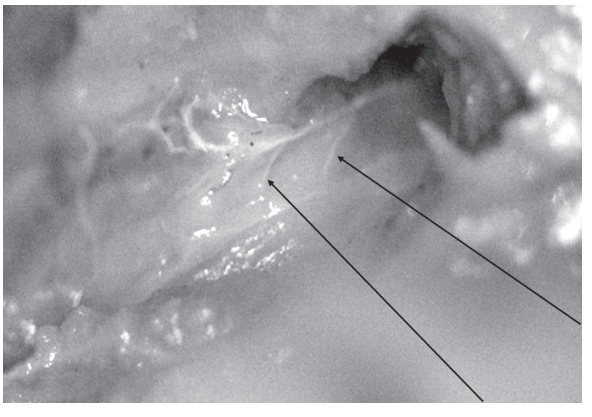

Figure 6. Caudally running branches originating from alveolar process artery marked with arrows.

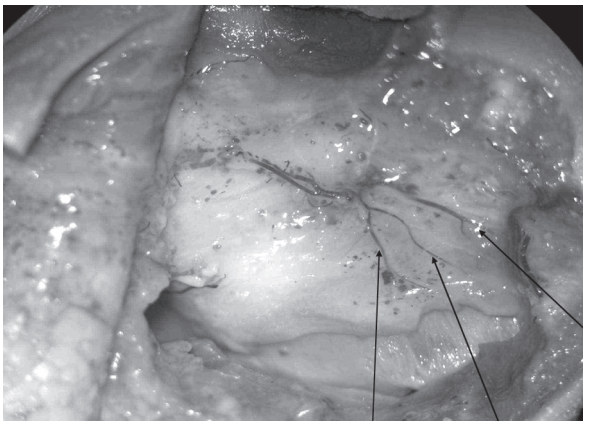

Figure 8. Anterior superior alveolar artery divides on this specimen into three smaller arteries.

Table 1. Lengths and number of the analysed arteries

	Length of the anterior superior alveolar artery [mm]	Number of caudally running branches of the alveolar process artery
Range	4–7	6–9
Average	5.472	7.22

PSAA extending to the incisive fosse, called, in our study, the "alveolar process artery" (APA) (Fig. 5).

Just under the mucosa covering alveolar process, caudally running branches originating from the APA were observed (Fig. 6). There were from 6 to 9 branches, on average 7.2.

Moreover, an artery branching from the IOA and descending medially to the alveolar process was observed. This vessel, known as the anterior superior alveolar artery, supplies the mucosa of the alveolar process with blood in the area of the medial upper incisive germs (Figs. 7, 8, Table 1).

DISCUSSION

The frequency of anastomosis between IOA and PSAA, in publications related to the arterial network of the maxilla, vary depending on the material and methods used in the study. Anatomical analysis made on cadaver bodies of adults has shown the presence of this anastomosis in all cases [9, 11]. On high resolution computer tomography (HRCT) images, this arterial connection was found in 55% of cases [4], but analysis of the foetal material displayed only occasionally anastomosis [3].

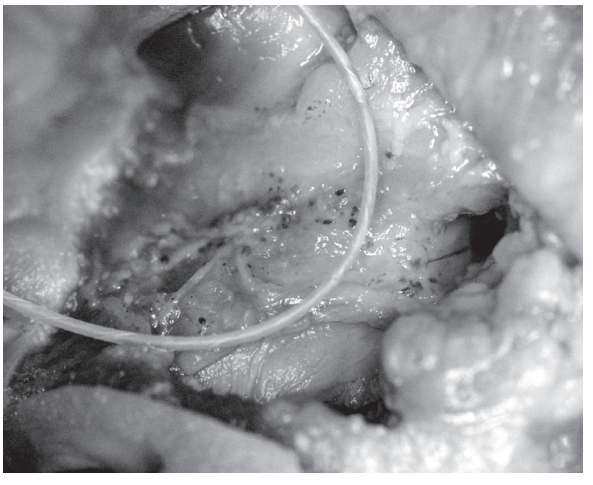

Figure 9. Anastomosis between infraorbital artery and posterior superior alveolar artery, visible over the filium, was not injected properly.

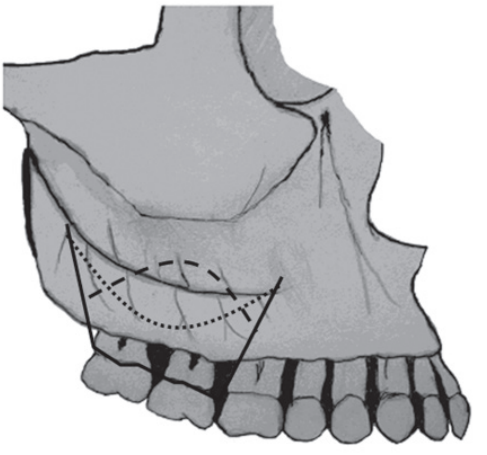

Figure 10. Dotted line — Partsch cut, spotted line — Pichlera cut, a solid line — Neumann cut.

The preparation of the foetuses arterial network at the maxilla body and at the alveolar process is hard because of the very small diameter of these vessels. It is easy to pass over this anastomosis during specimen analysis — such small arteries were not always filled with latex or ink along the whole length (Fig. 9). This can lead to false negative results.

The anastomosis between IOA and PSAA and the arteries of the maxillary sinus mucosa are the only routes of blood supply for the lower part of the maxilla body [9]. Maintaining this arterial connection during surgical procedures in this area can avoid bleeding and increase the chances of appropriate healing of transplanted bone during alveolar process augmentation, and our results show the varied course of this vessel [4, 9, 11].

During operation in this area, the surgeon should know the precise location of the anastomosis to avoid damaging it. Data about the length from this arterial connection to the lower alveolar ridge, the sixth tooth, or, with edentulous patients, the lowest palpable part of the zygomaticoalveolar crest.

The other possibility for the precise location of this anastomosis is individual analysis of HRCT images of the face made in the frontal plane. However, this is not possible in all cases because of the low sensitivity of this examination, as seen in earlier reports [4].

PSAA is shown in anatomical textbooks as a short, small vessel [1, 10] originating from the maxillary artery in the common trunk with IOA or independently earlier reports Choi and Park [2]. Our results, and results presented in other studies [3, 4, 9, 11], show that the PSAA reach at least as far as the canine fosse mesially. On its course, the PSAA branches into many caudally- and cranially-running small arteries [9] just under the mucosa. So the APA is supplying in blood mucous covering alveolar process in oral vestibule. It is important when choosing the cut used during dental surgery procedures such as root resection or cysts resection. By using the Pichler or Partsch cut, the risk of APA branch damage is greater than when using the Neumann cut (Fig. 10). Using the Neumann cut should decrease bleeding during surgery and improve wound healing.

CONCLUSIONS

There is an arterial connection between IOA and PSAA at the maxilla body of foetuses. It runs on the surface of the maxilla and alveolar process, contrary to adults, in whom the described anastomosis is in the bone or even in the maxillary sinus.

The course of the analysed arterial anastomosis at the front maxilla wall varies in location from just over and parallel to the alveolar process, and under zygomatic bone body.

The anastomosis described in the study shows caudally running arteries, which can be important in choosing incisions in procedures performed at the alveolar process.

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