Universitatea de Medicină şi Farmacie

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Medicine

The anatomical risk in dental implants

SUMMARY OF THE DOCTORAL THESIS

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TABLE OF CONTENTS

INTRODUCTION

Modern dentistry cannot be conceived without the implantology segment. Implantology is not a science in itself, but it is shaping up in medical practice as a chapter of great scope and success. The dentist carries out the clinical examination and the paraclinical examination, after which he makes the diagnosis and proposes a therapeutic approach.

Through discussion with the patient, the patient's expectations are assessed and the objectives and limits of treatment are presented. The implantology practitioner:

- Performs the clinical and paraclinical examination;
- Defines the objectives;
- Identifies risk factors;
- Assesses the level of difficulty;
- Establishes the treatment plan;
- Evaluates and prepares the means to achieve the objectives.

In this short presentation we have talked about the need to identify risk factors. As in any surgery, risk factors can be local or general. The very enumeration of these factors requires an extensive information and systematisation effort.

Local factors: history of periodontitis or peri-implantitis, immunological disorders, existence of gingival keratinisation, drilling procedures, surgical procedures (grafting), endodontic pathology of neighbouring teeth, type of interdental contact, position of the contact point, previous prosthetic work, bone factors (buccal concavity, vertical bone resorption, bony protrusions in the vicinity), etc.

General factors: aesthetic, gingival [1] (gingival quality, gingival papilla), oral hygiene, smoking, biomechanical factors, radio/chemotherapy, Crohn's disease, osteoporosis, other consumptive or metabolic diseases, doctor's experience, stress, patient's level of information, etc.

After this presentation (which is not exhaustive) the question obviously arises: "how can anatomical risks be quantified?".

This is not something that everyone can do, since computer tomography, which can provide information on bone density, and panoramic dental X-rays are increasingly used in anatomical descriptions and assessments. Information is thus gathered which, together with the means of classical anatomy, can provide a multidisciplinary opening to the assessment of intrinsic structural risks.

Thus, anatomical risk in dental implantology depends on:

- The jaw on which the implant is made;

- The curvature of the oral cavity;
- Respect of the natural insertion axes of the teeth;
- The appearance, structure and topography of the maxillary and mandibular cancellous tissue;
- Appearance of cortical bone;
- Variable arrangement of the nervous and vascular structures serving the two arches;
- Appearance, course, variability and topography of the inferior alveolar canal;
- Knowledge of vascular variants and anomalies;
- Knowledge of concavities on the lingual aspect of the mandible;
- Knowledge of palatal vasculo-nerve topography;
- Knowledge of maxillary alveolar ridge to nasal cavity and maxillary sinus relationships;
- Understanding the mechanisms that achieve the bone-implant junction (implant osseointegration);
- Knowledge of dental anomalies;
- Knowledge of loco-regional vascular-nerve relationships.

As can be seen, the anatomical risks for dental implantology are numerous and varied. Their assessment is, as we have shown, a multidisciplinary approach, and neglecting them can easily lead to the unfortunate situation in which the implant is rejected.

In this logic, starting from the fact that I am a practicing dentist and implantologist, I considered that the in-depth study of anatomical risk elements can be of real benefit to my daily practice.

Work hypothesis

For my doctoral research, I focused on a few areas of interest that I felt would be of practical benefit to me by deepening my anatomical knowledge. For each area, I carried out a dissection study. I would like to point out from the outset that my studies are not statistical in nature (access to a large number of cadavers being limited), but are purely descriptive studies, in which we have focused our attention on identifying anatomical landmarks that may be useful in my daily practice.

Scientific objectives

During the course of these studies, I set myself the specific objectives of descriptive anatomy: the description of structures, their paths, their neighbourhood and distance relationships and the topographic regions crossed by these structures. Specifically, I focused on highlighting anatomical relationships that would find relevance in everyday practice.

Method and methodology

For the embryological study we performed light microscopy slides by sectioning frontal and sagittal planes of embryo-fetal skulls at different ages.

For dissection studies we performed detailed dissections, highlighting all bone, dental, muscle and vascular-nervous structures of loco-regional interest. We also performed cross-sections of the mandible, as well as dissections by removal of the outer mandibular tray to reveal the mandibular canal.

For sinus reports we opened the maxillary sinus and made images of the dissection field by bone transillumination.

The large amount of literature studied for each study is not without interest.

Work hypothesis and general objectives

The paper is designed in a general part and a part of personal contributions.

In the general part there are three chapters:

1. Notions of embryology;
2. Notions of facial anatomy;
3. Healing process and osseointegration.

These chapters present, in a detailed way, the current state of knowledge on the subject of our study.

The personal contributions part is conceived in the form of five studies:

1st study: Contributions regarding the embryological development of the mandible the stages of odontogenesis. In this study we performed microscopic sections on embryos and fetuses of various ages, successive, as well as maxillo-mandibular dissections, with evidence of tooth formation and ossification. We conducted this study based on the idea that understanding maxillo-dental formation provides a sound scientific basis for understanding dento-maxillary anatomy and anomalies of these structures. We have succeeded in highlighting all the stages of dental development as well as the mode of mandibulo-maxillary ossification.

2nd study: Contributions regarding the palatine nerves and arteries and their importance in implantology. We conducted this study based on the idea that the disposition and topography of the palatine nerves are the touchstone in our knowledge of regional anatomy. These nerve structures are involved in the maintenance of palato-dental trophicity, zonal sensitivity, and the occurrence of trigeminal neuralgia complications. I set out to accurately dissect these structures and fit them into the loco-regional topographic pattern. I performed dissection of the pterygopalatine fossa, with highlighting of the pterygopalatine ganglion and its relationship to the maxillary artery. We traced, by dissection, the route of the palatine vascular bundle to the maxillary teeth.

3rd study: Contributions regarding the structure of the mandible in edentulous people and the highlighting of the importance of its knowledge in implantology techniques. Implants in edentulous people are a big part of everyday life. We felt the need to understand the change in mandibular anatomy in edentulous patients. I consider the modification of the inferior alveolar canal pathway in the edentulous mandible of utmost interest. I have performed dissections to highlight and define these changes. We have demonstrated the modification of the alveolar ridge and the distance between it and the alveolar canal. We have shown the general direction of evolution of the canal, as well as the fact that alveolar vascular-nerve branches persist in edentulous patients.

4th study: Contributions regarding the anatomical assessment of the mandibular canal. The main risk of mandibular dental implantology is the interception of the mandibular canal. Understanding its microstructure, intracanalicular relationships, path and regional topography at the level of individual teeth is one of the most important gains of anatomical study at this level. We have demonstrated the positioning of the mandibular canal relative to all mandibular anatomical landmarks, describing the canal parameters at the level of each mandibular tooth.

5th study: Contributions regarding the superior teeth relations to the maxillary sinus. When maxillary implants are inserted, there is a major risk that the implant may injure the sinus structures. The dissection and anatomical description of the relationship of the roots of the upper teeth to the maxillary sinus is a strength of my research. The information obtained is useful to both the implantologist and the maxillofacial surgeon called upon to perform sinus lift surgery [2].

We have shown that practically all the teeth of the maxilla proper can come into contact with the maxillary sinus and that, after edentulism, the pneumatization of the maxillary sinus changes, its volume shrinks and the lower nasal meatus increases.

General research methodology

My studies are mainly based on dissections, because I felt that this way I could carry out the most beneficial research, related to my specialty as a gynaecologist. The dissections were performed on formalinized cadavers in the Anatomy Discipline laboratory.

I have also performed fetal dissections on formalised cadavers of girls from the Anatomy Discipline collection.

Access to dissection plans was facilitated by making cross-sections, sagittal and parasagittal sections at pelvic level. In this way, dissection was made much easier, allowing the entire pathway of the pelvic nerve structures to be traced.

The dissection fields were prepared and digitally photographed in successive planes so that the information benefit to the surgeon was substantial.

The images obtained were edited, indicating each structure individually, so that we obtained highly suggestive plates for further analysis.

We also used MRI images obtained from the imaging clinic of the "Dr. Victor Babes" Medical Centre for Diagnosis and Treatment in Bucharest. These images were compared with the dissection plates, establishing anatomical criteria radiologically observable and useful in identifying and describing critical nerve relationships in the piriformis muscle region.

I would like to point out that specific objectives and methodologies are given extensively for each study.

1st study: Contributions regarding the embryological development of the mandible and the stages of odontogenesis

Introduction

The formation of the mandible and the process of odontogenesis are complex phenomena with multiple determinants. Their study is complicated, and disorders of the embryological process can generate rich variability and numerous anomalies. In this context, embryological concepts are practically of clinical significance. The development of the mandible is a complex process with a complicated anthropological evolution. The mandible is formed by the first branchial arch, which has the Meckel cartilage at its centre. Ossification is desmal and cartilaginous. On the border between the Meckel cartilage and the cortex resulting from membrane ossification, the mandibular canal appears. The mandibular canal is created by the union of three separate canals, corresponding to the nerve threads that innervate the different dental groups. The incisor segment appears first. The segment for the molars of the primary dentition appears next, and finally the segment for the permanent molars. The mandible undergoes remodelling processes, as a result of which the canalicular segments fuse. Tooth development is correlated with maturation and ossification of the surrounding bone. The presence of the nerve is necessary for tooth formation. During odontogenesis, various physiological processes occur consecutively: tooth induction, cell proliferation, cell differentiation, tooth morphogenesis and maturation. During odontogenesis, these processes overlap, but at each stage, one of them is predominant.

Rezults – I will present two suggestive images for my study:

Fig.1: 3-month-old fetus, with highlights of the facial primordia.

1. medial nasal buds; 2. lateral nasal buds; 3. maxillary buds; 4. mandibular arch.

Fig. 2.: Frontal section of embryo face in the posterior third of the mandibular body – 8th week.

1. Meckel cartilage; 2. mandibular desmal ossification centre; 3. lingual nerve; 4. tongue; 5. primitive buccal cavity; 6. nasal spine; 7. nasal septum. The arrow points to the entrance of the inferior alveolar nerve into the mandible.

Conclusions and personal contributions for this study

We have achieved a mandibular dissection that highlights the formation of the mandibular canal between the lingually located Meckel's cartilage and the vestibular cortex of the mandible. The mandibular canal is formed from the fusion of posterior canalicular segments.

We have identified the stages of tooth formation, going through the entire process of fetal odontogenesis from 6-7 weeks to the fifth month.

We identified the positions of tooth buds at the mandibular and maxillary primordia, demonstrating how the position of tooth primordia varies with fetal age.

Our study basically provides an overview by which the clinician understands the origins of the odontogenesis process, the evolution of this process and how the dental primordia change position in relation to the alveolar processes.

2nd study: Contributions regarding the palatine nerves and vessels and their importance in implantology

Introduction

The palatine nerves and vessels carry out the innervation and vascularization of the palate up to the alveolar crest [3]. T he origin of these structures is deep, in the pterygopalatine fossa, and the route is complicated, these structures crossing the pterygopalatine fissure and canal and then the palatine region, to end in the vicinity of the alveolar ridge [4]. They contribute to the vascularisation and innervation of the upper teeth. Following the insertion of maxillary implants, neuralgia or haemorrhages may occur, involving these structures [5]. The palatine nerves are the anatomical substrate on which trigeminal neuralgia can occur. The insertion of maxillary implants can trigger such an incident, which has the following pathway as its substrate: alveolar branches of the palatine nerves - pterygopalatine ganglion - maxillary nerve - trigeminal ganglion. The palatine vessels partially serve the alveolar crest and, depending on their variability and topography, the insertion of an implant may trigger haemorrhagic incidents if these vessels are not protected during the implantation technique. Consequently, a good knowledge of the origin, route and distribution of these structures keeps the specialist "on guard" to avoid and recognise the occurrence of complications.

Results – I will present two of the most suggestive pictures:

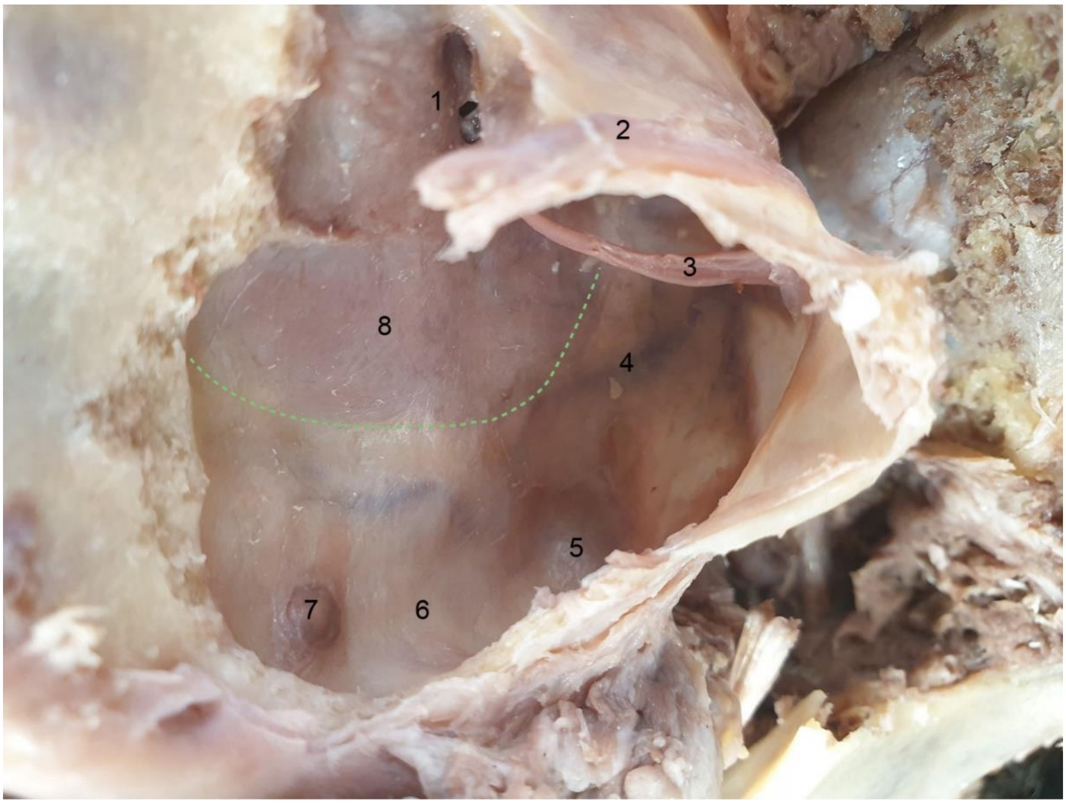

Fig. 1.: The pathway of the palatine vessels in the posterior and infero-medial walls of the maxillary sinus.

1. Sinusal aspect of the semilunar hiatus; 2. The infraorbital nerve inside the ceiling of the maxillary sinus; 3. Fibrous intrasinusal band; 4. The palatine vessels, seen by way of transillumination on the maxillary tuberosity; 5. Root of the third molar, prominent in the sinus cavity; 6. The palatine recess on the floor of the maxillary sinus; 7. Cyst in the floor of the palatine recess; 8. The lateral wall of the nasal cavity, corresponding to the medial wall of the maxillary sinus.

Fig. 2.: Highlighting of the pterygopalatine ganglion and of the originating bundle of the palatine nerves.

1. The infraorbital nerve, continuing the maxillary nerve; 2. The common bundle pf the palatine nerves, originating in the inferior angle of the pterygopalatine ganglion; 3. The anterior aspect of the pterygoid process; 4. The origins of the palatine nerves; 5. The middle nasal meatus mucosa; 6. The inferior nasal meatus mucosa. The green line shows the sphenopalatine foramen. The green arrows show the orbital branches of the pterygopalatine ganglion. The yellow circles show the pterygopalatine nerves, branching off the maxillary nerve and entering

the pterygopalatine ganglion. The red arrows point toward the nasal branches from the pterygopalatine ganglion, entering the nasal cavity through the sphenopalatine foramen.

Conclusions and personal contributions for this study

We have succeeded in highlighting in a single dissection image the entire course of the palatine vessels and nerves. At the same time, we have detailed their relationships in each region crossed. There are numerous clinical situations in which the anatomical approach we have developed can be useful: various types of anaesthesia, tumour resections, palatal mucosa flaps, Le Fort operation etc. All of these can benefit from a good anatomical presentation of the pathway of the palatine nerves and vessels.

Demonstration of the pterygopalatine ganglion and its relationships facilitates endoscopic interventions in the pterygopalatine fossa. Our results show that careful dissection, coupled with a simple and clear anatomical presentation, can find good clinical utility.

As can be seen, the results of our study far exceed the goals originally proposed. We would like to emphasize, however, the importance of knowing the topography of the palatine neurovascular bundles at the level of the palatine holes, through which they approach the palate. In this way, we can highlight the anatomical risk associated with the anaesthesia that is frequently performed as a preamble to implantation techniques. The risk of haemorrhage is obvious. Injury to the palatal vessels can lead to the formation of haematomas between the palatal mucosa and the hard palate. There is a possibility of loco-regional fusion of these haematomas. Injury to the palatal nerves may lead to permanent anaesthesia of the palate and hemiarch.

3rd study: Contributions regarding the structure of the mandible in edentulous people and highlighting the importance of its knowledge in implantology techniques

Introduction

Dental implants are inserted into the mandibular body, penetrating both compact and cancellous bone. Most of the implant is fixed in the cancellous bone. The implant's coils spread the bone trabeculae apart and compress the cancellous structure, thus achieving a good fit in the mandibular body. The depth level of the implant must take into account the existence, topography and course of the mandibular canal, through which the inferior alveolar vasculonervous bundle passes. [6]. In this context, the appearance of the cortical bone lamina and the structure of the cancellous bone, in relation to the mandibular canal, become very important [7]. In our study, we aim to follow these parameters by making serial cross-sections of the mandibular body.

Results – I will present two suggestive pictures for this study:

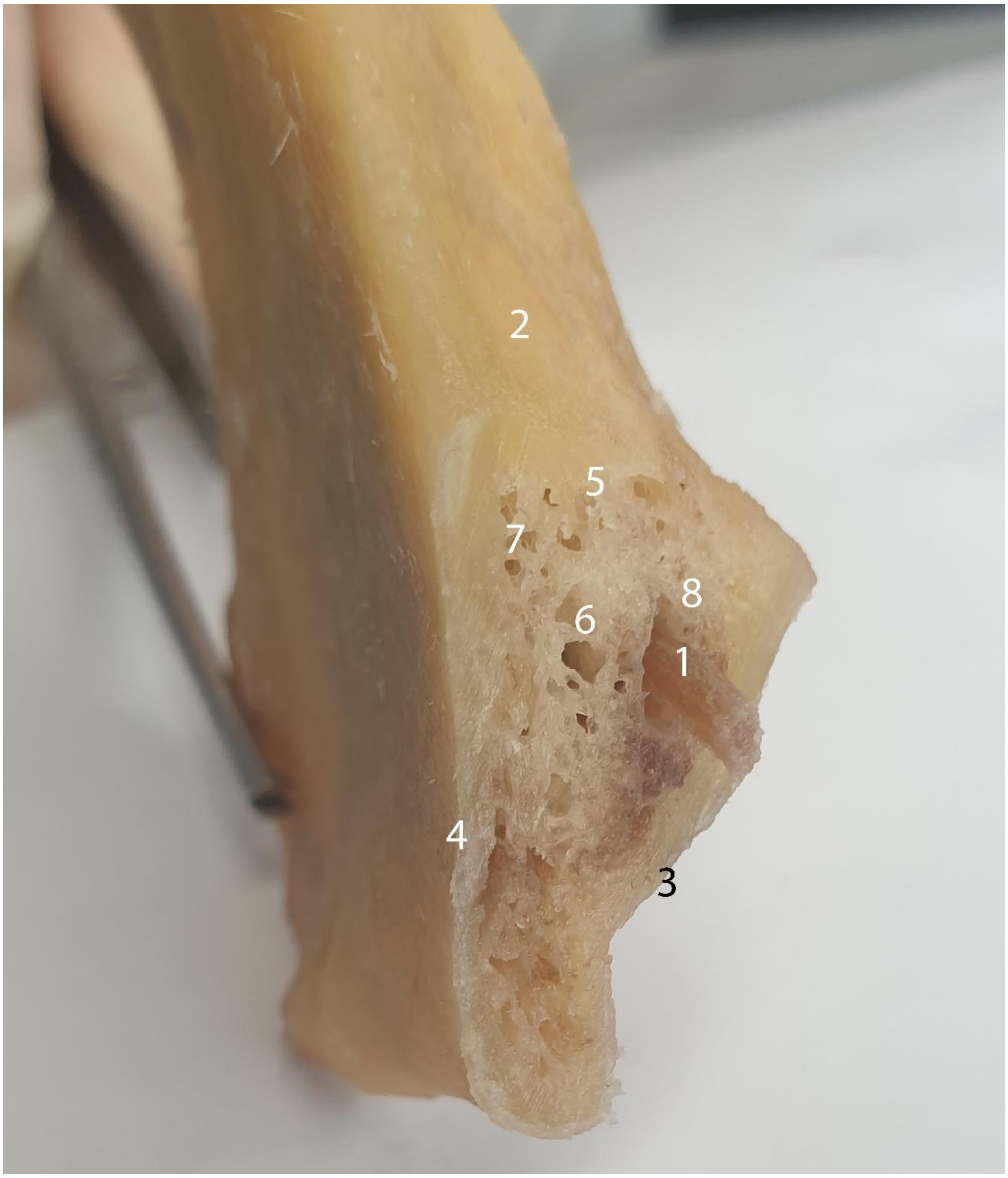

Fig. 1.: Section at the level of the retromolar fossa.

1. Inferior alveolar nerve in mandibular canal; 2. Retromolar fossa; 3. Lingual cortical lamina; 4. Vestibular cortical lamina; 5. Alveolar cortical lamina; 6. Large central areolae; 7. Small peripheral areolae; 8. Mandibular canal cortex.

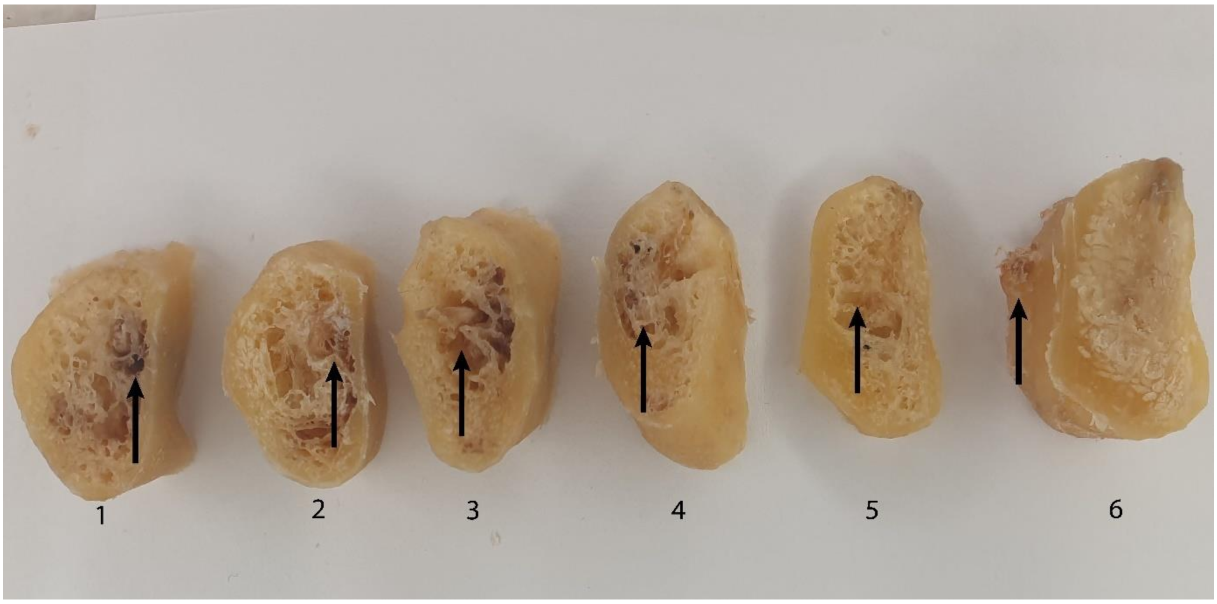

Fig. 2.: Series of cross-sections on the body of the mandible on the right side, corresponding to the relative position for the lower teeth.

Each sectioned fragment corresponds to the relative position of a tooth, so that, from right to left, the fragments correspond to the dentition in the following order: 2nd molar, 1st molar, 2nd premolar, 1st premolar, canine, lateral incisor.

Conclusions and personal contributions for this study

The mandibular cortex has the appearance of a compact bone plate, continuous around the circumference of the mandibular body. At the alveolar ridge, its thickness varies around 1 mm.

The cancellous bone tissue is represented by bony trabeculae, which intersect and delimit the areolae. They have a typical distribution, with small diameters towards the periphery and large diameters around the alveolar canal. Obviously, the areolae communicate with each other, this element makes it possible to take up the pressure in the entire mass of cancellous bone tissue, thus protecting the mandibular canal.

The mandibular canal runs obliquely from medial to lateral and from posterior to anterior at the level of the mandibular body, and ends at the level of the chin hole. This observation is of major importance for the practitioner, who thus has a global indication of where to insert the implant in order to protect the mandibular canal and its contents. Throughout, a distance of approximately 8.5 mm is maintained between the alveolar ridge and the mandibular canal. This distance is an important indicator of the space the surgeon has available for the insertion of the implant.

4^{th} study: Contributions regarding the anatomical assessment of the mandibular canal

Introduction

During the insertion of mandibular dental implants there is an obvious major risk of injury to the mandibular canal and its contents. The mandibular canal may be directly injured mechanically by the implant or it may be deformed as a result of the surrounding pressure and consequent oedema. In these circumstances, knowledge of the mandibular canal route becomes the most important element in avoiding surgical risk [8].

The mandibular canal contains the inferior alveolar neurovascular bundle, represented by the inferior alveolar nerve with its branches and the inferior alveolar vessels. Knowledge of their position is an important factor in assessing operative incidents following canal interception. Variability in the appearance of the inferior alveolar neurovascular structures should be known [9,10].

The distance between the alveolar ridge and the canal, and how it varies in different mandibular segments, is a constant concern of the surgeon [11].

Knowing all these elements, the surgeon makes an operative plan of the insertion site and the space available for the insertion of each implant.

Consequently, accurate topography of the position of the mandibular canal is the basis for the design of the surgical strategy.

Results – I will present two suggestive pictures for this study:

Fig. 1.: Medial view of the mandibular foramen.

1. Lingula; 2. Mandibular foramen; 3. Inferior alveolar nerve; 4. Groove of the mylohyoid nerve; 5. Insertion of the medial pterygoid muscle

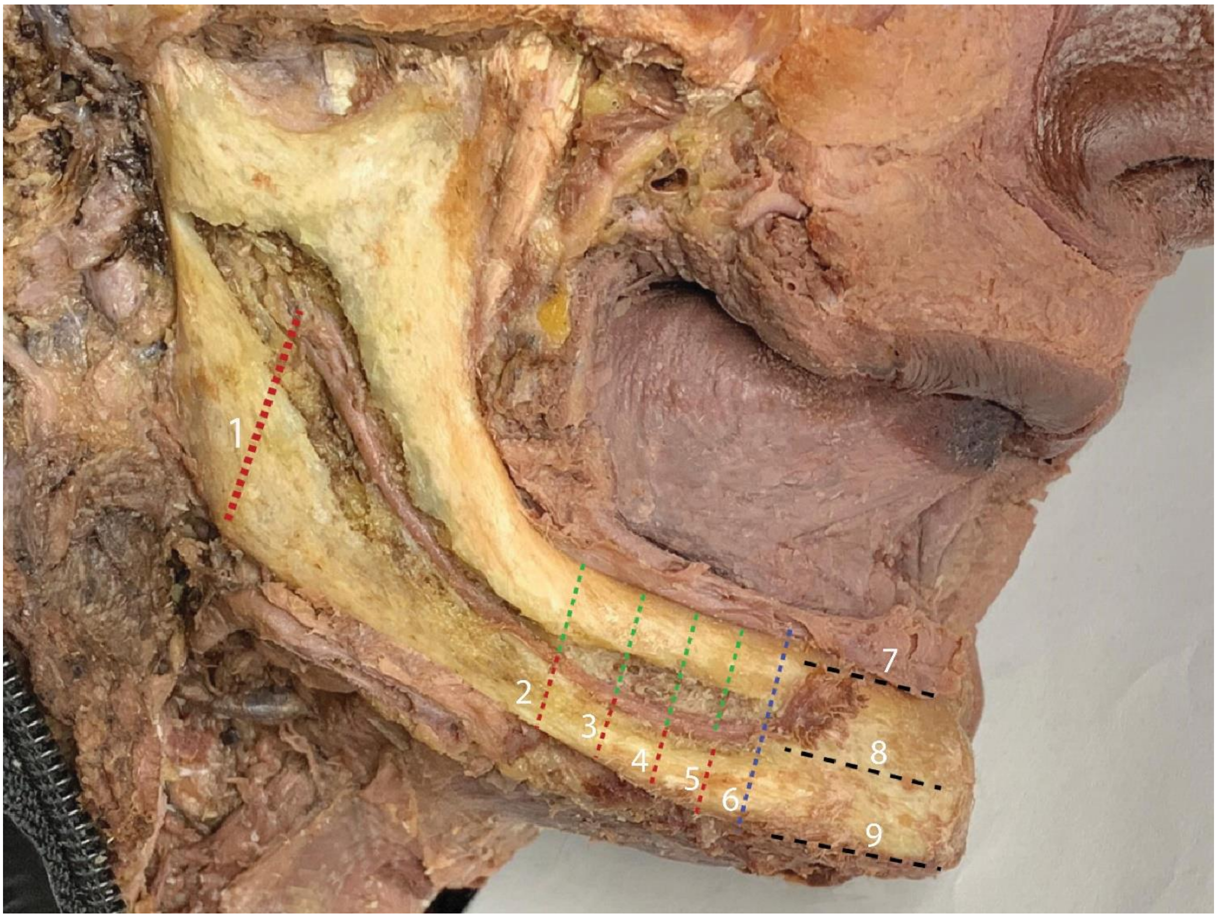

Fig. 2.: Topographical landmarks of the inferior alveolar nerve, in relation to the structure of the mandible.

Conclusions and personal contributions for this study

Basically, from the structure of the results obtained, we can draw conclusions that outline the anatomical risk existing in the case of dental implant insertion.

A first risk is the risk of anaesthesia. Concerning the existing risks due to anaesthesia of the inferior alveolar nerve at the spix, from our observations it is clear that palpation of the spix is an indicator for the position of the nerve. Increasing the amount of anaesthetic that the operator injects into the pterygomandibular space will lead to anaesthesia of the mandibular nerve and widening of anaesthesia or entrapment of the lingual and mylohyoid nerves in anaesthesia. This technique will additionally provide anaesthesia in the area corresponding to the third molar. From our dissection it is clear that the optimal position of the needle tip is superior to the spix, in the space called pterygomandibular. Basically, this space contains the terminal branches of the mandibular nerve: buccal, inferior alveolar, mylohyoid and lingual. This topographical arrangement constitutes a containment space for the anaesthetic mass and, depending on the quantity injected, the extent of the anaesthetised territory varies. From the above, the risk of injury to one of the nerve structures listed and to the regional arteries can be deduced.

The existence of holes in the retromolar fossa may be radiologically evident and thus draws attention to the risk of injury to the retromolar vascular-nerve bundle. Such an incident may underlie the development of a regional submucosal haematoma or trigger trigeminal neuralgia.

The existence of the lingual orifice can be radiologically objectified by a surgeon alerted to such a variant. Insertion of an implant at this level should be avoided, because during the manoeuvre the vessels accessing the orifice may be injured, or a haemorrhage with submucosal haematoma of the buccal floor may occur through this orifice.

The existence of the sublingual gland fossa creates a concavity of the lingual face of the mandible superior to the mylohyoid crest. For the insertion of implants at the level of the canine and premolars, the surgeon must take into account here the inclination of the long axis of the implant corresponding to the alveolar process and the alveolar ridge. If this is not taken into account, in the case of well-shaped fossae, the tip of the implant may penetrate the lingual cortex of the mandible.

The position and situation of the alveolar ridge varies along the mandibular arch. Basically, outside the ridge, the mandibular cortex corresponds vertically to the mandibular canal. In other words, the insertion of implants should follow the ideal insertion position of the natural teeth.

The path of the inferior alveolar nerve through the mandibular canal is from medial and superior to lateral. This observation is one of the most valuable pieces of information available to the surgeon.

The distance between the alveolar ridge in the edentulous mandible and the mandibular canal can and should be assessed by the surgeon using CT scanning. Our study confirms the existence of this distance and the importance of its assessment in the case of dental implant insertion. Our study confirms the existence of a variable gap that allows the insertion of implants. The variability of this space is, in fact, the biggest risk element throughout the operation.

5th study: Contributions regarding the superior teeth relations with the maxillary sinus

Introduction

The anatomical configuration of the upper jaw makes it more difficult to insert implants at this level than in the mandible. The maxillary alveolar process naturally offers less space for implant insertion. The relationship with the maxillary sinus and the floor of the nasal cavity are risk factors in implantology [12]. Detailed knowledge of the anatomical configuration [13] is an advantage for the practicing surgeon. The risk of sinus lesion, with consequent migration of the implant into the sinus, is a concern with any implant insertion procedure in the upper jaw. [14]. In addition, it is necessary to know, as we have shown in the study of the palatine nerves, the distribution of the vasculonervous bundles along the alveolar process [15]. Knowledge of the existence and course of the sinuous canal (containing the anterosuperior alveolar nerve - branch of the infraorbital nerve [16]) is important to understand why incisor anaesthesia must be gingival, otherwise the anaesthetic does not reach the intrabony nerve branch. We have considered as very important the dissection of the sinus mucosa at the level of the sinus floor [17], because this is where the sinus lift procedure is performed, with the insertion of bone transplants, to increase the substrate necessary for the insertion of implants in the maxillary arch [18].

Results – I will present two of the most suggestive pictures:

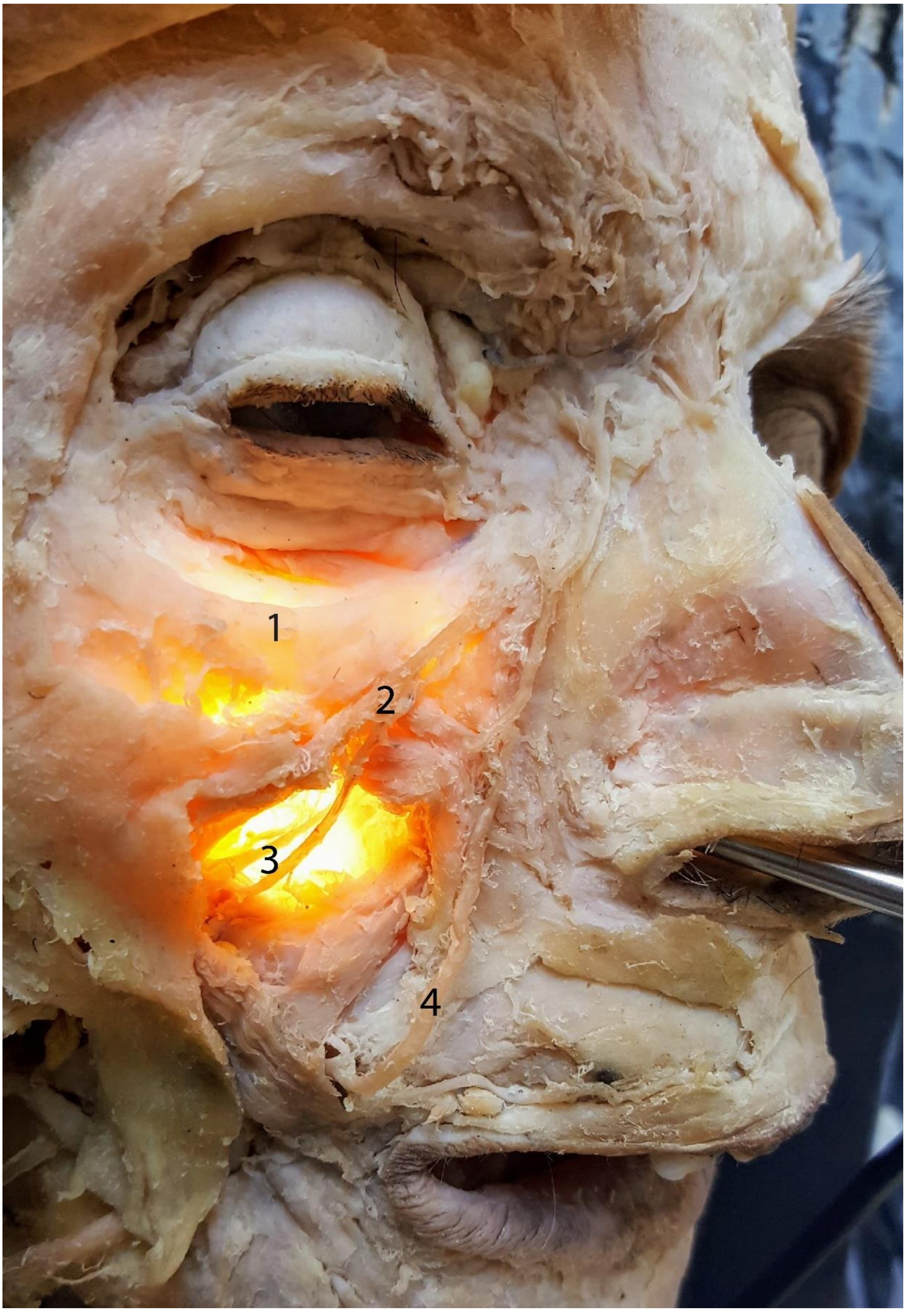

Fig. 1.: Endoscopic transillumination of the maxillary sinus with identification of the middle superior alveolar nerves.

1. Lower orbital rim; 2. Infraorbital nerve; 3. Superior middle alveolar nerves; 4. Facial artery.

Fig. 2.: Highlighting the maxillary sinus mucosa, anterosuperior alveolar nerve and anterosuperior alveolar arterial branch.

1. Alveolar recess; 2. Nasopalatine recess; 3. Maxillary alveolar ridge; 4. Hard palate; 5. Incisive cyst; 6. Ethmoid recess; 7. Zygomatic recess; 8. Infraorbital vasculonervous bundle; 9. Anterosuperior alveolar nerve; 10. Anterosuperior alveolar artery.

Conclusions and personal contributions for this study

From observing the external appearance of the jaw and the way the upper teeth are inserted, it is clear that there is a compact, small bone plate between the dental roots and the jaw surface. If the implant is inserted into the edentulous jaw in the natural direction of the initial teeth, there is a risk of penetration of the cortical surface of the jawbone.

The presence of superior-middle alveolar nerves between the sinus mucosa and the sinus wall is a risk factor during sinus lift procedures.

Normally, the sinus mucosa is thin, semi-opaque, and can be easily injured by inadvertent manoeuvres during the sinus lift procedure. Demonstration of the superior alveolar nerve and how it enters the sinus canal draws attention to the need for an effort to radiologically identify the sinus canal. We have as an important anatomical landmark the 3-4 mm distance between the lateral edge of the pyriform aperture and the sinus canal. Even if the radiological identification of the canal is not achieved, this landmark is important for the surgeon, leading him to avoid inserting the implant at this level.

The anterior wall of the maxillary sinus is thin and semi-opaque. If this observation is not taken into account when creating the bony volar during the sinus lift procedure, the sinus mucosa may be injured with the piezoelectric scalpel.

With regard to the internal aspect of the maxillary sinus, we consider it particularly important to understand the topography of the two lower recesses: the alveolar recess, which partially corresponds to the maxillary alveolar process, and the nasopalatine recess, which can be perforated if the position and length of the implants are not adapted to the frontal implants.

The alveolar recess has a vertical portion corresponding to the maxillary tuberosity and a horizontal portion corresponding to the maxillary alveolar process. It is bounded by two ridges, a medial and a lateral ridge, which can be clearly seen radiologically.

The identification during dissection of perforating veins at the base of the maxillary alveolar process is an important risk factor during the insertion of upper implants.

The route of the nasopalatine vasculonervical bundle through the incisive foramen should be known, as the orientation of the implant tip posteriorly in the case of front teeth may lead to interception of the nerve in the incisive canal. The path of the large palatal nerve overlaps the wall of the nasolabial recess. This observation is particularly important to avoid injury to the vasculoneural structures.

The dissection of the postero-superior alveolar nerves and vessels is practically the theoretical background to be known in the case of buccal anaesthesia of the upper molars. The fact that the vascular-nerve formations have a close relationship with the bone is particularly useful to the surgeon when performing anaesthesia, who is warned to avoid contact between the needle tip and the sinus bone wall. The tip of the needle should remain submucosal.

In preoperative radiological assessment of the maxillary sinus, cord-like structures crossing the sinus lumen may be identified. They may be mistaken for vasculonavus structures but, as we have shown, they may actually be fibrous cords of no functional significance.

The sinus mucosa may be altered in appearance and size, either due to age or due to pre-existing chronic inflammatory processes. The information obtained by history taking on sinus pathology is valuable because it alerts the surgeon to structural changes in the sinus mucosa.

The variability of maxillary sinus dimensions is recognised in the literature. With age, the sinus may narrow posteriorly at the expense of increasing the size of the lower nasal meatus. This may result in the sinus lift procedure actually addressing the lower nasal meatus.

During the sinus lift procedure, the initial step is to detach the muco-periosteal complex. The surgeon seeks to penetrate with a delicate decollator into the cleavage space existing between the periosteum and the cortex of the jawbone. In the course of performing the bone flap, the condition of the mucosa and the associated existence of any sinus pathology is important.

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List of published scientific papers in the subject of the doctoral study

1. Lupu F, Iliuță C, Enyedi M, Panțu C, Stănciulescu R, Enciu O, Filipoiu F – *The Pterygopalatine Ganglion, Palatine Nerves and Vessels: Dissection and Pathway*. *Int J Morphol* 40(3):601–607, 2022. – articol ISI – FI = 0.52.
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2. Lupu F, Iliuță C-P, Bulescu I-A, Enyedi M, Gheoca Mutu D-E, Enciu O, Filipoiu FM – *Investigation of the morphometry of the pre-lacrimal recess of the maxillary sinus for the pre-lacrimal approach of the maxillary sinus and paramedian skull base. A computed-tomography study*. *J Med Life* 15(6):805–809, 2022. – articol PubMed.
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