

**XXXI Student International Conference of
MORPHOLOGY SCIENCES**

7 May 2026, Rīga

Abstracts Book





Institute of Anatomy and Anthropology

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Anatomical Variation of the Ulnar Nerve and Ulnar Artery in Guyon's Canal

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Introduction. The ulnar tunnel, known as Guyon's canal, is a fibro-osseous space at the wrist through which the ulnar nerve and artery enter the hand. While vital to hand function, this region is frequently underemphasized in clinical settings. Mastering the complex anatomy of the canal is crucial for clinicians to properly identify and treat local pathologies. The most common of these is ulnar tunnel syndrome, a compression of the ulnar nerve that can significantly impair patient dexterity and sensation (Saran et al., 2025).

Aim. This study aimed to conduct a detailed morphometric and anatomical analysis of the ulnar neurovascular bundle within Guyon's canal, specifically quantifying the bifurcation levels and branching patterns of the ulnar nerve and artery relative to the pisiform bone, to provide comparative data against the established benchmarks of König et al. (1994).

Materials and methods. The anatomical study was conducted on six hands from three cadaveric specimens, utilizing the “Anatomage” virtual dissection table to provide high-resolution, three-dimensional visualization of the wrist's internal structures at the Department of Morphology, Institute of Anatomy and Anthropology, Rīga Stradiņš University. For each specimen, the boundaries of Guyon's canal were systematically defined using the pisiform bone as the medial landmark and the hook of the hamate as the lateral boundary. Within this space, the ulnar neurovascular bundle was isolated to evaluate the morphology and morphometry of both the ulnar nerve and artery. Data collection focused on the level of ulnar artery bifurcation, classified as occurring proximal to, within, or distal to the canal, alongside the linear distance from the pisiform to the arterial branching point. Furthermore, the distal termination of the deep arterial branch was traced to determine its destination within the midpalmar space, the hypothenar muscles, or both. Regarding the ulnar nerve, the analysis documented the level of division relative to the canal and the specific branching pattern, noting bifurcations *versus* trifurcations. All measurements were recorded in millimetres using the digital tools integrated into the “Anatomage”, and the resulting

morphological findings were subsequently compared with the landmark reference study by König et al. (1994).

Results. The morphometric analysis of the six cadaveric specimens revealed significant anatomical variations in both the ulnar artery and ulnar nerve, with several findings deviating sharply from established benchmarks. Regarding the ulnar artery, bifurcation occurred within Guyon's canal in four hands (67%) and proximal to the canal in the remaining two (33%). The mean distance from the pisiform bone to the arterial bifurcation point was 33.7 mm for divisions within the canal and 61.6 mm for those occurring proximally. Notably, one specimen exhibited a unique arterial trifurcation, characterized by two distinct bifurcation points, a morphological variant not documented in previous studies by König et al. (1994). Even more striking were the neurological findings, as all six hands (100%) demonstrated ulnar nerve trifurcation proximal to Guyon's canal. In each of these cases, a sensory branch bypassed the canal entirely to provide innervation to the ulnar aspect of the hand. These nerve divisions occurred at two distinct points, with a primary division located at a mean of 42.3 mm proximal to the pisiform and a secondary division at a mean of 26.2 mm. This observed trifurcation rate of 100% represents a significant departure from the 9% reported by König et al. (1994), suggesting that these anatomical variations may be more prevalent than previously documented.

Conclusions

1. The significant deviations from established data highlight the necessity of population-specific anatomical studies to account for morphological diversity.
2. The 100% prevalence of branches bypassing the canal requires surgeons to explicitly identify these variants to ensure complete ulnar nerve decompression.
3. Consistent proximal trifurcation patterns underscore the need for rigorous preoperative assessment to prevent incomplete decompression or accidental nerve injury.
4. Utilizing "Anatmage" technology establishes precise "danger zones" at 42.3 mm and 26.2 mm proximal to the pisiform for safer surgical navigation.

Sex-Related Differences in Colon Length and Their Association with Intestinal Transit Time and Defecation Frequency

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Introduction. Recent studies suggest that sex-related differences in colon length may significantly impact intestinal transit time and defecation frequency (Utano et al., 2021). While some clinical data indicate that women tend to have longer colons and slower transit time (Verkuijl et al., 2020), cadaveric studies present conflicting results due to post-mortem tissue rigidity and varying measurement methodologies (Phillips et al., 2015; Alqarni et al., 2024). Understanding these differences in length is essential for gastroenterological diagnostics and surgical planning, particularly in colonoscopy and laparoscopic procedures (Anderson et al., 2001).

Aim. This study aimed to determine sex-related differences in colon length in the adult population based on cadaveric material and their impact on colon transit time and defecation frequency.

Materials and methods. The colon was measured in six cadavers and three digital cadavers provided by the Laboratory of Anatomy, Department of Morphology, Institute of Anatomy and Anthropology, Rīga Stradiņš University. A measuring tape was used to determine the length of the colon and its segments (*caecum*, *colon ascendens*, *colon transversum*, *colon descendens*, and *colon sigmoideum*) in the cadaveric specimens. Three of the cadavers were female and three were male. The digital cadavers, one female and two males, were accessed using the "Anatomege" table. Measurements in the digital cadavers were obtained by placing digital markers on different points of the colon for distance measurement. Digital analysis of the measurements was performed, and statistical parameters, including the mean, median, and standard deviation, were analysed using Microsoft Excel. Statistical analysis was performed using the non-parametric Mann-Whitney *U* test and Spearman's correlation analysis.

Results. No significant difference in overall colon length was found between males and females ($p = 0.063$), although males showed a tendency towards greater overall colon length. The mean colon length (excluding the rectum) was 139.5 ± 19.6 cm in males and 94.1 ± 21.7 cm in females. Correlation analysis revealed a moderately strong, positive association ($\rho = 0.693$). Segmental analysis showed no significant differences in the caecum (10.3 ± 6.9 cm vs. 10.1 ± 3.3 cm,

$p > 0.05$) or ascending colon length (15.3 ± 1.4 cm vs. 15.0 ± 4.5 cm, $p > 0.05$) between males and females. However, the transverse colon was significantly longer in males (45.0 ± 5.8 cm) compared to females (28.2 ± 4.5 cm, $p < 0.05$). Spearman's correlation revealed a strong, positive, and statistically significant correlation for *colon transversum* length ($\rho = 0.845$). No statistically significant differences were observed in the descending colon (30.2 ± 10.4 cm vs. 24.4 ± 7.3 cm, $p > 0.05$) or sigmoid colon (39.1 ± 15.0 cm vs. 23.5 ± 3.8 cm, $p > 0.05$). Rectal measurements were not obtained due to limited access and were therefore excluded from the analysis.

Conclusions

1. No significant sex-related differences in overall colon length were identified, although greater colon length values tended to be associated with males.
2. A statistically significant difference between the sexes was identified in the transverse colon.
3. No significant differences were found in the caecum, ascending, descending, or sigmoid colon, suggesting relative anatomical consistency of these colon segments between the sexes.
4. Previous studies conducted on cadaveric specimens have revealed similar results, with males demonstrating greater overall colon length; however, investigations involving *in vivo* measurements have reported contrasting findings, with females exhibiting greater overall colon length.
5. Anatomical differences may have clinical relevance, as variation in colon length could influence intestinal transit time and defecation frequency, as well as the technical aspects of diagnostic or surgical procedures (e.g., colonoscopy).
6. Future studies should include complete colorectal measurements, consider additional factors such as age, anthropometric parameters, population variability, and data on defecation frequency, and incorporate a larger study population to provide a more comprehensive analysis.

Comparison of Morphological Variations of the Cruciform Eminence in Human Skull Samples

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Supervisor – Dr. med., Associate Professor Dzintra Kažoka

Introduction. Five dural venous sinuses drain into the confluence of sinuses (CS; also known as the *torcular Herophili*): the superior sagittal sinus (SSS), transverse sinuses (TSs), occipital sinus (OS), and straight sinus (SS). The CS exhibits significant morphological variability, which is well documented. Typically, the right TS is dominant and drains the SSS (Altafulla et al., 2020). The OS is rarely prominent in adults (Satyarthee et al., 2019). Few studies, however, address the variability of the cruciform eminence above the CS. Further research in this area would help neurosurgeons better understand occipital bone morphology and its variations, thereby supporting safer posterior cranial fossa surgery (Hosapatna et al., 2024; Couldwell et al., 2023).

Aim. This study aimed to analyse morphological variations of the cruciform eminence in 14 natural and 4 virtual skull samples, classify the skulls based on these variations, and compare findings between the two groups.

Materials and methods. The study cohort comprised 18 human skull specimens, divided into 14 natural dry skulls and 4 virtual models. The natural samples were obtained from the Laboratory of Anatomy within the Department of Morphology at the Institute of Anatomy and Anthropology. These physical specimens were evaluated using traditional morphometric tools, specifically a calibrated compass and ruler. In contrast, the four virtual specimens were accessed via the “Anatomage” virtual dissection table, where all measurements were performed using integrated digital calipers.

Anatomical assessment was standardized across both groups using three primary criteria. First, the shortest cross-sectional lengths of the grooves for the transverse sinuses (TS) were measured to determine hemispheric dominance. Secondly, the morphology of the superior sagittal sinus (SSS) was characterized by measuring the groove thickness along its first 2.0 cm posterior segment. These measurements were recorded at 0.5 cm increments to identify specific structural patterns, such as tapering or widening. Finally, each specimen was inspected for the presence or absence of a groove for the occipital sinus (OS) as a morphological alternative to the internal occipital crest.

All quantitative data regarding the TS cross-sectional lengths and SSS thickness were recorded and processed using Microsoft Office Excel. Descriptive statistical analysis was employed to classify the observed variations

and to compare the morphometric trends between the natural and virtual cohorts.

Results. In natural skulls, right-sided dominance of the groove for the TS was observed in 7 skulls (50%), whereas left-sided dominance was observed in 6 skulls (42.9%). One skull (7.1%) showed no dominance. The posterior portion of the groove for the SSS was concave in 5 skulls (35.7%), upward narrowing in 6 skulls (42.9%), convex in 2 skulls (14.3%), and upward widening in one skull (7.1%). A groove for the OS, rather than an internal occipital crest, was present in one skull (7.1%).

In the virtual skulls, left-sided dominance of the TS groove was observed in all 4 samples, although the small sample size may limit interpretation. The posterior portion of the groove for the SSS was concave in 3 skulls (75%) and upward narrowing in one skull (25%), mirroring the most common shapes found in natural skulls. A groove for the OS, rather than an internal occipital crest, was present in one skull (25%).

Conclusions

1. The CS and cruciform eminence exhibit significant variability, although both natural and virtual skulls consistently feature a concave, upwardly narrowing profile in the posterior SSS groove.
2. While virtual skulls showed left-sided dominance of the TS grooves, natural skulls demonstrated this trait in only 42.9% of cases, indicating a notable discrepancy in venous sinus asymmetry between the two groups.
3. Natural and virtual samples differ significantly in the cross-sectional length of TS grooves, necessitating a larger and more balanced virtual sample size to validate these morphological differences effectively and ensure digital models accurately reflect biological reality.

Anatomical Variability of Piriformis Muscle Length and Its Potential Clinical Relevance

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Introduction. The piriformis muscle is located in the gluteal region, originating from the anterior surface of the sacrum and inserting onto the greater trochanter of the femur. The average piriformis muscle length in adults varies from 12 to 15 cm. According to research by Deepak et al. (2024), shortened piriformis length is associated with increased symptom severity in patients with low back pain and radiculopathy, a condition caused by compression or irritation of a spinal nerve root. Therefore, anatomical evaluation of piriformis muscle length in a living patient may be relevant for understanding its potential role in clinical symptom development and in the subsequent treatment process.

Aim. The aim of this study was to perform an anatomical macroanalysis of the piriformis muscle by dissecting and measuring it to provide data relevant to understanding piriformis muscle shortening and its potential clinical implications.

Materials and methods. The study analysed seven distinct specimens to evaluate the morphology of the piriformis muscle: four digital specimens (two male and two female) sourced from the “Anatmage” virtual dissection table, and three natural male specimens. Notably, two of the natural specimens featured unilateral lower limb amputations. All materials were provided by the Laboratory of Anatomy of the Department of Morphology at the Institute of Anatomy and Anthropology, Rīga Stradiņš University. To quantify the anatomy, measurements were taken using a standard measuring tape, defining muscle length as the distance from the attachment point on the greater trochanter of the femur to the midpoint of its origin on the anterior surface of the sacrum. Morphological classification followed the system established by Landfald et al. (2025), which categorizes the muscle into four distinct types: Type 0 (absent), Type 1 (single belly), Type 2 (double belly), and Type 3 (multiple bellies).

Results. The results revealed a discrepancy between the digital and natural specimens. The average length of the piriformis muscle in digital table materials was 12.1 ± 0.15 cm on the right side and 11.8 ± 0.11 cm on the left side, which is consistent with the theoretical values for piriformis muscle length. Conversely, the natural specimens exhibited shorter average lengths of 9.3 ± 0.12 cm on the right side and 10.6 ± 0.11 cm on the left side, falling below the expected theoretical average. Both groups demonstrated slight bilateral asymmetry.

Regarding morphological structure, all specimens examined were identified as Type 1. However, a significant outlier was observed in one natural male specimen, in which the right piriformis muscle was markedly reduced to 7.5 ± 0.12 cm, representing the minimum value recorded across the entire study.

Conclusions

1. The study revealed that the piriformis muscle exhibits notable variability in length across different specimen types, with significant discrepancies observed between digital models and natural cadaveric materials, as well as between the right and left sides of the same individuals.
2. One specific natural specimen exhibited a markedly shortened piriformis muscle, falling well below the average theoretical length, highlighting the potential for substantial anatomical deviation from standard models.
3. The observed discrepancies underscore that, while the digital table provides a consistent theoretical baseline, dissection remains essential for capturing the full range of human morphological diversity required for accurate clinical and surgical planning.
4. Although clinical symptoms were not evaluated, comparison of these findings with the existing literature contributes to a more nuanced understanding of piriformis-related pain and may provide valuable clinical insights for the diagnosis and treatment of associated pathologies.

Distribution and Appearance of Remodelling Factors in Reinke's Oedema-Affected Larynx Tissue Compared with Control Tissue

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Introduction. Reinke's oedema is a chronic benign condition characterised by fluid accumulation within the superficial *lamina propria* of the vocal folds, with cigarette smoking as its primary aetiological factor. Dysregulation of matrix metalloproteinases (MMPs) and their endogenous inhibitors, tissue inhibitors of metalloproteinases (TIMPs), is known to contribute to extracellular matrix remodelling in various pathological conditions; however, its contribution to the structural changes observed in Reinke's oedema has not been well studied.

Aim. The aim of this study was to assess the distribution and appearance of MMP2, MMP3, MMP9, TIMP1, TIMP2, and TIMP4 in Reinke's oedema-affected larynx tissue compared with control tissue.

Materials and methods. An immunohistochemical analysis of 5 patients with Reinke's oedema and 7 control subjects was conducted for MMP2, MMP3, MMP9, TIMP1, TIMP2, and TIMP4 using a semi-quantitative method. Statistical analyses using the Mann-Whitney *U* Test and Spearman's rank correlation test were performed.

Results. MMP3-positive epitheliocytes were more prominent in the patient's epithelium ($\alpha = 0.01$), and positive subepithelial cells were also observed ($\alpha = 0.034$), while MMP9 showed an elevated number of subepithelial cells in patients ($\alpha = 0.002$). Among the inhibitors, TIMP1 was more distinct in both the epithelium ($\alpha = 0.035$) and subepithelium ($\alpha = 0.004$) in patients, whereas TIMP2 predominated in the epithelium of the control group ($\alpha = 0.004$). However, TIMP-4 also showed a tendency towards increased expression in epitheliocytes. Spearman's rank correlation test revealed no statistically significant correlations between any of the investigated markers.

Conclusions. An elevated number of MMP3- and MMP9-immunoreactive cells in Reinke's oedema-affected tissue indicates active ECM proteolysis driven by chronic irritation, while TIMP1 upregulation, and partially TIMP4 upregulation, likely reflects a compensatory inhibitory response to counterbalance MMP-mediated degradation.

Changes in the Expression of Tissue Innervation Factors and Cytokine Gene Proteins in Children with Intestinal Neuronal Dysplasia

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Introduction. Intestinal neuronal dysplasia is associated with abnormalities of the enteric nervous system and altered intestinal wall organization. Inflammatory, neuronal, and Hedgehog signalling pathways may contribute to the pathogenesis of this disorder.

Aim. The aim of this study was to evaluate the expression and localization of PGP 9.5, neurofilament, motilin, interleukin-1, interleukin-10, Sonic Hedgehog,

and Indian Hedgehog in the intestines of children with Hirschsprung's disease, as well as to analyse the interrelationships among these markers in relation to disorders of enteric nervous system development and inflammatory processes.

Materials and methods. A descriptive cross-sectional study was conducted using intestinal tissue samples from 15 children aged 7 months to 17 years with intestinal neuronal dysplasia. Control material consisted of 5 intestinal tissue samples from adults. Tissue was processed by routine histology and immunohistochemistry. Positively stained cells and structures for each marker were quantified semiquantitatively in multiple visual fields. Mean values and standard deviations were calculated. The markers evaluated included PGP 9.5, neurofilament, motilin, interleukin-1, interleukin-10, Sonic Hedgehog, and Indian Hedgehog.

Results. Interleukin-1, interleukin-10, Sonic Hedgehog, Indian Hedgehog, PGP 9.5, and motilin were the most consistent findings. Interleukin-1 and interleukin-10 showed moderate to numerous positive structures in most samples. Sonic Hedgehog and Indian Hedgehog demonstrated numerous positive structures, predominantly in the epithelium. PGP 9.5 showed low to numerous positive structures, mainly in connective tissue and the nerve plexus. Neurofilament was detected predominantly in the nerve plexus. Motilin demonstrated variable positivity, with numerous positive structures in several biopsy samples.

Conclusions. Intestinal tissue from children with intestinal neuronal dysplasia shows heterogeneous expression of inflammatory, neuronal, and Hedgehog pathway markers. The pronounced presence of interleukin-1, interleukin-10, Sonic Hedgehog, and Indian Hedgehog in several specimens suggests the active involvement of the tissue in local, still balanced inflammatory processes and altered signalling pathways. The dominating expression of the markers in the epithelium indicates marked compartment-specific differences in tissue response, localized mainly in the border tissue. Changes in innervation underline its decreased presence in intestinal neuronal dysplasia.

Evaluation of Incisive Foramen Anatomy, Morphometry, and Variations

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Supervisors – Dr. Normunds Bauers; Dr. med., Associate Professor

Dzintra Kažoka

Introduction. The incisive foramen is the opening of the incisive canal, also known as the palatine canal. It serves as a passageway for the nasopalatine nerve, which provides sensation to the anterior palate, and is an important site for anastomoses between the greater palatine artery and the sphenopalatine artery. The foramen has important clinical relevance in dentistry, including for nasopalatine nerve blocks, apical resections, extractions, central incisor implants, and palatal surgery (Bahşi et al., 2019). There have been reports of complications, including a lack of osseointegration of implants, linked to nerve and blood vessel damage in the incisive canal (Sarna et al., 2023). Therefore, understanding the anatomy and morphometric features of the incisive foramen is important for presurgical assessment, thereby improving clinical outcomes in dentistry.

Aim. The aim of this study was to measure and analyse the anteroposterior (AP) and mediolateral (ML) diameters of the incisive foramen, as well as to provide morphological descriptions of dentition status, symmetry, and the shape of the foramen in order to explore anatomical and morphometric variations.

Materials and methods. This study utilized a cross-sectional morphometric design to evaluate the anatomical dimensions and morphological variations of the incisive foramen in 20 human skulls. All material was provided by the Laboratory of Anatomy, Department of Morphology, Institute of Anatomy and Anthropology, Rīga Stradiņš University. Only specimens with intact mandibles, palates, and incisive foramina were used in this study and were labelled from 1 to 20 to ensure systematic data tracking and maintain consistency. Each specimen was placed in an inverted position on a stable surface to enable clear visualization of the incisive foramen. A digital caliper (precision ± 0.01 mm) was used to measure the mediolateral (ML) and anteroposterior (AP) diameters in millimetres. Mean values for AP and ML diameters were recorded. The symmetry of the incisive foramen was described for each skull as either positioned in the midline, slightly asymmetrical to the left, or slightly asymmetrical to the right. Dentition status was noted, as well as the presence or absence of a septum. Finally, the overall qualitative morphological shape was described as oval, round, irregular, slit-shaped, pear-shaped, heart-shaped, or

peanut-shaped. Microsoft Office Excel and IBM SPSS 30.0 were used for statistical analysis. To assess the strength and direction of relationships among variables, Pearson's correlation coefficient (r) was used.

Results. The morphometric analysis of 20 specimens provided a comprehensive overview of the anatomical variations in the sampled population. The mean AP diameter was 5.16 ± 1.29 mm, and the mean ML diameter was 3.57 ± 1.20 mm. AP dimensions ranged from 2.87 mm to 7.53 mm, and ML dimensions ranged from 1.07 mm to 6.87 mm. Analysis showed that AP and ML diameters varied independently across specimens ($r = -0.17$), highlighting the inherent diversity of these structures.

Dentition status had an impact on AP dimensions. Specimens with the most teeth ($n = 6$) exhibited the highest mean AP diameter (6.02 ± 1.22 mm), while adentate ($n = 8$) and partially dentate ($n = 6$) specimens showed lower values. Statistical analysis confirmed a moderate negative correlation ($r = -0.39$) between dentition status and AP diameter, suggesting that reduced tooth presence is associated with reduced AP dimensions.

The majority of the specimens (75%) were positioned in the midline ($n = 15$), whilst the remaining 25% showed slight asymmetry. The widest ML diameters were observed in specimens with a single midline septum.

A wide variety of morphologies were observed, including 25% oval-shaped foramina, which had the highest mean AP diameter of 6.11 mm. Other shapes included 20% irregular, 20% pear-shaped, 15% slit-shaped, 10% round-shaped, and 5% heart-shaped and peanut-shaped foramina, respectively. Round foramina showed the largest mean ML diameter, and statistical analysis further confirmed a correlation between ML dimension and round morphology ($r = 0.39$).

Conclusions

1. The independent variation of AP and ML diameters across individuals necessitates personalized anatomical assessment for precise surgical planning.
2. Notable changes in AP dimensions linked to dental status indicate that tooth loss directly impacts the morphometry of the incisive foramen.
3. The correlation between a round morphological shape and increased ML diameter highlights the importance of qualitative assessment in predicting foramen boundaries.

Comparison of Inflammatory Gene CXCL8 and Gene Protein IL-8 Expression in Cleft Lip Tissues

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Introduction. Cleft lip (CL), one of the most common orofacial cleft subtypes, is observed in 1 in 700 births. Approximately 70% of all reported orofacial cleft cases are non-syndromic, whereas only 30% represent syndromic clefts. CXCL8, the IL-8 coding gene, has four variations that are linked with increased cancer risk and prognosis; however, its role in cleft formation has not yet been clarified. Similarly, IL-8 has not been proven to be a gene protein inducing cleft formation, but it is responsible for immune cell trafficking during wound healing and infection.

Aim. The aim of this study was to evaluate the presence of the inflammatory gene CXCL8 and gene protein IL-8 in tissue samples from the control group, non-syndromic CL group, and CL patients with proven cleft occurrence in the family history.

Materials and methods. CXCL8 expression in control, syndromic, and non-syndromic cleft samples was evaluated by the tissue *in situ* hybridisation (ISH) method, and IL-8 expression by immunohistochemistry. Semi-quantitative evaluation was used for both IL-8 and CXCL8. Non-syndromic cleft lip cleft samples were taken from six patients aged 3 to 6 months. Eight tissue samples were taken from patients aged 3 to 10 months who had at least one ancestor with cleft characteristics. For the control group, five patients with no characteristics of clefts and representing the primary dentition age group were selected. The Kruskal-Wallis test and Spearman's rho correlation were chosen for statistical analysis.

Results. Among syndromic and non-syndromic cleft-affected tissue samples, the median CXCL8 expression showed a moderate level in the epithelium, few positive structures in the connective tissue, and rare occurrence in the endothelium. No positive structures were found in the control group tissue samples.

On the contrary, IL-8 expression in the control group showed numerous positive structures in all tissue types. In syndromic tissue samples, the median IL-8 expression showed a moderate level in the epithelium, few positive structures in the connective tissue, and rare occurrence in the endothelium. In non-syndromic cleft lip tissue samples, the median IL-8 expression showed a moderate level in the epithelium, few to moderate positive structures in the connective tissue, and rare occurrence in the endothelium.

Across all groups, a strong positive correlation of CXCL8 expression was determined between the epithelium and connective tissue, and between the epithelium

and endothelium, while a very strong positive correlation was observed between the connective tissue and endothelium in syndromic cleft tissue samples.

A strong positive correlation of IL-8 was found between the epithelium and endothelium, and between the connective tissue and endothelium in control group tissue samples. A strong positive correlation was also detected between CXCL8 distribution in the connective tissue and IL-8 in the endothelium.

Conclusions. CXCL8 expression confirms its association with pro-inflammatory characteristics in the tissue, particularly with regard to neutrophil attraction. No difference between CXCL8 and IL-8 expression in syndromic and non-syndromic tissue samples was detected. The lack of correlations between IL-8 and CXCL8 in syndromic cleft-affected tissue samples suggests a possible structural difference in the CXCL8 gene that may lead to its involvement in the cleft formation process.

Macroscopic Evaluation of Wall Thickness as a Predisposing Factor in Gastric Lesion Formation

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Introduction. Gastric lesions are most frequently located along the lesser curvature, particularly in the transition zone between the body and the antrum (Casalnuovo et al., 2022). The lesser curvature, fundus, and antrum are the primary sites for gastric lesion development. Benign gastric ulcers predominantly occur in elderly individuals and are most often found on the lesser curvature. In contrast, ulcers located on the greater curvature, fundus, and antrum are more likely to be malignant (Weledji, 2020). The thickness of the gastric wall is a critical factor influencing the rate of lesion development, as perforations tend to form more rapidly in regions with a thinner gastric wall. However, limited data exist regarding gastric wall thickness in regions where lesions commonly occur. Existing case reports primarily address the correlation between gastric wall thickening and the diagnosis of gastric cancer (Akbas et al., 2019).

Aim. The aim of the study was to quantify gastric wall thickness across three distinct anatomical regions (the lesser curvature, fundus, and antrum) and to evaluate the potential relationship between variations in wall thickness and the development of gastric lesions.

Materials and methods. The study was conducted using a sample of nine human stomachs provided by the Laboratory of Anatomy within the Department of Morphology at the Institute of Anatomy and Anthropology, Rīga Stradiņš University. The specimen pool consisted of four previously excised stomachs, one specimen evaluated *in situ* during cadaveric dissection, and four digital specimens analysed using the “Anatmage” virtual dissection table. Each stomach was systematically evaluated to determine its overall morphological form and the specific characteristics of the gastric rugae. Morphometric data collection involved measuring the lengths of the greater and lesser curvatures using an elastic thread to accurately follow the organ’s anatomical contours. Furthermore, the thickness of the gastric wall was measured in three predefined regions: the lesser curvature, the fundus, and the antrum. For the physical specimens, these measurements were obtained using a precision compass and a metric scale, while the integrated digital measurement tools of the “Anatmage” platform were utilized for the virtual specimens to ensure data consistency across both physical and digital formats.

Results. Along the lesser curvature, the average gastric wall thickness was 4.33 mm, ranging from 2.50 to 6.00 mm. Plicae patterns in this region varied significantly. In the antrum, the average gastric wall width was 4.17 mm, ranging from less than 1.00 mm to 6.15 mm. The antrum showed plicae of normal height and no signs of lesions. There was also a relationship between overall stomach size and gastric wall width in the antrum. In the fundus region, the average gastric wall width was 3.33 mm, with a maximum of 5.67 mm and a minimum of 1.50 mm. In four stomachs, the fundus wall width was less than 4.00 mm, with absent or small plicae, and all showed dilation in this region. One stomach exhibited a perforation in the fundus.

Conclusions

1. The study demonstrates that gastric wall thickness is non-uniform, with the lesser curvature consistently exhibiting a more robust structure compared to the significantly thinner fundus.
2. A relationship exists between the overall dimensions of the stomach and the thickness of the antrum, suggesting an adaptive morphological response to maintain functional integrity as the organ increases in size.
3. The combination of wall thinning, the absence of gastric plicae, and localized fundic dilation represents a critical precursor to structural compromise and potential perforation.
4. Systematic morphometric analysis of regional wall thickness and mucosal relief serves as a vital tool for identifying anatomical zones predisposed to lesion formation.

Assessment of Stress Fracture Risk Factors in a Group of Young Athletes

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Introduction. In recent decades, the involvement of schoolchildren in sports has significantly increased, accompanied by higher training intensity and early specialization in a single sport (Schreiber, 2024). Knechte et al. (2021) and Schreiber (2024) report a rising incidence of sports-related injuries such as joint trauma, overuse injuries, stress fractures, etc. Sports trauma not only reduces the physical activity and training time of young athletes, but also has detrimental long-term health consequences (Schreiber, 2024). Stress fractures are associated with intrinsic risk factors (e.g., age, sex, and individual health status) and extrinsic risk factors (e.g., training duration and training plans).

Aim. The aim of this study was to provide questionnaire-based weekly survey in a group of athletes aged 13 to 20 years to assess stress fracture risk factors and analyse the scientific literature on stress fractures.

Materials and methods. A structured literature review was conducted using the PubMed, Scopus, and Web of Science databases (2015–2025). The study was supported by permission from the Research Ethics Committee (no. 2-PĒK-4/392/2026). Data were collected from respondents (n = 13), young athletes of both sexes aged 13 to 20 years from sports school OGRE. Participants completed weekly surveys about dietary habits, sleep habits, sports training (training frequency, training duration, training intensity, and self-evaluated training effect), foot deformities (orthopaedic inserts and flat feet (*pes planus*)), infectious diseases, injuries, and the regularity of girls' menstrual cycles.

Results. An analysis of literature sources showed that stress fractures in young athletes primarily result from repetitive mechanical loading that exceeds the bone's adaptive capacity, leading to the accumulation of microdamage. Both intrinsic and extrinsic risk factors emphasise female sex, menstrual disorders, Relative Energy Deficiency in Sport (RED-S), and insufficient intake of calcium and vitamin D (25(OH)D). In addition, the findings highlight that training-related factors, such as high intensity, high frequency, and sudden changes in workload, significantly contribute to injury development, especially in runners and jumping athletes.

Survey results showed that 50% of the athletes reported a daily diet consisting of 1/4 vegetables, 1/2 healthy carbohydrates and protein, and 1/4 snacks. In total, 66.6% of athletes rated their training intensity during weekdays as 7 to 8 on

a scale of 1 to 10. It is important to mention that 33.3% of athletes had flat feet (*pes planus*), and 66.7% of athletes experienced regular pain (in the arms, legs, palms, feet, etc.) after intense training.

Conclusions. The survey findings suggest that many athletes aged 13 to 20 years may be at elevated risk of stress fractures due to an unbalanced diet, excessive training intensity, and existing biomechanical issues (e.g., *pes planus*), combined with frequent post-training pain. This highlights the need for improved nutritional and training habits, as well as regular monitoring of health status.

Anatomical Aspects of the Topography and Clinical Significance of Traumatic Pancreatic Injury

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Introduction. Pancreas is a J-shaped organ located at the level of the transpyloric plane (L1). It is conventionally divided into the head, body, and tail. With the exception of its tail, it is a retroperitoneal structure lying deep within the epigastric and left hypochondriac regions. It is a large gland with exocrine and endocrine components, producing digestive enzymes and hormones, respectively. Traumatic injuries to the pancreas are infrequent, accounting for only 0.2–0.3% of all trauma patients (Soreide et al., 2018). The predominant mechanism of trauma is firearm injury, followed by blunt injury and stab wounds. Penetrating injuries are far more common in regions with a high prevalence of gunshot wounds, such as North America and South Africa. In most other regions, a blunt aetiology following motor vehicle crashes or falls prevails (Braden et al., 2024). It is important to assess the integrity of the pancreatic duct, thereby reducing the rate of complications (Petroni et al., 2017).

Aim. The aim of the study was to analyse the topographical anatomy of the pancreas during dissection and to review and analyse the available literature on traumatic pancreatic injury.

Materials and methods. The Anatomy Laboratory of the Department of Morphology at the Institute of Anatomy and Anthropology, Rīga Stradiņš University, provided the human cadaver and all necessary equipment used for dissection.

Results. More than 20 literature sources from medical databases PubMed and UpToDate were analysed. The American Association for the Surgery of Trauma grading system (AAST, 1990) is a prognostic tool used to describe pancreatic injury. Grades I and II include minor pancreatic contusions and lacerations without pancreatic duct damage. Grade III injuries include pancreatic duct injuries of the body and tail, and grade IV injuries include ductal injuries of the pancreatic head. Grade V injuries include massive disruption of the pancreatic head (Ho et al., 2017; Al-Thani et al., 2022). The most common site of traumatic pancreatic injury is the junction of the body and tail. Injuries to the pancreas most commonly result from penetrating trauma caused by gunshot or stab wounds (Debi et al., 2013).

The dissection was performed on the abdomen of a cadaver, specifically the retroperitoneal cavity, the pancreas, and its surrounding organs and vessels. The pancreas lies directly in front of the vertebral column (L1-L2), the inferior vena cava, and the abdominal aorta in the retroperitoneal space behind the stomach and transverse colon. The *caput pancreatis* is enclosed by the *duodenum*, while the *cauda pancreatis* is in close proximity to the spleen. The *caput pancreatis* receives blood from the *a. pancreaticoduodenalis superior et inferior*, whereas the *corpus et cauda pancreatis* are supplied by the *arteria splenica*.

Conclusions. The retroperitoneal position of the pancreas at the level of L1-L2 makes it less susceptible to isolated pancreatic injury; however, it may be associated with other visceral injuries. Surgical intervention is necessary for high-grade (Grades III-V) injuries, particularly those with ductal disruption (AAST). Knowledge of the topography of the pancreas has clinical significance for identifying pancreatic injury and evaluating its severity using the AAST system.

Morpho-Topographic Parameters of the Common Femoral Artery Bifurcation and Their Clinical Significance for Access Safety

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Introduction. The common femoral artery (CFA) is the primary access site for endovascular procedures, such as digital subtraction angiography (DSA) and percutaneous transluminal angioplasty (PTA). The CFA bifurcation relative to the inguinal ligament is a critical anatomical landmark that defines the “safe zone” for arterial puncture. Anatomical variations, such as a high bifurcation, significantly increase the risk of iatrogenic complications, including retroperitoneal hemorrhage and pseudoaneurysms (Nakasone et al., 2023; Mengal et al., 2018; Gupta et al., 2014). Variability in bifurcation angles and vessel diameters can complicate the identification of the *profunda femoris* artery (PFA) and superficial femoral artery (SFA) during clinical interventions. These morphological differences are key factors that may lead to catheter misplacement or accidental nerve damage (Manjappa et al., 2014).

Aim. The aim of this study was to dissect the femoral artery to determine the distance from the inguinal ligament to the origin of the *profunda femoris* artery, to measure its branching angle, and to evaluate the diameters of both the *profunda femoris* artery and superficial femoral artery in order to provide precise morphometric data for ensuring safety and precision during endovascular interventions.

Materials and methods. All the necessary materials for this study were provided by the Laboratory of Anatomy of the Department of Morphology at the Institute of Anatomy and Anthropology, Rīga Stradiņš University. The dissection process involved a layered approach to expose the femoral triangle. The inguinal ligament was identified as the superior boundary and used as the primary reference point. The common femoral artery (CFA), superficial femoral artery (SFA), and *profunda femoris* artery (PFA) were carefully isolated from the surrounding connective tissue to ensure clear visualization of the bifurcation. Morphometric measurements were performed using a digital sliding caliper with a precision of 0.01 mm and a manual protractor for angular data. Four specific parameters were recorded for each specimen: the distance from the midpoint of the inguinal ligament to the origin of the PFA, the branching angle of the PFA relative to the main arterial trunk, the outer diameter of the PFA at its origin,

and the outer diameter of the SFA distal to the bifurcation. All measurements were taken by a single investigator to minimize observational error. Statistical analysis was performed using Microsoft Office Excel.

Results. The morphometric analysis of 5 femoral arteries (FA) revealed significant anatomical variations in bifurcation patterns and vessel dimensions. The mean distance from the inguinal ligament (IL) to the origin of the *profunda femoris* artery (PFA) was 6.80 ± 1.17 cm, with individual measurements ranging from 5.80 cm to 7.83 cm. The branching angle of the PFA showed substantial variability, with a mean value of $27.57^\circ \pm 6.50^\circ$, while the mean diameters for the PFA and the superficial femoral artery (SFA) were 5.44 ± 1.18 mm and 7.96 ± 1.22 mm, respectively.

A comparison of these findings with existing literature reveals a notable discrepancy; for instance, the study by Manjappa et al. (2014) reported a significantly shorter mean distance of 3.56 cm from the midpoint of the inguinal ligament to the PFA origin in the South Indian population. A study by Ashraf et al. (2014) reported similar results, with a mean distance of 51.5 ± 1.90 mm in the Middle Eastern population.

Conclusions

1. The femoral artery bifurcation in the observed samples occurs more distally than in other regions, which is directly attributable to the taller average stature and longer femoral segments.
2. The identified distance from the inguinal ligament to the *profunda femoris* artery origin establishes a population-specific “safe zone” for arterial puncture to prevent iatrogenic complications.
3. The distinct diameter difference between the superficial femoral artery and the *profunda femoris* artery serves as a verified anatomical baseline for correct vessel identification and stent sizing during DSA.
4. The high degree of individual variability in branching angles and vessel dimensions confirms that standard anatomical models must be individualized to ensure procedural safety.

Morphological Aspects of the Topography of Coronary Arteries and Their Clinical Significance in Sudden Cardiac Death in Young Athletes

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Introduction. The coronary arteries supply blood to the myocardium, and variations in their origin, course, branching pattern, and dominance affect myocardial perfusion. Such congenital coronary artery anomalies compromise coronary blood flow during intense physical exertion and are prominent causes of sudden cardiac death (SCD). SCD is the leading medical cause of death in young professional athletes aged 18 to 25 years and is defined as a natural, unexpected cardiac death, with or without underlying structural cardiac abnormalities. In one of the largest autopsy studies conducted to date, the anomalous aortic origin of a coronary artery was the second most common cause of SCD in young competitive athletes (Sgarro et al., 2026).

Aim. The aim of this study was to perform a cadaveric dissection, examine the anatomical topography and branching patterns of the coronary arteries, review contemporary literature on SCD in young athletes, identify the main risk groups, and analyse the clinical significance of underlying pathologies.

Materials and methods. A human cadaver provided by the Anatomy Laboratory of the Department of Morphology, Rīga Stradiņš University, was dissected, and its coronary artery origins and branches were analysed. A literature analysis was conducted using PubMed and ScienceDirect, reviewing studies published between 2021 and 2025.

Results. Cadaveric dissection revealed a typical coronary artery pattern: the right coronary artery originated from the right aortic sinus, coursed within the coronary sulcus, and gave branches including the posterior interventricular artery. The left coronary artery originated from the left aortic sinus, branching into the anterior interventricular artery and the circumflex artery (Thiene et al., 2021).

Coronary circulation is also characterized by coronary dominance, defined by the origin of the posterior descending artery. In approximately 70% of individuals, the artery arises from the right coronary artery, in about 10%, from the circumflex artery, while codominance occurs in about 20% of cases. These variations influence myocardial perfusion, affecting the severity of ischemia and arrhythmias in pathological conditions (Gentile et al., 2021). Literature analysis indicates that several congenital coronary artery anomalies are associated with sudden cardiac death in young athletes. The most clinically significant is

the anomalous aortic origin of a coronary artery: when the artery arises from the opposite aortic sinus and follows an interarterial course between the aorta and pulmonary trunk, it tends to be compressed during intense physical exertion. Additional coronary anomalies include myocardial bridging, coronary aneurysm, and coronary artery fistulas, which lead to altered myocardial perfusion and exercise-induced ventricular arrhythmias (Yow et al., 2024).

SCD occurs predominantly in male athletes (~ 1 in 35,000), particularly in high-intensity sports such as basketball, football and ice hockey (Harmon et al., 2022).

Conclusions. Certain coronary anomalies, particularly anomalous origin of a coronary artery, impair myocardial perfusion during intense physical exertion. Variations in the origin, course, and branching pattern of coronary arteries represent important anatomical factors contributing to SCD in young athletes. Careful anatomical evaluation, modern imaging techniques as well as emergency plans are essential for early detection of high-risk coronary abnormalities and prevention of SCD.

Anatomical Revision Regarding the Femoral Nerve During a Direct Anterior Approach to Total Hip Arthroplasty

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Introduction. Hip joint deterioration resulting from trauma, osteoarthritis, or other etiologies is often highly disabling. Total hip arthroplasty (THA) remains the primary intervention. The direct anterior approach (DAA) is frequently employed due to its potential to minimize muscle damage. Although THA is generally considered safe, iatrogenic complications may arise. Among neurological complications, femoral nerve palsy, while rare, is particularly serious and leads to motor and sensory deficits in the anterior lower extremity. Intraoperative nerve compression by retractors has been identified as a potential cause (Yoshino et al., 2015). Additionally, female sex is recognized as a risk factor for postoperative femoral nerve palsy following THA (Sean, 2022).

Aim. The aim of this study was to measure and compare the distance between the femoral neck and the femoral nerve at various angles to assess

the risk of femoral nerve palsy during the direct anterior approach to total hip arthroplasty.

Materials and methods. Four cadavers (three male, one female) from the Laboratory of Anthropology, Department of Morphology, Institute of Anatomy and Anthropology, Rīga Stradiņš University, and two female body scans from the “Anatomage” virtual dissection table were included. The femoral nerve in the femoral triangle was identified by anatomical dissection. Femoral neck localization followed the direct anterior approach to THA. Distances between the femoral neck and femoral nerve were measured using a compass and protractor at angles of 60°, 90°, and 120°, corresponding to typical retractor placement. Femoral length, from the greater trochanter to the lateral epicondyle, was measured with a plastic tape for normalization.

Results. Dissection was performed along the interval, progressing through the intermuscular plane between the tensor fasciae latae and sartorius muscles, originating near the anterior superior iliac spine. The approach continued between the rectus femoris and gluteus medius muscles, providing clear exposure of the anterior hip capsule and the underlying femoral neck.

Upon resection of the capsule, the spatial relationship between the femoral neck and the femoral nerve was visualized and measured across multiple joint angles. The data revealed that the shortest distance between these two structures consistently occurred at 90°, indicating that the femoral nerve is most proximal to the femoral neck along the perpendicular axis.

Interestingly, female specimens exhibited a greater absolute distance at this angle (45.10 ± 0.10 mm) compared to male specimens (35.7 ± 0.10 mm), a trend that also persisted at 60° and 120°. To account for overall skeletal variation, these measurements were normalized against total femoral length, which averaged 367.30 ± 0.10 mm in females and 496.80 ± 0.10 mm in males. Even after normalization, the relative distance remained significantly higher in the female cohort (13.0%) than in the male cohort (7.6%). This underscores the necessity of sex-specific considerations when navigating the intermuscular plane to avoid neurovascular compromise during anterior hip arthroplasty or femoral neck fixation.

Conclusions

1. The femoral neck and nerve are closest at a 90° angle, creating a high-risk zone where retractor placement should be avoided to prevent iatrogenic compression.
2. Both absolute and normalized measurements show that the femoral nerve-to-neck distance is significantly greater in females than in males.
3. These findings suggest that the higher incidence of femoral nerve palsy in females is likely due to factors other than anatomical proximity, such as pelvic morphology or soft tissue tension.

Arm Span–Height and Leg Length Ratios in Latvian Populations: A Regional Comparison in Piebalga, Kuldīga, Liepāja, and Ventspils

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Introduction. Anthropometric parameters such as height and arm span have a variety of applications in clinical settings. However, one or the other cannot always be determined due to patient’s physical condition or injury; therefore, the ability to evaluate height based on arm span (or vice versa) is essential.

Aim. This study aimed to determine the correlation between arm span and standing height, as well as the correlation between leg height and standing height, in the adult population of Latvia using data collected in Piebalga in 2024 and in Kuldīga, Liepāja, and Ventspils in 2025.

Materials and methods. The study population consisted of 1599 males and females aged ≥ 25 years from four Latvian cities (Piebalga, $n = 532$; Kuldīga, $n = 339$; Liepāja, $n = 440$; Ventspils, $n = 288$). Anthropometric measurements, including arm span and standing height, were obtained using standardized procedures with a stadiometer and anthropometer. Demographic variables, including sex, age, and place of birth, were recorded for all participants, and the arm span–height ratio (ASHR) was calculated. Statistical analyses were conducted after assessing data distribution. As the data were not normally distributed, non-parametric methods were applied. Group differences across cities were evaluated using the Kruskal–Wallis test with Dunn–Bonferroni post hoc pairwise comparisons in IBM SPSS software. Results were considered statistically significant at $p < 0.05$. Next, leg–height ratio was calculated, and ARHS data were divided into two groups: ASHR values above 1.00 and ASHR values below 1.00. Non-parametric tests were performed. According to Spearman’s correlation, the correlation between ASHR and leg–height ratio for all cities was positive, with an average correlation coefficient of 0.214.

Results. Median age differed across cities, with participants from Piebalga being older (55 years) than those from Kuldīga and Liepāja (52 years), and Ventspils (51 years). ASHR values were comparable across all four cities, with median ratios ranging from 1.00 in Kuldīga to 1.02 in Piebalga, indicating similar arm span–height proportionality. The group “ASHR below 1.00” (meaning arm span is shorter than height) in all four cities presented lower values than the “ASHR above 1.00” group, indicating that people with shorter arm span relative to height also have shorter legs. The average leg–height ratio for the “ASHR below 1.00” group varied

from 56.0 in Liepāja to 56.8 in Ventspils, whereas “ASHR above 1.00” group varied from 56.5 in Liepāja to 57.1 in Piebalga.

Conclusions. While age distributions varied modestly between cities, arm span-height ratios remained consistent across the study population, and so did the leg-height ratios. This stability in body proportionality suggests that regional differences in anthropometric characteristics among Latvians are minimal and confirms that arm span can be reliably used to estimate standing height in clinical and public health applications.

Implications of Sacrococcygeal Dimorphism: A Multimodal Morphometric Study

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Introduction. The sacrococcygeal region is a fundamental component of pelvic anatomy, playing a critical role in weight distribution, pelvic floor stability, and obstetric mechanics (Skalski et al., 2020). Beyond its biomechanical functions, the morphology of the sacrum and coccyx serves as a vital marker in forensic identification and physical anthropology. While pelvic sexual dimorphism is one of the most widely documented phenomena in human osteology, detailed morphometric characterization of the coccyx remains surprisingly limited. Most existing literature focuses on the gross anatomy of the pelvis, often overlooking subtle sex-specific variations in coccygeal curvature and dimensions (Kuytu et al., 2024). Furthermore, studies that bridge the gap between radiological and osteological methodologies are scarce. This lack of integrated data limits the development of precise anatomical standards, which are necessary to improve surgical outcomes in coccydynia treatment and to refine forensic sex estimation models.

Aim. This study aimed to evaluate the morphometric parameters of the sacrococcygeal region and assess the extent of sexual dimorphism within these measurements.

Materials and methods. A total of eight pelvis specimens (3 male, 5 female) were analysed using a dual-methodological approach. Four were assessed using the virtual dissection Table “Anatomage” from post-mortem scans, and four dry bone specimens were analysed from the Laboratory of Anatomy of the Institute

of Anatomy and Anthropology at Rīga Stradiņš University. Parameters included coccygeal width, straight and curved length, thickness, intercoccygeal angle, and sacral measurements (anterior sacral length (ASL), maximum transverse diameter (MTD), anterior sacral width (ASW), and distance between auricular surfaces). Measurements were performed using a digital caliper and protractor. Coccygeal morphology was classified according to Nathan et al. (2010). Statistical analysis was performed using the Mann–Whitney U test ($p < 0.05$).

Results. The morphometric analysis revealed distinct trends in sexual dimorphism. Females exhibited greater mean coccygeal width (35.51 ± 6.68 mm vs. 33.52 ± 0.37 mm) and curved length (39.78 ± 9.04 mm vs. 37.80 ± 6.96 mm) compared to males. Conversely, coccygeal thickness was higher in males (9.47 ± 1.26 mm vs. 8.68 ± 0.36 mm). A notable difference was observed in the intercoccygeal angle, which was larger in females ($152.50 \pm 12.47^\circ$ vs. $132.63 \pm 7.61^\circ$); although this did not reach the threshold for significance, it indicated a strong upward trend. Regarding sacral metrics, the ASL was greater in males, while the MTD and ASW were more pronounced in females. In terms of morphology, the majority of specimens were classified as Type I ($n = 6$), with no clear sex-related distribution.

Notably, measurements obtained using the “Anatamage” virtual dissection table showed trends comparable to those from the dry bone specimens, suggesting consistency across both digital and physical methodologies.

Despite the observed anatomical variations, no parameters reached statistical significance ($p \geq 0.05$), although a trend towards a higher intercoccygeal angle in females was observed ($p = 0.095$).

Conclusions

1. Sexual dimorphism in the sacrococcygeal complex is best captured by a combination of angular and transverse dimensions.
2. Although the coccyx alone may not serve as a primary indicator of sex, its assessment alongside sacral metrics significantly enhances the precision of pelvic characterization.
3. The findings validate the use of integrative morphometric methodologies and provide a foundation for future large-scale anatomical research.

Health Implications of Incorrect Footwear Size: A Cross-Sectional Study in Latvia

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Dzintra Kažoka

Introduction. Incorrectly fitted footwear is a common but often overlooked risk factor for foot pathology and musculoskeletal disorders. Studies show that 63–72% of individuals wear shoes that do not match their foot dimensions. Shoes that are too small are linked to increased forefoot pressure, foot pain, deformities such as *hallux valgus*, and, in severe cases, ulceration and impaired balance (Buldt et al., 2018). These issues may also lead to abnormal gait patterns and secondary complications in the lower limbs and spine.

Aim. The study aimed to assess the prevalence of footwear size mismatch, its association with demographic factors, and its potential implications for foot health in a Latvian population.

Materials and methods. The data for this study were collected between 2024 and 2025 as a primary component of a large-scale anthropological research project conducted in Latvia. From the broader participant pool, a cohort of 1,857 individuals was selected for specific analysis based on the completeness of their anthropometric and footwear data.

The research protocol began with a subjective assessment, in which participants completed a structured questionnaire to report their habitual footwear size and any perceived issues with shoe fit. Following the self-reporting phase, objective measurements were obtained using a standardized dual-metric approach. Initial anatomical foot length was recorded to the nearest millimetre using a spreading caliper, with all measurements taken while the participant was in a relaxed, weight-bearing standing position to account for natural physiological foot expansion. Subsequently, the recommended footwear size was determined using a Brannock device, which enabled precise assessment of both heel-to-toe length and arch length.

To evaluate the prevalence and magnitude of footwear size mismatch, these objective physical measurements were statistically compared with the self-reported data. A mismatch was defined as any discrepancy of 0.5 units or greater between the size habitually worn and the size recommended by the Brannock scale. This comparative framework facilitated the categorization of the sample into those wearing correctly sized, undersized, or oversized footwear, providing a comprehensive overview of footwear trends and their potential health implications within the Latvian population.

Results. The vast majority of participants were found to wear incorrectly sized footwear: 95.05% wore shoes that were too small, while only 3.23% wore correctly fitted shoes and 1.72% wore shoes that were too large. Across age groups, the prevalence of undersized footwear increased from 86.43% in individuals aged 1–20 years to 98.19% in those aged 61–80 years, while the proportion of correctly fitted footwear decreased from 9.95% to 1.36%. A statistically significant association was observed between footwear size mismatch and both age and gender ($\chi^2(8) = 62.65$, $p < 0.001$), with a significant linear trend indicating increasing mismatch with age ($p < 0.001$), although the strength of the association was small (Cramer's $V = 0.13$).

The median footwear size was higher in males ($M = 46$, IQR: 44–47) compared to females ($M = 42$, IQR: 40–43), with an overall median of 42 (IQR: 41–44). Additionally, asymmetry between left and right foot size was observed in a considerable proportion of participants, with 40.82% having a larger left foot, 28.33% a larger right foot, and only 30.86% showing equal foot size.

Conclusions. The findings demonstrate a high prevalence of incorrect footwear usage within the study population, with a significant majority of individuals wearing undersized shoes. The data suggest that the likelihood of wearing inadequately sized footwear increases progressively with age and exhibits notable variation between genders. Furthermore, the results highlight a frequent occurrence of foot asymmetry, a factor that likely complicates footwear selection and contributes to sizing discrepancies. These findings underscore the critical importance of objective foot measurement and informed footwear selection as essential strategies for mitigating foot pathology and broader musculoskeletal disorders.

Local Defence in the Gallbladder Wall in Pediatric Calculous Cholecystitis

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Professor Aigars Pētersons (Department of Paediatric Surgery)

Introduction. Cholecystitis in children is an inflammatory disorder of the gallbladder that may occur in acute or chronic forms, with or without gallstones. In recent years, its frequency has increased, likely due to dietary changes, metabolic disturbances, and the growing prevalence of childhood obesity. Alterations in immune regulation are considered essential in disease development,

particularly involving antimicrobial peptides and immune-related proteins such as β -defensins, LL-37, galectin-10, and CD163.

Aim. This study aimed to analyse the expression and localization of antimicrobial peptides (BD2, BD3, BD4, LL-37) and immune-regulatory markers (galectin-10, CD163) in gallbladder tissues of pediatric patients with chronic calculous cholecystitis and to evaluate their potential role in disease progression.

Materials and methods. Gallbladder tissue samples from 11 patients aged 12–17 years with chronic calculous cholecystitis and 5 control subjects without gallbladder pathology were examined. Immunohistochemistry was applied to detect BD2, BD3, BD4, LL-37, galectin-10, and CD163. Semi-quantitative assessment was performed, followed by statistical analysis using the Mann-Whitney *U* test and Spearman's rank correlation ($p < 0.05$).

Results. Histological evaluation demonstrated inflammatory infiltration extending into the muscular layer of affected tissues. A significant increase in BD2, BD3, BD4, and LL-37 expression was observed in both epithelial and stromal compartments compared with controls ($p < 0.05$). Additionally, galectin-10 and CD163-positive cells were more abundant, indicating activation of immune and anti-inflammatory mechanisms. Strong positive correlations were identified between BD2 and BD3 ($\rho = 0.866$, $p < 0.01$), BD2 and BD4 ($\rho = 0.797$, $p < 0.01$), and BD4 and CD163 ($\rho = 0.683$, $p < 0.01$).

Conclusions. Antimicrobial peptides (BD2, BD3, BD4, LL-37), galectin-10, and CD163-positive macrophages are markedly increased in gallbladder tissues of children with cholecystitis. These findings suggest activation of local immune responses; however, this activation appears insufficient to resolve chronic inflammation. The observed correlations indicate a complex interaction network within innate immunity that may contribute to disease persistence.

Morphological Variability of the Subacromial Space: The Role of Acromion-Coracoid Distance

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Introduction. The subacromial space serves as a vital anatomical corridor, housing the supraspinatus tendon and the subacromial bursa. As a cornerstone of shoulder biomechanics, its dimensions are largely determined by the unique morphology and orientation of the acromion and its surrounding scapular structures (Diercks et al., 2014). When this space is compromised, whether by anatomical variation or postural changes, the resulting reduction in volume mechanically compresses soft tissues during arm elevation. This entrapment is the primary driver of subacromial impingement syndrome, a leading cause of functional impairment and chronic shoulder pain (Bigliani et al., 1986).

Aim. This study aimed to quantify the morphological variability of the acromion and the subacromial space using normalized morphometric indices and to further evaluate the clinical utility of these indices in enhancing imaging-based diagnostics and optimizing conservative treatment strategies.

Materials and methods. The study was conducted on a sample of 54 dry human scapulae (22 right and 32 left), provided by the Laboratory of Anatomy of the Department of Morphology at Rīga Stradiņš University. To ensure the integrity of the morphometric data, specimens exhibiting signs of prior fracture, significant cortical erosion, or advanced osteophytic changes were excluded from the analysis. All linear measurements were obtained using a digital caliper with a precision of 0.01 mm. To minimize intra-observer variability, each anatomical parameter was measured three times, and the resulting mean value was recorded for statistical analysis.

The morphometric evaluation focused on the primary landmarks of the subacromial architecture. These included the acromial chord length, the maximum curvature depth of the acromion, and the linear distances from the inferior acromial surface to the superior glenoid rim. Additionally, the acromion-coracoid distance was measured to define the anterior boundaries of the subacromial space. Following the primary measurements, acromial morphology was qualitatively classified into Type I (flat), Type II (curved), or Type III (hooked) according to the criteria established by Bigliani (1986). To account for individual anatomical variability and to provide a scalable metric for clinical comparison, two normalized indices were derived: the Relative Spacing Index (RSI) and the Relative Spacing Volume Index (RSVI). These indices were calculated as ratios to assess

the proportional volume of the subacromial corridor relative to the overall dimensions of the scapula. Statistical comparisons between acromial types were performed using Microsoft Office Excel.

Results. The acromion-coracoid distance exhibited the highest degree of variability, ranging from 21.0 to 60.0 mm. Type I (flat) acromia predominated (n = 48), demonstrating significantly larger mean distances (38.2 mm) than Type II (curved) acromia (32.6 mm). Accordingly, higher RSI and RSVI values in Type I specimens indicate a relatively wider subacromial corridor. These findings suggest that while acromial morphology is a predisposing factor, it is not the sole determinant of pathology. Instead, subacromial space variability reflects a complex, multifactorial interplay between osseous structures, soft tissues, and dynamic shoulder biomechanics.

Conclusions

1. The subacromial space exhibits significant morphological variability, particularly regarding the acromion-coracoid distance.
2. When normalized, this distance serves as a practical, objective parameter for anatomical assessment, providing a more reliable metric than absolute linear measurements alone.
3. These findings underscore the value of implementing standardized morphometric indices in anatomical research and highlight their potential for integration into imaging-based diagnostics to enhance the precision of subacromial evaluations.

Exploring the Variations of Human Nasal Shapes Using Digital Landmark Measurements and Anatomical Illustrations

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Dzintra Kažoka

Introduction. Human noses are a significant facial feature, exhibiting a great variety of shapes and appearances. Studies show that the nasal index, which describes the ratio of nasal breadth to nasal length, varies widely across anthropological groups and climate zones (Zaidi et al., 2017). Arthur Thomson (1923) discovered that long, thin noses were more common in colder, drier regions,

whereas shorter, wider noses were more common in hotter, more humid regions. Moreover, other factors, such as development of a sedentary lifestyle or the adaptation to long-distance travel, have shaped the appearance of human noses.

Aim. This study aimed to quantify the morphological diversity of the human nose using 3D digital landmarks and to evaluate how specific geometric variations correlate with climatic adaptation and evolutionary stressors.

Materials and methods. This study employed a dual-approach methodology, integrating digital morphometrics with traditional anatomical illustration. Primary data collection was conducted using the virtual dissection table “Anatmage” from the Laboratory of Anatomy at the Department of Morphology, Rīga Stradiņš University. It enabled a high-resolution 3D examination of four specimens. Using this digital platform, precise measurements were captured at specific nasal landmarks, including the nasion, alare, and subnasale, to calculate the nasal index with high reproducibility. Using a specialized suite of art supplies and professional pencils, high-fidelity renderings were produced to highlight the subtle surface contours, soft-tissue variations, and complex curvatures of each nasal profile. This transition from virtual data to hand-drawn visualization bridged the gap between raw volumetric measurements and the holistic, aesthetic reality of human facial variation.

Results. The examined specimens demonstrated noticeable variation in nasal height, width, and projection. Differences were observed in nostril size and overall external nasal area. This confirms the visible diversity of external nasal morphology even in a limited anatomical sample. Calculated nasal indices ranged from approximately 63 to 76, indicating morphological diversity within the examined specimens. Most specimens corresponded to the leptorrhine (narrow nose) type, while one specimen fell within the mesorrhine range. In the present sample, narrower nasal indices were observed in both Asian individuals and in one Caucasian individual. The male Caucasian specimen demonstrated the widest nasal proportions, whereas the lowest nasal index was observed in a female Caucasian specimen. These observed proportions align with established anthropological patterns of climatic adaptation (Thomson, 1923), suggesting that even a small cohort can reflect the broader evolutionary pressures that shape human facial architecture.

Conclusions

1. The significant variations observed in nasal height, width, projection, and naris (nostril) aperture confirm that the external nose is one of the most anatomically diverse structures of the human face.
2. These measured differences reinforce the continued relevance of the nasal index as a robust and accessible tool for quantifying anthropological variation and distinguishing between distinct craniofacial phenotypes.

3. The morphological range identified within this sample is consistent with Thomson's rule, supporting the theory that human nasal architecture evolved as a functional adaptation to local environmental stressors, specifically temperature and humidity.
4. Integrating digital morphometric data from the "Anatmage" table with traditional scientific illustration creates a powerful multidisciplinary approach, and this synergy enhances anatomical education by improving spatial comprehension and providing a more nuanced visualization of human diversity.

Evaluating the Impact of Interosseous and Ulnar Recurrent Artery Variations on Collateral Circulation

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Introduction. The common interosseous and ulnar recurrent arteries exhibit significant morphometric variability, yet quantitative data regarding their distance from the brachial artery bifurcation remain sparse (Miguel-Pérez et al., 2025). Given their roles in deep forearm perfusion and the elbow's collateral network, variations in the origins of these branches may critically influence regional hemodynamics and surgical outcomes. Understanding these variations is essential, as the position of these branches dictates the efficiency of collateral circulation and deep forearm blood supply (Smith et al., 2024).

Aim. This study aimed to investigate the branching patterns of the common interosseous and ulnar recurrent arteries, specifically measuring their distance from the brachial bifurcation, and to provide findings for evaluating regional perfusion and the robustness of the arterial anastomoses surrounding the elbow joint.

Materials and methods. Morphometric analysis was conducted on a series of human upper limbs using both gross cadaveric dissection and high-resolution virtual dissection, with materials provided by the Laboratory of Anatomy of the Institute of Anatomy and Anthropology of Rīga Stradiņš University. In the cadaveric samples, the cubital fossa was carefully reflected to expose the terminal branches of the brachial artery (BA). The brachial bifurcation was

established as the primary anatomical landmark (zero point). The linear distances from this reference point to the origins of the common interosseous artery (CIA) and the ulnar recurrent artery (URA) were quantified using a drawing compass and ruler. To ensure consistency, all measurements were recorded along the longitudinal axis of the parent vessel. Complementary digital measurements were performed using the "Anatomage" virtual dissection table. Utilizing three-dimensional (3D) reconstructed volumetric data, the vascular architecture was visualized in multiple planes. The software's integrated digital measurement tool was employed to replicate the physical dissection parameters, measuring the distance from the bifurcation to the respective arterial origins with micron-level precision. This dual-methodology approach allowed for a comparative assessment of arterial variability across both physical and digital anatomical materials.

Results. Morphometric analysis included 13 upper limbs from 7 specimens (5 male, 2 female). The distance from the brachial artery bifurcation to the origin of the common interosseous artery ranged from 12.3 to 38.7 mm (mean 26.1 ± 9.7 mm). In one specimen, the ulnar artery was transected 40 mm distal to the bifurcation, with no arterial branches observed. The common ulnar recurrent artery originated at distances ranging from 1 to 42 mm (mean 21.8 ± 11.6 mm). In three upper limbs, the ulnar recurrent artery was absent as a common trunk and arose as separate anterior and posterior branches, originating at mean distances of 11.3 mm (range 4.5 to 24 mm) and 26.2 mm (range 17.3 to 30.7 mm), respectively. The wide range of distances observed indicates considerable variability in branch origin, which may be relevant to the arrangement of collateral arterial pathways in the elbow and proximal forearm region.

Conclusions

1. The common interosseous and ulnar recurrent arteries exhibit significant morphometric variability in their origins relative to the brachial artery bifurcation, necessitating precise anatomical mapping to account for non-standard branching patterns.
2. Given the critical role of these vessels in the peri-articular anastomoses of the elbow, characterizing this variability is essential to ensure hemodynamic stability and preserve collateral inflow during surgical or interventional procedures.

Body Mass Index Analysis of Children Aged 1–17 Years in Kurzeme and Vidzeme within the *Jēkabs Prīmanis* Anthropological Research Group

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Introduction. Body mass index (BMI) is widely used to assess nutritional status and physical development in children. According to international growth standards, BMI-for-age is a reliable indicator for identifying underweight, overweight, and obesity (WHO, 2006). Studies in Latvia suggest that children's physical development generally corresponds to established norms (Umbraško et al., 2024). However, a proportion of children exhibit increased body weight and obesity, with 11.8% classified as overweight and 4.6% as obese among preschool children (Martinsons-Bērzkalne et al., 2020). Similar trends have been observed in Lithuania, where changes in BMI distribution over time have been reported, with a general decrease in overweight prevalence, although obesity remains present in certain subgroups (Špečkauskienė et al., 2023).

Aim. This study aimed to analyze BMI distribution in children aged 1–17 years in Kurzeme (Kuldīga, Liepāja, Ventspils) and Vidzeme (Piebalga), and to evaluate anthropometric variability in the study population.

Materials and methods. Anthropometric data were collected during field expeditions conducted by the *Jēkabs Prīmanis* Anthropological Research Group. Participation was voluntary. Multiple anthropometric measurements were recorded, of which only body height and weight were used to calculate BMI. Nutritional status was assessed using BMI-for-age percentiles: underweight (< 5th), healthy weight (5th to < 85th), overweight (85th to < 95th), and obesity (≥ 95th percentile). A total of 295 children aged 1–17 years were included, with BMI successfully calculated for 290 participants due to incomplete data in 5 cases. Data were analysed using IBM SPSS Statistics.

Results. Among participants, 80.3% had healthy weight ($n = 233$), 4.8% were underweight ($n = 14$), 10.0% were overweight ($n = 29$), and 4.8% were obese ($n = 14$). Thus, 14.8% of children had elevated body weight (overweight or obesity). BMI values varied among participants, reflecting differences in nutritional status across the study population. Although the majority of children demonstrated BMI within the normal range, a noticeable proportion showed deviations associated with both undernutrition and excess body weight. The age distribution across the sample was relatively balanced, with all age groups represented. The largest subgroup consisted of 8-year-old children ($n = 27$; 9.2%), while other age groups

ranged from 2.4% to 8.5% of the total sample. Overall, the data indicate variability in BMI distribution among children, with a predominance of healthy weight but a relevant presence of both underweight and overweight categories.

Conclusions

1. The majority of children (80.3%) demonstrated normal BMI values, indicating generally adequate physical development.
2. Elevated body weight was observed in 14.8% of participants, including 10.0% overweight and 4.8% obese children.
3. Underweight was identified in 4.8% of children, suggesting the presence of both ends of nutritional imbalance within the population.
4. The findings highlight variability in BMI distribution and emphasize the importance of early monitoring and prevention strategies to address both undernutrition and excess body weight.

Le Fort II Fracture: Experimental Simulation, Repositioning, and Fixation

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Dzintra Kažoka

Introduction. Le Fort II fracture represents a classical pyramidal midfacial fracture pattern extending from the nasal bridge through the medial orbital wall and infraorbital rim, crossing the anterior maxilla and involving the pterygoid plates bilaterally (Rhea et al., 2005). Accurate identification of this fracture type requires radiological evaluation, as clinical mobility may be absent in incomplete fracture variants (Romano et al., 1990). The predictable anatomical lines form the structural basis for the Le Fort II osteotomy used in corrective midface surgery (Hopper et al., 2021).

Aim. The aim of this study was to demonstrate the anatomical course of the Le Fort II fracture line on a prepared human skull specimen and to experimentally simulate, reposition, and fix a controlled midfacial fracture following the Le Fort II pattern.

Materials and methods. The material and instruments were provided by the Laboratory of Anatomy of the Department of Morphology of the Institute of Anatomy and Anthropology at Rīga Stradiņš University. A human skull was

prepared by the complete removal of soft tissues to expose the craniofacial skeleton. Relevant anatomical landmarks were identified bilaterally: *os nasale*, *processus frontalis maxillae*, *paries medialis orbitae*, *margo infraorbitalis*, *facies anterior maxillae*, and *laminae processus pterygoidei*. The Le Fort II fracture line was marked as a pyramidal trajectory from the nasal bridge through the infraorbital region toward the pterygoid plates. A controlled osteotomy was then performed along the marked line using an electrically powered oscillating bone saw equipped with a circular blade. Following the procedure, the mobilized midfacial segment was repositioned to its anatomical alignment and stabilized at a single site using rigid internal fixation with three titanium mini-plates and 11 monocortical screws, each 6 mm in length.

Results. The experimental simulation on the prepared human skull successfully produced a classic pyramidal fracture pattern, demonstrating the precise anatomical path characteristic of a Le Fort II injury. The fracture line initiated superiorly at the nasofrontal suture and extended posterolaterally through the nasal bones and the frontal processes of the maxilla. Upon reaching the orbits, the fracture traversed the lacrimal bones and the medial orbital walls before descending across the infraorbital rims. The path then continued through the anterior and lateral walls of the maxillary sinus, ultimately extending posteriorly to include the pterygoid plates of the sphenoid bone. This fracture pattern resulted in a mobile midfacial segment comprising the nose and dental arch, while the zygomatic bones remained stable and attached to the cranial base.

The subsequent repositioning of the midfacial complex allowed for a complete restoration of the specimen's pre-traumatic dimensions. By using the nasofrontal junction and the infraorbital margins as primary landmarks, the anatomical projection and vertical height of the face were accurately recovered. The fixation process utilized a titanium mini-plate system to bridge the fractured segments and restore structural continuity. Through the application of plates at the nasofrontal buttress and the bilateral zygomaticomaxillary buttresses, the midfacial complex was successfully immobilized. Final physical assessment of the specimen confirmed that the previously mobile "floating maxilla" was rendered entirely rigid, with the elimination of all palpable step-off deformities along the orbital rims and the restoration of a stable occlusal relationship.

Conclusions

1. The Le Fort II fracture follows a predictable, pyramidal pathway governed by stable craniofacial landmarks, making it a reproducible model for anatomical study.
2. Experimental simulation confirms that this traumatic pattern can be precisely replicated via controlled osteotomy to evaluate midfacial mobilization and repair.

3. Effective repositioning and internal fixation demonstrate that structural integrity and facial projection can be fully restored using standardized surgical principles.
4. While surgical outcomes are generally favorable, long-term success relies on a mastery of regional anatomy and the careful mitigation of patient-specific risk factors.

Morphometric Analysis of the Proximal Femur: Anatomical Measurements and Clinical Relevance

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Dzintra Kažoka

Introduction. Morphometric analysis of the proximal femur is significant in both anatomical research and clinical evaluation. Parameters such as the neck-shaft angle, femoral neck length, and femoral head diameter are routinely evaluated in imaging studies, including X-ray and computed tomography (CT), to assess hip morphology (Mokrovic et al., 2021). These measurements are clinically important for diagnosing various deformities, including *coxa vara* and *coxa valga*, evaluating fractures, and planning orthopaedic procedures such as hip arthroplasty (Gupta et al., 2022). Variations in proximal femur morphology may also influence biomechanical load distribution and are associated with an increased risk of femoral neck fractures (Gumuchdjian et al., 2024).

Aim. This study aimed to analyse the morphometric characteristics of the proximal femur, evaluate differences between right and left femora, and assess potential correlations among the measured parameters. Additionally, the study sought to relate these findings to clinical practice by emphasizing their relevance in orthopaedic diagnostics, fracture risk assessment, and surgical planning.

Materials and methods. The study was conducted at the Laboratory of Anatomy in the Department of Morphology, Institute of Anatomy and Anthropology, which provided the necessary instruments and 25 femoral bones, including 14 right-sided and 11 left-sided. The neck-shaft angle was measured using both digital and manual methods, and the mean was calculated to achieve more precise results. The femoral head diameter was measured at its widest and narrowest

points, and the mean value was used for analysis. The femoral neck length was also recorded as described by Late et al. (2022). Statistical analysis was performed using IBM SPSS 30.0. Descriptive statistics (mean, median, standard deviation, minimum, and maximum) were calculated. Differences between the right and left femora were analysed using the Mann-Whitney U test. Correlations between parameters were assessed using Pearson correlation analysis. A significance level of $p < 0.05$ was considered statistically significant.

Results. The mean neck-shaft angle was 120.92° (SD = 8.72), femoral head diameter was 44.31 mm (SD = 3.46), and neck length was 49.56 mm (SD = 6.67). The neck-shaft angle ranged from 97° to 137° , indicating the presence of both *coxa vara* ($< 120^\circ$) and *coxa valga* ($> 135^\circ$). No statistically significant differences were found between the right and left femora for the neck-shaft angle ($p = 0.228$), femoral head diameter ($p = 0.681$), and neck length ($p = 0.138$), as all p -values were greater than 0.05. A moderate positive correlation was observed between femoral head diameter and neck length ($r = 0.503$, $p = 0.010$), which was statistically significant ($p < 0.05$). No significant correlations were found between the neck-shaft angle and femoral head diameter ($r = 0.082$, $p = 0.699$) or neck length ($r = 0.251$, $p = 0.225$).

Conclusions

1. The proximal femur reveals overall morphometric symmetry between right-sided and left-sided parameters, as no statistically significant differences were observed.
2. A statistically significant correlation was found between femoral head diameter and femoral neck length, indicating that greater neck length is associated with greater femoral head diameter.
3. The presence of both *coxa vara* and *coxa valga* indicates variability in the neck-shaft angle, which may be relevant in orthopaedic planning, as it can influence the selection and positioning of implants.
4. The neck-shaft angle showed no significant correlation with the other parameters, indicating that it varies independently.

Expression of Inflammatory Proteins and Factors in the Tissue of Patients with Cleft Lip Palate

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Introduction. Orofacial clefts are among the most common hereditary craniofacial anomalies. The development of orofacial clefts is complex and remains unclear. Much evidence suggests that inflammation is strongly present in cleft-affected tissue. However, the histomorphological basis on which this inflammation persists remains unknown.

Aim. The aim of this study was to evaluate the presence of inflammation in cleft palate tissue and to assess the expression of granulysin, resistin, FCGR1A, CD68, and NF- κ B p65. Furthermore, the interconnections between the mentioned factors were studied. All of these factors are related to local and systemic inflammatory response; however, no studies on their expression in orofacial cleft tissue have been conducted.

Materials and methods. Tissue samples were obtained from 14 patients with bilateral cleft lip and palate, who were in both the primary and mixed dentition stages, during cheiloplasty surgery. Ten control samples were used for comparison. The samples were analysed using light microscopy, first evaluating routine staining and then the immunohistochemical expression of granulysin, resistin, FCGR1A, CD68, and NF- κ B p65. Immunohistochemical evaluation was performed using semi-quantitative method. Statistical analysis was conducted using the IBM SPSS v31.0 program. Comparison of the patient and control groups was performed using the chi-square test, whereas Spearman's rank correlation was used to evaluate the interconnections between the mentioned factors.

Results. Routine staining revealed hyperplasia of the basal cell layer, as well as vacuolization and atrophy of the epithelium. Significant inflammatory cell infiltration was observed in patient samples compared to the controls. NF- κ B p65 in the primary dentition age group, and FCGR1A and CD68 in the mixed dentition age group, showed statistically significant differences in expression in palatal tissues compared to the controls. Spearman's rank correlation revealed eight very strong correlations between several factors and one strong correlation between factors. Two correlations were detected in the primary dentition age group, whereas seven were found in the mixed dentition age group. Granulysin showed the highest number of interconnections, indicating its strong association with other inflammatory proteins.

Conclusions. The presence of numerous very strong and strong Spearman's correlations between inflammatory factors in cleft-affected tissue suggests intensification of inflammatory signal pathways. Differences in factor expression between dentition stages suggest variation in the inflammatory basis depending on the stage of dentition.

Histological Changes and Extracellular Matrix Remodelling Markers in Proximal and Distal Esophageal Tissue of Children with Esophageal Atresia

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Supervisors - Dr. habil. med., Professor Māra Pilmane; Dr. habil. med.,
Professor Aigars Pētersons (Department of Paediatric Surgery)

Introduction. Esophageal atresia (EA) is a congenital interruption of the esophageal lumen caused by disturbed foregut morphogenesis. Besides the anatomical defect, intrinsic abnormalities of the esophageal wall and extracellular matrix (ECM) turnover may contribute to dysmotility, impaired healing, and later morbidity. Routine histology combined with immunohistochemical evaluation of ECM-remodelling factors can help characterize these changes.

Aim. The aim of the study was to compare hematoxylin and eosin (H&E) morphology and the distribution of matrix metalloproteinases (MMP-1, MMP-2, MMP-9) and tissue inhibitors of metalloproteinases (TIMP-1, TIMP-2, TIMP-4) in proximal and distal EA segments versus control esophagus, and to assess their possible role in EA morphopathogenesis.

Materials and methods. Formalin-fixed, paraffin-embedded esophageal tissue from children with EA (n = 21; proximal n = 8, distal n = 13; age 1 day to 11 months) and control cases (n = 5; newborn to 24 weeks) was stained with H&E and analysed immunohistochemically by the streptavidin-biotin method. Immunopositive structures were assessed semi-quantitatively in the epithelium and connective tissue by two independent morphologists. Statistical analysis was performed using IBM SPSS version 26; the Kruskal-Wallis test and Spearman's rank correlation were applied, with $p < 0.05$ considered significant.

Results. Control esophagus showed non-keratinized stratified squamous epithelium, a fibrous lamina propria with only slight inflammatory cell

infiltration, and an orderly wall structure. In contrast, EA tissue demonstrated preserved viable stratified squamous epithelium together with a thickened muscularis mucosae, subepithelial cellular infiltration, and chaotically arranged muscularis. Significant intergroup differences were detected for epithelial MMP-1 ($p = 0.043$), epithelial MMP-2 ($p = 0.019$), connective tissue MMP-2 ($p = 0.022$), and connective tissue TIMP-2 ($p = 0.021$). Epithelial MMP-1 was lower in proximal EA than in controls. MMP-2 immunoreactivity was more pronounced in controls than in EA tissue, both in the epithelium and connective tissue, indicating reduced basement membrane and ECM-remodelling potential in EA. Connective tissue TIMP-2 was lowest in the proximal segment compared with controls, suggesting disturbed regulation of metalloproteinase activity in the proximal pouch. No significant intergroup differences were found for MMP-9, TIMP-1, or TIMP-4, although segment-specific correlations showed coordinated regulation within the remodelling network, particularly between MMP-2 and TIMP-1 and between MMP-9 and TIMP-4 in distal tissue.

Conclusions

1. H&E staining reveals preserved epithelium but a structurally altered esophageal wall in EA, characterized by thickened muscularis mucosae, subepithelial infiltration, and disorganized muscularis.
2. Reduced MMP-2 in EA and decreased connective tissue TIMP-2 in proximal EA indicate impaired ECM homeostasis and remodelling capacity.
3. Changes in epithelial MMP-1 and segment-specific MMP/TIMP correlation patterns suggest different remodelling behaviour in proximal and distal EA tissue that may contribute to the morphopathogenesis and post-operative tissue behaviour of EA.

Antimicrobial Peptides and Immunomodulatory Proteins in the Temporomandibular Joint (TMJ) of Children with Ankylosis and During Disease Recurrence

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Introduction. Temporomandibular joint (TMJ) ankylosis impairs jaw function, limiting mouth opening, speech, and mastication, and rendering airway access high-risk. Additionally, even correctly performed arthroplasty does not always lead to improvement of the primary condition. Despite the clinical relevance of this issue, the morphopathogenesis of TMJ ankylosis is still not fully clarified.

Aim. The aim of the study was to investigate the appearance of antimicrobial peptides, immunomodulatory proteins, and tissue remodelling factors in the bone of ankylotic TMJs in primary and repeatedly operated children.

Materials and methods. Ankylotic tissue was collected during arthroplastic surgery from two 6-year-old children (a boy and a girl) diagnosed with the osseous type of temporomandibular joint ankylosis. The female patient underwent a second TMJ surgery at the age of 12 due to the same diagnosis. The collected ankylotic tissue was analysed for the presence of human beta-defensin HBD-2, HBD-3, HBD-4, galectin Gal-3, Gal-10, and cathelicidin LL-37.

Results. Results demonstrated a lack of LL-37 and Gal-3, but a numerous number of HBD-2 containing cells in the bone of all tested cases. Beta-defensins 3 and 4 were not detected in primarily operated TMJ samples; however, they were present in the supportive tissue of a patient with recurrent ankylosis. Opposite results were found for Gal-10, which was absent in repeated surgery but present in primary surgical bone tissue.

Conclusion. The abundant presence of HBD-2 in both cases suggests increased local antimicrobial defence. Beta-defensins 3 and 4 in recurrent ankylotic tissue probably indicate an increased necessity for different antimicrobial proteins in the TMJ. The presence of Gal-10 in primary ankylotic bone proves intensification of bone remodelling factor stimulation pathways, which is lost in the case of recurrent ankylosis. The lack of Gal-3 and LL-37 excludes these factors from the local defence line in TMJ ankylosis.

The Comparative Anatomy and Functional Evolution of the Cricoid Cartilage

Elza Lāce, Faculty of Medicine, 1st year

Supervisor – Dr. med., Associate Professor Dzintra Kažoka

Introduction. As the only complete ring in the airway, the cricoid cartilage forms the laryngeal foundation, and its morphology dictates subglottic diameter and the kinetics of the cricothyroid and cricoarytenoid joints. These articulations establish the biomechanical tension of the vocal folds, yet the cricoid's specific contribution to frequency and intensity remains under-researched despite the vast diversity in vertebrate phonation. Recent work by Brualla et al. (2024) on specialized cricoid morphotypes and Titze et al. (2025) on laryngeal stability suggests that this structural base is a primary driver of acoustic power and vocal complexity across species (Fitch et al., 2025).

Aim. This study aimed to investigate the comparative morphometry of the cricoid cartilage across phylogenetically diverse taxa to elucidate the structural determinants of species-specific phonation and to hypothesize that variations in cricoid geometry and articular orientation serve as primary biomechanical constraints on fundamental frequency, dynamic range (dB), and respiratory efficiency.

Materials and methods. Laryngeal specimens from a phylogenetically diverse cohort, including humans, felids, canids, rodents, avians, and crocodylians, were prepared for comparative analysis. Initial macroscopic examination of isolated larynges was augmented by the high-resolution digital dissection table “Anatomage” at the Department of Morphology, Institute of Anatomy and Anthropology of Rīga Stradiņš University. Quantitative morphometry focused on the internal architecture of the cricoid ring, specifically the inner anteroposterior and transverse diameters, minimum luminal diameter, and total cross-sectional area. To assess the mechanical leverage of the laryngeal framework, digital multi-planar reconstruction tools were used to measure posterior lamina height, anterior arch height, and regional wall thickness at predefined landmarks. Furthermore, the spatial orientation and surface area of the cricothyroid and cricoarytenoid articulations were mapped to evaluate potential rotational kinetics. Morphometric indices were derived to standardize shape, symmetry, and relative proportions across varying body scales (Mishra et al., 2024). These structural data were subsequently related to established bioacoustic profiles, including fundamental frequency, sound intensity, and respiratory biomechanics, to model the cricoid's role in laryngeal power transfer (Brualla et al., 2024; Titze et al., 2025).

Results. Marked interspecies variability in cricoid architecture reveals distinct evolutionary strategies for balancing respiratory patency with specialized acoustic output. Results revealed marked interspecies variability. Humans exhibit a relatively narrow subglottic lumen paired with a disproportionately large posterior lamina, a geometry that facilitates precise cricothyroid modulation required for speech but also predisposes the species to subglottic stenosis (Mishra et al., 2024). In contrast, canids and felids exhibit a wider lumen and robust cricoid arch consistent with managing high-pressure glottal bursts. Rodents possess diminutive, lightweight cricoids adapted for the rapid laryngeal cycles of ultrasonic phonation. Avian species show reduced cricoid involvement due to the evolutionary shift toward syrinx-based sound production (Fitch et al., 2025), while crocodylians retain a massive, reinforced framework suited for low-frequency resonance and aquatic pressure changes. These findings indicate that cricoid morphology serves as a primary biomechanical constraint, shaping airflow resistance, subglottic pressure, and laryngeal joint mechanics to define the physical limits of a species' vocal repertoire (Brualla et al., 2024; Titze et al., 2025).

Conclusions

1. The cricoid cartilage serves as a primary biomechanical anchor that has evolved distinct morphotypes to support diverse vertebrate vocal strategies, from ultrasonic rodent phonation to resonant crocodylian calls.
2. Although cricoid geometry does not dictate specific vocal timbre, it establishes the essential structural limits for airflow resistance and the rotational kinetics required for frequency modulation.
3. Comparative analysis of cricoid architecture highlights the unique structural vulnerabilities of the human airway and provides a morphometric foundation for developing species-appropriate models in reconstructive laryngeal surgery.

Design of a Customizable Stability System for Total Hip Arthroplasty Using Additive Manufacturing

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Introduction. Total hip arthroplasty (THA) has revolutionized the management of end-stage hip osteoarthritis and femoral neck fractures, significantly improving patient quality of life and functional mobility. Despite its high success rate, prosthetic dislocation remains a common postoperative complication (Hermansen et al., 2021). The stability of the hip joint following reconstruction depends on surgical technique, component positioning, anatomy, and implant design. Current prosthetic designs often struggle to balance the dual requirements of maximal range of motion (ROM) and joint stability, especially in the presence of anatomical variability and pathological alterations, which may result in suboptimal biomechanical compatibility between standard prosthetic components and the native joint, ultimately contributing to implant failure. The emergence of additive manufacturing (3D printing) offers a novel avenue to address these limitations by allowing patient-specific customization and topological optimization of the acetabular-femoral interface (Javaid et al., 2018).

Aim. The aim of this study was to design customizable, patient-specific 3D-printed implants to improve joint stability in total hip arthroplasty, with a particular focus on enhancing stability through anti-dislocation mechanisms, preserving liner retention, optimizing biomechanical compatibility, and maintaining range of motion.

Materials and methods. Before initiating the design process, a detailed morphological analysis of existing hip prosthetic systems was performed. The study was conducted on 15 dry human hip specimens obtained from the Laboratory of Anatomy, Department of Morphology, Institute of Anatomy and Anthropology, Rīga Stradiņš University. Measurements included the acetabular depth-to-width ratio and hip joint lever arm ratio. Additionally, a digital anatomical evaluation was performed using the 3D dissection table “Anatimage”, allowing precise assessment of femoral head dimensions, acetabular morphology, and head-to-neck diameter ratios. All measurements were statistically analysed using Microsoft Office Excel. A 2D biomechanical model was applied to analyse forces and reaction patterns within the hip joint. Based on these data, 3D models were developed using “Autodesk Inventor®” to define appropriate component

geometry and dimensions. The design process considered various mechanical stresses, including compression, traction, and torsion, along with appropriate safety coefficients. The design focused on improving the stability of the polyethylene component within the acetabular cup. The system was assessed for range of motion (ROM), and topological optimization techniques were applied to develop a capsule-like structural configuration to reduce the risk of instability. No physical prototypes or experimental mechanical testing under real loading conditions were performed at this stage.

Results. Compared with conventional prosthetic solutions, the proposed 3D-designed system offers potential advantages such as patient-specific customization, reduced surgical invasiveness, and improved support in cases of muscular weakness or moderate instability, potentially reducing the risk of recurrent dislocation and improving long-term outcomes. However, it does not fully restore native hip anatomy or correct pre-existing biomechanical alterations, and it is not intended to address severe instability, complex fractures, or structural damage such as avascular necrosis.

Conclusions. This solution may be integrated into existing hip endoprostheses following further validation. It is designed to reduce the risk of dislocation by maintaining stable articulation between the femoral head and the acetabular component while limiting polyethylene liner wear. Material selection was guided by commonly used biocompatible polymers; however, additional validation is required to confirm performance and clinical applicability.

Morphometric Variations in the Distal Femur

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Introduction. The morphology of the distal femur plays a critical role in determining joint biomechanics. Due to substantial individual variability, detailed analysis of distal femoral parameters enhances understanding of biomechanical risk factors and informs surgical planning, thereby reducing complications arising from anatomical incompatibility between implants and bone. Degenerative changes, including osteophyte formation, may obscure anatomical landmarks and complicate accurate implant placement. Additionally, femoral intercondylar notch width varies by sex and is associated with both notch volume and the incidence of anterior cruciate ligament (ACL) rupture (Zheng et al., 2020; Gupta et al., 2022).

Aim. The primary objective of this study was to analyse the morphometric parameters of the distal femur, specifically by evaluating the variability of the medial and lateral condyles and the intercondylar notch, and to identify the potential clinical implications of these variations.

Materials and methods. Thirteen isolated dry human femoral specimens (eight right, five left) were obtained from the Laboratory of Anatomy, Department of Morphology, Institute of Anatomy and Anthropology, Rīga Stradiņš University. Only specimens with well-preserved articular surfaces were included to ensure accurate identification of anatomical landmarks and reliable measurements. All specimens were fully ossified, representing adult morphology, and free from gross traumatic damage. Linear measurements were performed manually using a high-precision digital caliper (accuracy ± 0.01 mm). The following parameters were recorded: bicondylar width (BW), medial condyle depth (MCD), lateral condyle depth (LCD), intercondylar notch width (NW), and intercondylar notch depth (ND). The Notch Width Index (NWI) was calculated as the ratio of notch width to bicondylar width ($NWI = NW/BW$) to assess the relative size of the intercondylar space. Statistical analysis was conducted using Microsoft Office Excel after all measurements were completed. Each parameter was measured three times to ensure consistency and minimize intra-observer error, with the mean value and standard deviation (SD) recorded.

Results. The mean bicondylar width (BW) was 7.64 ± 0.67 cm (range: 6.51–8.56 cm). Morphometric analysis indicated that the lateral condyle was slightly deeper than the medial condyle. The mean medial condyle depth (MCD) was 5.80 ± 0.49 cm (range: 5.01–6.52 cm), and the mean lateral condyle depth (LCD) was 5.94 ± 0.55 cm (range: 5.14–6.90 cm). For the intercondylar notch, the mean width (NW) was 2.06 ± 0.48 cm (range: 1.35–2.58 cm), and the mean depth (ND) was 2.01 ± 0.35 cm (range: 1.38–2.68 cm). Notch width demonstrated greater individual variability than notch depth.

The left femoral specimens had a slightly larger mean BW (7.76 cm) than the right specimens (7.57 cm), while the right specimens had slightly greater mean condyle depths (MCD: 5.88 cm; LCD: 6.04 cm) compared to the left specimens (MCD: 5.67 cm; LCD: 5.79 cm). Despite these minor differences, the mean difference between lateral and medial condyle depths was approximately 0.14 cm, indicating a generally symmetrical load distribution. Intercondylar depth (ND) was similar between sides (right: 2.03 cm; left: 1.97 cm).

All specimens had an NWI value of 0.21 or higher. These findings suggest that none of the femora, regardless of biological sex, reached the critical morphometric threshold for notch-related ACL injury risk due to notch stenosis. The overall BW varied by more than 2 cm across the sample, underscoring the limitations of a standardized approach in knee arthroplasty and highlighting the need for precise preoperative sizing.

Conclusions

1. Considerable morphometric variability was observed, confirming that a standardized approach is inadequate and emphasizing the necessity for precise preoperative sizing.
2. All specimens exhibited a Notch Width Index (NWI) above the clinical risk threshold (≥ 0.20), indicating that notch stenosis was not a predisposing factor for ACL injury in this sample.
3. Despite minor individual variations, the relative symmetry between medial and lateral condyle depths suggests a balanced mechanical load distribution in all studied specimens.
4. The small sample size and absence of demographic data limit the ability to perform detailed correlation analyses between morphology and individual characteristics.
5. Future studies should include a larger sample size and incorporate digital imaging to correlate bony morphology with soft tissue and cartilage health, thereby providing a more comprehensive understanding of knee joint biomechanics.

Morphological Features of the *Orbicularis Oculi* Muscle

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Introduction. The *orbicularis oculi* muscle is one of the main mimetic muscles of the upper face and plays an essential role in eyelid movement and facial expression. Anatomically, the muscle consists of three parts (the orbital, palpebral, and lacrimal portions), with the palpebral portion being particularly important for eyelid closure and facial mimicry. Age-related structural changes in the *orbicularis oculi* muscle may contribute to morphological alterations of the periorbital region (Tong et al., 2025).

Aim. The aim of this study was to examine the anatomical structure and morphological features of the *orbicularis oculi* muscle through anatomical dissection and literature review.

Materials and methods. An anatomical dissection of a human cadaver was performed in the Anatomy Laboratory of the Department of Morphology at

the Institute of Anatomy and Anthropology, Rīga Stradiņš University. The cadaver and the necessary dissection instruments were provided by the institute. Relevant anatomical literature was reviewed.

Results. Dissection of the periorbital region allowed observation of the *orbicularis oculi* muscle as a thin muscular layer located directly beneath the skin and surrounding the orbital region. It formed a circular structure around the eye and demonstrated close anatomical relationships with adjacent periorbital soft tissues.

According to anatomical descriptions reported in the literature, the *orbicularis oculi* muscle is organized into orbital, palpebral, and lacrimal portions that occupy different anatomical planes of the periorbital region. The orbital portion lies more superficially along the orbital margin, the palpebral portion is situated within the upper and lower eyelids, and the lacrimal portion is located medially in association with the lacrimal apparatus (Tong et al., 2025). In the examined specimen, the palpebral portion appeared to be the most distinct component within the eyelid region.

Clear anatomical boundaries between these portions were not distinctly identifiable in the examined specimen. Nevertheless, the overall morphology corresponded to the general anatomical organization described in the literature.

Conclusion. The anatomical organization of the *orbicularis oculi* muscle and the spatial arrangement of its portions reflect its important role in eyelid movement and facial expression. Understanding the morphology of this muscle may contribute to a better interpretation of structural changes in the periorbital region associated with aging. Over the past decade, more than 100 publications have addressed age-related changes in the *orbicularis oculi* muscle and approaches to their correction.

Morphometric and Volumetric Analysis of the Adult Orbit: Clinical Utility for Enophthalmos Reconstruction

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Dzintra Kažoka

Introduction. Enophthalmos is the posterior displacement of the globe within the orbit, which results from a critical imbalance among orbital structures. Globe stability is primarily maintained by the bony orbital walls, a complex seven-bone pyramidal cavity that contains the extraocular muscles, orbital fat, and the optic nerve (Tintinalli, 2019). Disruption of the orbital walls due to trauma, inflammation, or degenerative processes increases the functional orbital volume, leading to globe displacement (Shah, 2023). Current research indicates a strong correlation between increased orbital volume and enophthalmos, where a 1 cm³ expansion results in approximately 0.8 mm of displacement (Murray-Douglass, 2023; Shah, 2023).

Aim. This study aimed to establish anatomical baselines of the orbital cavity and investigate the importance of morphometric and volumetric parameters in guiding reconstructive surgery for the correction of enophthalmos.

Materials and methods. Twenty adult dry human skulls (40 orbits), provided by the Laboratory of Anatomy of the Department of Morphology of the Institute of Anatomy and Anthropology, Rīga Stradiņš University, were evaluated, excluding specimens with any damage. The morphological evaluation of the orbital aperture was based on four anatomical landmarks: the maxillofrontale (MF) at the frontomaxillary suture, the ectoconchion (EC) at the lateral horizontal midline, and the supraorbital (SO) and infraorbital (IO) points, defined as the highest and lowest vertical markers perpendicular to the MF–EC line. The orbital dimensions were measured with a Vernier caliper to 0.01 mm precision. Orbital breadth was defined as the MF–EC distance, and orbital height as the SO–IO distance. The orbital index (OI) was calculated using the formula: (orbital height/orbital breadth) x 100. Based on OI, orbits were categorized into three standard classes described by the French anthropologist and surgeon P. Broca (1875): megaseme (≥ 89), mesoseme (83–89), and microseme (≤ 83). The orbital perimeter was measured using an elastic thread, while the orbital opening area was calculated using the formula: $\pi \times A \times B$, where A and B represent half of the orbital height and breadth. Orbital volume was measured by filling an intra-orbital expandable balloon with water; the mass (0.1 g sensitivity) was recorded as equivalent to volume (1 g = 1 ml).

Results. Morphometric analysis of the orbital cavities demonstrated a high degree of bilateral symmetry, although the right orbit was consistently larger than the left in most parameters. The mean height and width of the left orbit were 34.44 ± 1.9 mm and 39.74 ± 3.1 mm, respectively. In comparison, the right orbit exhibited a mean height of 34.72 ± 1.9 mm and a mean width of 40.24 ± 3.0 mm. The mean orbital perimeter measured 11.84 ± 0.7 cm on the left and 11.9 ± 0.7 cm on the right. The mean orbital aperture area was 10.77 ± 1.3 cm² for the left orbit and 11.00 ± 1.2 cm² for the right orbit. The mean orbital volume was 26.6 ± 2.7 cm³ on the left and 26.7 ± 2.9 cm³ on the right. The mean orbital index (OI) was 86.92 ± 5.8 for the left orbit and 86.50 ± 5.5 for the right orbit, indicating that these cavities are mesoseme.

Conclusions

1. While bilateral symmetry is high, the right orbit is systematically larger than the left across all primary metrics, including height, width, perimeter, aperture area, and total volume.
2. The calculated mean orbital indices classify both cavities as mesoseme, representing the intermediate orbital shape typical of most human populations.
3. The minimal volumetric variance between sides allows the healthy orbit to serve as a reliable 3D template for precise surgical planning and enophthalmos correction in cases of unilateral injury.
4. These quantified aperture areas and orbital indices provide the essential morphometric baselines required for the accurate sizing and design of orbital implants to restore natural facial symmetry.

Anatomical Variations of the *Foramen Mentale* and Their Impact on Local Anesthesia

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Introduction. The *foramen mentale* (FM) is a vital anatomical landmark on the anterior surface of the mandible, transmitting the nerve and vessels that supply sensation to the lower lip, chin, and buccal gingiva (Algabri et al., 2025). Precise localization of the FM is crucial for effective dental anesthesia, routine restorative dentistry involving the first and second premolars, as well as implant

placement and various oral surgical procedures (Cellina et al., 2023). Significant anatomical variations exist in both the horizontal and vertical positioning of the FM among individuals (Sakalem et al., 2024).

Aim. This study aimed to evaluate the anatomical variations of the FM in relation to surrounding anatomical landmarks, including the mandibular borders, the midline, and the premolars, while analysing bilateral symmetry, dimensional differences, and positional variability, and to interpret how these variations affect the efficacy and safety of dental anesthesia.

Materials and methods. Ten human dry mandibles and the instruments used for measurements were provided by the Laboratory of Anatomy of the Department of Morphology of the Institute of Anatomy and Anthropology, Rīga Stradiņš University. The diameter of the FM and the distances from the FM to various anatomical landmarks, including the *ramus mandibulae*, the midline, and the *processus alveolaris* in the region of the first and second premolars, were measured and recorded on the provided skulls. These measurements were made using a Vernier caliper (accuracy 0.01 mm). Microsoft Office Excel was used to perform statistical analysis after the measurements were completed.

Results. Regarding the diameter of the FM, the mean vertical measurement on the right side was 2.09 ± 0.80 mm, whereas the left side was slightly larger at 2.57 ± 0.47 mm, representing a difference of 0.48 mm. In terms of distances from anatomical landmarks, the study identified unique variations in the nerve exits. An accessory mental foramen (AMF) was observed on the left side of one mandible, situated inferior to the primary canal. Similarly, a distinct opening was noted on the right side of another mandible, located anterior to the main canal. These supplementary exits indicate a bifurcated path for the mental nerve branches, which requires specific consideration during anesthetic administration. Measurements regarding the midline and premolars revealed that the FM is consistently positioned closer to the second premolar than to the first. This spatial bias was more pronounced on the right side, with a difference of 0.72 mm, while the left side showed only a minimal difference of 0.12 mm.

Finally, the distance from the *processus alveolaris* to the FM was recorded to determine its vertical position on the mandibular body. The average distance was 13.84 ± 2.50 mm on the right and 13.64 ± 2.89 mm on the left. These measurements confirm that the FM lies in relatively close proximity to the alveolar crest, a finding that carries important clinical implications for determining appropriate needle length and placement during dental anesthesia.

Conclusions

1. Although general patterns for FM location have been identified, individualized anatomical assessment is necessary to achieve effective anesthesia.

2. The vertical diameter of the FM is smaller on the right side than on the left, which may affect anesthetic diffusion.
3. On the right side, the FM is positioned closer to the second premolar, whereas on the left side the difference between the first and second premolars is minimal, underscoring the importance of individualized evaluation.
4. The average distance from the *processus alveolaris* to the FM remains relatively constant.
5. Because the FM is close to the alveolar crest, clinicians should select needle length and insertion depth carefully to ensure effective anesthesia and prevent nerve injury.
6. The distances of the specific AMFs suggest that standard injection techniques may require additional volume or repositioning to achieve complete anesthesia.

The Association Between Educational Level and Anthropometric Parameters Among Women in Latvia

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Introduction. Lower educational level has been associated with higher body mass index (BMI) and greater waist circumference (WC), both widely used indicators of obesity. In Latvia, women are more likely to have higher education than men. This study compares anthropometric parameters among Latvian women by educational level and may provide insights into health behaviours and lifestyle patterns across different educational groups.

Aim. This study aimed to compare anthropometric parameters, including body weight, height, BMI, waist circumference, hip circumference, and waist-to-hip ratio, among women with and without higher education in Latvia.

Materials and methods. This cross-sectional study was based on anthropometric data collected during anthropological expeditions conducted in Latvia (Piebalga, Kuldīga, Liepāja, and Ventspils) between 2024 and 2025. The analysis included 1164 women aged 23 years and older. Participants were divided into two groups based on educational level: 737 with higher education and 427 without

higher education. Measurements were performed with participants in a relaxed standing position. Body weight was measured using a medical scale, while waist and hip circumferences were measured using a measuring tape. BMI was calculated as weight in kilograms divided by the square of height in metres (kg/m^2). Waist-to-hip ratio (WHR) was calculated as waist circumference divided by hip circumference. Data were analysed using descriptive statistics in Microsoft Office Excel and IBM SPSS Statistics (version 31). Differences between groups were evaluated using the Mann-Whitney U test. Statistical significance was set at $p < 0.05$.

Results. Women with higher education were significantly taller (166.18 ± 6.51 cm vs. 163.37 ± 6.59 cm, $p < 0.001$). Those without higher education had higher BMI (28.35 ± 5.98 vs. 26.87 ± 5.62 kg/m^2 , $p < 0.001$), as well as greater waist circumference (87.56 ± 13.33 cm vs. 84.06 ± 13.11 cm, $p < 0.001$) and hip circumference (105.25 ± 11.83 cm vs. 103.80 ± 11.68 cm, $p = 0.011$). Waist-to-hip ratio was also higher in this group (0.830 ± 0.069 vs. 0.808 ± 0.063 , $p < 0.001$), indicating greater central fat distribution. No significant difference in body weight was observed between groups (75.48 ± 15.58 kg vs. 73.99 ± 14.79 kg, $p = 0.100$).

Conclusions

1. Women without higher education tend to have less favourable anthropometric profiles, with higher BMI and greater central adiposity.
2. Differences in BMI appear to be primarily driven by variations in height rather than body weight.
3. These findings suggest that educational level is an important determinant of body composition, fat distribution, and potential health inequalities among women in Latvia.

Facial and Lip Morphological Proportions in Men and Women from Latvia Based on Historical Photographs from 1936

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Introduction. Beauty is a highly subjective concept that differs across cultures and historical time periods. The concept of ideal facial proportions has been discussed, and attempts to define objective features of an attractive face have continued since ancient times (Vegter et al., 2000). Since the lower third

of the face is important for overall facial harmony, understanding how these parameters have changed over time is relevant.

Aim. The aim of this study was to assess the morphological proportions of the face and lips using two-dimensional historical photographs from 1936. It focused on measuring key parameters of the lower third of the face and comparing these measurements between men and women.

Materials and methods. A photogrammetric analysis of individuals' facial features was performed using historical two-dimensional images from 1936, when Professor *Jēkabs Prīmanis* conducted an anthropological research study in Piebalga, Latvia. A collection of 343 historical photographs from the Rīga Stradiņš University Anatomy Museum was analysed in this study. The analysis was performed using the methodology reported in the study "The Concept of Ideal Lips of Caucasian Female: An Anthropometric Analysis of the Lower Third of the Face" (Winiarska et al., 2024). GIMP version 3.0.6 was used to measure facial anthropometric parameters, enabling linear measurements. The results were calculated and analysed based on the proportional ratios of the determined facial parameters.

Results. The mean ratio of the upper segment of the lower third of the face height for women was 0.31, whereas the lower segment comprised 0.69. For men, the results were the same: 0.31 and 0.69. The mean ratio of Cupid's bow width to total lip width for women was 0.20, and for men, 0.26. The average lip ratio was 0.57 for women and 0.61 for men. Variations among individuals were observed, reflecting the natural morphological diversity within the studied population.

Conclusions. The results demonstrate that the ratio of the upper and lower segments of the lower third of the face is the same for men and women, whereas differences can be observed in the lip parameters. These findings provide a historical reference for anthropometric research and can contribute to comparative studies across populations.

Association Between Physical Activity, Respiratory Function, and Blood Pressure in Children Aged 9–14 Years: A Study in Valkas Jāņa Cīmzes Gymnasium

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Introduction. Physical activity plays a significant role in the development of the cardiovascular and respiratory systems during childhood. Variations in physical activity levels may influence physiological parameters, including lung function and blood pressure.

Aim. The aim of this study was to evaluate the association between physical activity and spirometry parameters, as well as arterial blood pressure, in children aged 9–14 years.

Materials and methods. A cross-sectional study was conducted in *Valkas Jāņa Cīmzes* Gymnasium, including 42 children aged 9–14 years. Spirometry parameters – forced expiratory volume in 1 second (FEV1), forced vital capacity (FVC), and FEV1/FVC ratio – were measured, along with arterial blood pressure. Physical activity was assessed using a questionnaire evaluating exercise frequency, duration, and type of physical activity. Participants were stratified based on physical activity level, and mean values of spirometry and blood pressure parameters were compared between groups.

Results. Children with higher physical activity levels demonstrated higher mean spirometry values, with FEV1 reaching 2.43 L compared to 2.12 L in less active children, and FVC 2.58 L vs. 2.19 L, respectively. The FEV1/FVC ratio remained relatively similar between groups. Systolic blood pressure did not differ substantially between physically active and less active participants, with mean values remaining within the normal range in both groups. A slight tendency towards lower blood pressure values was observed in more physically active children.

Conclusion. Increased physical activity is associated with improved lung function parameters in children aged 9–14 years, while its influence on blood pressure is less pronounced. These findings emphasize the role of regular physical activity in promoting respiratory health during childhood. Further studies including a larger sample size and data from multiple schools are needed to confirm these findings.

Cadaveric Simulation of Reduction and Fixation Techniques for Frontal Bone Fractures Involving the Superior Orbital Rim

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Dzintra Kažoka

Introduction. Fractures of the frontal bone involving the superior orbital rim represent a distinct subset of craniofacial trauma that falls outside the traditional Le Fort classification, which primarily describes patterns of midfacial disruption. Unlike Le Fort injuries (craniofacial disjunctions), these fractures affect the upper facial skeleton and are closely related to both aesthetic contour and orbital integrity (Pereira et al., 2020). The proximity of the frontal bone to the orbital rim means that even limited displacement can disrupt periorbital support and alter globe position. Such injuries may compromise critical structures, including the supraorbital nerve and surrounding soft tissues, resulting in functional and cosmetic deficits (AlAnsari et al., 2025). These fractures require a distinct approach focused on accurate reduction and stable fixation to restore both form and function (Dumitru et al., 2022).

Aim. This study aimed to develop and evaluate a cadaveric model of frontal bone fractures involving the superior orbital rim, focusing on surgical exposure, neurovascular preservation, reduction, and rigid internal fixation techniques.

Materials and methods. A controlled fracture was created in a human cadaver head provided by the Laboratory of Anatomy, Department of Morphology, Institute of Anatomy and Anthropology of Riga Stradiņš University. An osteotomy line was marked approximately 2–3 cm superior to the supraorbital rim and extended inferiorly to involve the rim. Using osteotomes, a single continuous fronto-orbital bone segment was mobilized while preserving partial attachment. The fragment was displaced to simulate the injury. Reduction and fixation were performed via a bicoronal subpericranial approach using a 1.5 mm low-profile titanium plating system.

Results. The bicoronal approach provided optimal exposure of the frontal bone and supraorbital rims while preserving the supraorbital and supratrochlear neurovascular bundles. After exposure, the displaced fronto-orbital fragment was reduced (< 1 mm step-off) and aligned using periosteal elevators. Stable fixation was achieved with a 1.5 mm low-profile titanium plating system (two 4-hole plates at the medial and lateral pillars, with monocortical screws). Mechanical stability of the reconstruction was confirmed by visual inspection, palpation, and comparison with the contralateral intact bone, demonstrating rigid fixation without detectable fragment mobility or contour deformity. Orbital volume and

globe position were restored, with careful attention to the alignment of the orbital rims and medial and lateral buttresses, ensuring proper globe positioning and symmetry relative to the contralateral side.

Conclusions

1. Cadaveric simulation is an effective method for acquiring technical skills in the management of complex fronto-orbital fractures.
2. Wide subpericranial exposure via a bicoronal incision, combined with low-profile 1.5 mm plating, reliably restores anatomical contour and orbital volume while protecting critical neurovascular structures.
3. Although limited to cadaveric tissue, this model offers a safe, reproducible platform for surgical training.

Comparative Dissection Analysis of Structural Differences Between Human and Porcine Hearts

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Introduction. The study of human cardiac anatomy has long relied on cadaver dissection as the gold standard for achieving a comprehensive understanding of complex internal structures (Cooper et al., 2022). While human specimens are ideal, the porcine heart has emerged as a premier model due to its remarkable anatomical parallels, including a shared four-chamber configuration and comparable blood flow patterns. These similarities enable medical students and surgeons to use pig hearts for high-fidelity training in a more accessible and cost-effective manner. However, despite these commonalities, subtle morphological variations exist between the two species that can significantly impact clinical translation (Ingrassia et al., 2014).

Aim. This study aimed to conduct a comparative, dissection-based morphometric analysis of human and porcine hearts to identify structural divergences and to evaluate the efficacy of the porcine model as a high-fidelity surrogate for human cardiac education and surgical training.

Materials and methods. The study utilized a comparative anatomical approach, employing longitudinal dissection from the base to the apex to expose the internal architecture of both human and porcine specimens. The human and pig hearts were provided by the Laboratory of Anatomy at the Institute of Anatomy and Anthropology, Rīga Stradiņš University. Precise morphometric measurements of the chambers, valves, and myocardial walls were obtained using a standard

metric ruler and a digital caliper to ensure submillimetre accuracy. Following the physical dissection, a systematic literature review was conducted across major biomedical databases, including Scopus, PubMed, and ResearchGate, to correlate experimental findings with established anatomical benchmarks.

Results. To prepare the specimens for observation, the aortic arch and cardiac sulci were first cleared of epicardial adipose tissue, ensuring a high degree of anatomical visibility. Initial measurements revealed that both the human and porcine hearts shared remarkably similar overall dimensions, with a base width of 86.6 mm and 86.2 mm, respectively. However, significant morphological divergences were noted during the internal examination of the ventricular walls and the interventricular septum. Specifically, the porcine heart exhibited a considerably thicker left ventricular wall (22.2 mm) and interventricular septum (18.6–22.0 mm) compared to the human heart, which measured 12.9 mm and 14.3 mm in the same regions. The right ventricular wall followed a similar trend, measuring between 5.8 and 8.5 mm in the pig and 4.6 mm in the human.

The vascular architecture of the aortic arch also highlighted critical species-specific variations. While the human aortic arch opening was larger at 18.3 mm compared to the pig's 13.6 mm, the most notable difference lay in the branching patterns. In the human heart, three primary vessels typically arise from the aortic arch; however, in the porcine aortic arch, only two main arterial branches arise. Consequently, while the brachiocephalic trunk and left subclavian artery were identified in both specimens, slightly larger diameters were observed in the human heart. In the porcine specimen, the diameter of the subclavian artery was measured at its origin (8.7 mm), whereas the brachiocephalic trunk measured 5.7 mm along its course. Additionally, the common carotid arteries in the pig originated from the brachiocephalic trunk and measured approximately 2.8–3.4 mm in diameter, which is smaller than the left common carotid artery in the human heart (3.8 mm).

Conclusions

1. While the porcine heart is a highly effective anatomical model due to its comparable base dimensions and four-chamber structure, significant divergences in myocardial thickness and aortic branching must be considered.
2. Specifically, the porcine heart exhibits a substantially thicker left ventricular wall and a simplified two-branch aortic arch compared to the three-branch human standard.
3. Ultimately, these structural nuances do not diminish its utility as a training model but necessitate careful clinical correlation during surgical simulation.

Sex-Specific Differences in Anthropometric Predictors of Elevated Blood Pressure in Kurzeme and Piebalga

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Dzintra Kažoka

Introduction. Elevated blood pressure is a major modifiable risk factor for cardiovascular disease and is strongly associated with body composition and fat distribution (Zhao et al., 2022). Anthropometric indicators such as body mass index (BMI) and waist circumference (WC) are widely used as simple, non-invasive predictors of cardiometabolic risk. Previous studies indicate that both general and central obesity are associated with increased blood pressure, with central adiposity often showing stronger predictive value (Re et al., 2023). Sex differences in fat distribution and vascular physiology suggest that these associations may differ between males and females.

Aim. The study aimed to assess the prevalence of elevated blood pressure and to evaluate sex-specific differences in the association between anthropometric indicators and blood pressure in the adult populations of Kurzeme and Piebalga.

Materials and methods. A study was conducted among 1719 adult residents (482 males, 1237 females) of Kurzeme and Piebalga, aged 18 to 99 years, with a mean age of 50.05 ± 16.81 years. Height, weight, and waist circumference were measured using a tape measure, and BMI was calculated. Blood pressure was measured twice with a calibrated sphygmomanometer after 5 minutes of rest, and the mean value as used for analysis. Blood pressure was classified as normal if systolic BP was ≤ 130 mm Hg and diastolic BP was ≤ 80 mm Hg, and as elevated (pre-hypertensive or hypertensive state) if systolic BP was > 130 mm Hg and/or diastolic BP was > 80 mm Hg. Statistical analysis was performed using IBM SPSS Statistics version 31.0.1.0.

Results. The overall prevalence of elevated blood pressure in the population was 59.7% ($n = 1027$), with a higher prevalence in males ($n = 339$, 70.3%) compared to females ($n = 688$, 55.6%). Mean systolic blood pressure (SBP) was 134.5 ± 17.4 mm Hg in males and 123.2 ± 18.5 mm Hg in females, while mean diastolic blood pressure (DBP) was 83.9 ± 11.5 mm Hg in males and 81.5 ± 11.0 mm Hg in females. Correlation analyses showed that BMI and WC were positively associated with both SBP and DBP. In males, BMI correlated with SBP ($r = 0.29$, $p < 0.001$) and DBP ($r = 0.31$, $p < 0.001$), while WC correlations were slightly

stronger (SBP: $r = 0.34$; DBP: $r = 0.35$; $p < 0.001$). In females, BMI correlations with SBP and DBP were both $r = 0.37$ ($p < 0.001$), while WC correlations were SBP: $r = 0.41$ ($p < 0.001$) and DBP: $r = 0.38$ ($p < 0.001$). Systolic and diastolic blood pressures were strongly correlated in both males ($r = 0.76$, $p < 0.001$) and females ($r = 0.77$, $p < 0.001$). Sex-specific regression analyses indicated that WC was the strongest predictor of SBP and DBP in males (SBP: $\beta = 0.389$, $p < 0.001$; DBP: $\beta = 0.400$, $p < 0.001$), whereas BMI had weak or non-significant associations (SBP: $\beta = -0.056$, $p = 0.64$; DBP: $\beta = -0.051$, $p = 0.64$). In females, WC remained the strongest predictor of SBP and DBP (SBP: $\beta = 0.433$, $p < 0.001$; DBP: $\beta = 0.249$, $p < 0.001$), with BMI showing a weaker positive association with DBP ($\beta = 0.147$, $p = 0.022$) and a negligible association with SBP ($\beta = -0.023$, $p = 0.718$).

Conclusions

1. Waist circumference demonstrated the strongest association with both systolic and diastolic blood pressure in males and females, indicating that central adiposity is a more important determinant of blood pressure than general adiposity measured by body mass index.
2. Sex-specific differences exist in the relationship between anthropometric indicators and blood pressure, with body mass index contributing independently to diastolic blood pressure only in females, whereas waist circumference remains the dominant predictor in males for both systolic and diastolic blood pressure.
3. Males exhibited higher mean systolic and diastolic blood pressure compared to females, and the magnitude of associations between anthropometric indicators and blood pressure differs slightly by sex.

Integrating Morphoscopic, Metric, and 2D Greater Sciatic Notch Shape Analysis for Sex Estimation Based on the Hip Bone

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Dzintra Kažoka

Introduction. Sex estimation is a fundamental component of biological profile reconstruction in physical anthropology (Pavličev et al., 2020). The hip bone (*os coxae*) provides the most reliable skeletal indicators of sex due to

functional adaptations associated with childbirth (Stan et al., 2024). Osteological sex estimation methods are commonly divided into morphoscopic (visual) and metric (quantitative) approaches. In samples of unknown sex (e.g., archaeological collections lacking independent reference data), comparing approaches is necessary to evaluate consistency, uncertainty, and potential diagnostic bias.

Aim. This study aimed to compare the *Phenice* morphoscopic method with the *Diagnose Sexuelle Probabiliste* (DSP) metric method using a sample of unknown sex and to contextualize ambiguous outcomes using 2D shape analysis of the greater sciatic notch (GSN) (Rennie & Tamminen, 2025).

Materials and methods. Twenty-two dry human hip bones were examined from the Laboratory of Anatomy, Department of Morphology, Institute of Anatomy and Anthropology, Rīga Stradiņš University, with no independent sex information available. Morphoscopic assessment followed the criteria established by Phenice (1969): the ventral arc, the subpubic concavity, and the medial aspect of the ischiopubic ramus. Metric estimation used 10 standardized pelvic measurements collected with digital calipers and processed in DSP software, Osteomics. A sex classification was accepted only when the posterior probability was ≥ 0.95 ; otherwise, results were recorded as “undetermined”. To further interpret borderline cases, a 2D GSN outline analysis was conducted. The notch margin was digitized as an A-to-B open curve (A superior, B inferior), resampled to a fixed number of points (200), aligned using Generalized Procrustes Analysis, and summarized using Principal Component Analysis (PCA).

Results. The metric analysis provided a definitive sex estimation for 16 cases (73%) with high posterior probability. The remaining 6 cases (27%) were categorized as “undetermined” because they failed to meet the required statistical threshold. In contrast, the visual method assigned a sex to all 22 cases in the sample. Among the 16 cases with definitive DSP results, there was 87.5% agreement (14 cases) with the visual findings, while 2 cases showed clear discrepancies. Further inspection often revealed a mosaic of traits, such as a well-defined ventral arc (typically female) paired with a narrow subpubic angle or a robust ischiopubic ramus (typically male). A significant finding was that all 6 cases labeled “undetermined” by the metric software were nevertheless assigned a sex by the visual method.

For the 2D component, all cases were analysed. PCA of aligned outlines showed that variation was concentrated in PC1 (approx. 75.3%) and PC2 (approx. 17.1%). Importantly, morphoscopic “male” and “female” groups showed substantial overlap in PC space (i.e., no clearly separated sex-specific clusters), and DSP “undetermined” cases were located predominantly within or adjacent to this overlap region.

Conclusions

1. The high agreement (87.5 %) between Phenice and DSP in definitive cases supports their combined use; however, DSP is more conservative, retaining uncertainty (nearly 27 % “undetermined”), whereas the visual method is more broadly applicable but may overclassify borderline individuals.
2. The concentration of “undetermined” results among visually identified females suggests that population-specific dimorphism or skeletal preservation may influence the expression of traditional morphological traits, potentially leading to sex-biased discrepancies.
3. 2D GSN shape analysis does not establish true sex without an external reference, but it objectively visualizes continuous GSN shape variability, demonstrates overlap between morphoscopic sex categories, and helps interpret why undetermined cases arise by situating them within the shared overlapping region of shape space.

Creation of Durable and Interactive Epoxy Resin Models Enhanced by Digital Resources for Anatomical Education

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Introduction. The preservation of biological specimens is a cornerstone of anatomical education, providing students with the tactile and spatial understanding necessary for clinical practice. Traditionally, organ immersion in formaldehyde has been the gold standard for long-term preservation; however, this method is increasingly scrutinized due to significant health risks, including respiratory irritation and potential carcinogenicity (Musial et al., 2016). Consequently, there is a growing demand for safer, more durable alternatives that maintain the tissue’s structural integrity and visual clarity (Chisholm et al., 2018). Epoxy resin embedding offers a promising solution, transforming perishable biological material into permanent, odorless, and non-toxic educational tools. While various plastination and embedding techniques exist, many remain time-consuming or fail to highlight anatomical structures, and the availability of digital resources is limited.

Aim. This study aimed to: 1) synthesize existing literature regarding current organ preservation protocols to establish a baseline for comparative methodology; 2) evaluate the efficacy of established epoxy resin embedding techniques when applied to a diverse range of specimens, including whole organs and anatomical slices from both human and animal sources; 3) to optimize procedural efficiency by identifying and modifying critical variables in the embedding process to ensure superior visual clarity and structural durability while minimizing production time; 4) enhance pedagogical utility by integrating anatomical labeling and digital resources into the physical models, ensuring their suitability for modern education.

Materials and methods. At the Department of Morphology of the Institute of Anatomy and Anthropology, Riga Stradiņš University, tissue samples were initially incubated in a 96.2% ethanol solution for 24 hours to ensure disinfection and the removal of residual formalin and excess lipids. Following dehydration, the specimens were submerged in 100% glycerol for two hours under vacuum conditions to enhance tissue translucency. For selected models, acrylic colours were applied to specific anatomical structures to improve visual differentiation and clarity. The prepared tissues were secured within custom scaffolds and embedded in activated epoxy resin. This process was conducted under vacuum conditions to eliminate air bubbles and ensure deep resin penetration. A vacuum chamber corrector was then applied to stabilize the resin before the final curing phase. Once cured, the models underwent post-processing to optimize material longevity and optical clarity. To enhance the educational value of the specimens, each model was mounted on a wooden platform attached to a QR code that provides an interactive link to a digital presentation detailing the specific anatomical structures visible within the corresponding model.

Results. A total of 30 high-quality anatomical models were successfully produced from 15 human cadaveric tissues and 15 animal specimens. Among these, two specimens demonstrated exceptional anatomical and clinical significance: a human eye exhibiting retinal detachment that had previously undergone surgical repair via the scleral buckling technique, and a human meniscus integrated with a sutured porcine graft, illustrating the structural relationship between host tissue and graft material.

Notable optimizations were made to existing epoxy resin-embedding protocols to improve procedural efficiency. Specifically, replacing traditional fixation rods with 5-minute epoxy adhesive for securing organs within their scaffolds proved a critical advancement. This modification not only ensured superior specimen stability during resin infusion but also substantially reduced overall preparation time, streamlining the transition from fresh tissue to a finished educational model.

Conclusions. Resin-embedded models offer a transformative approach to gross anatomical teaching, facilitating safe, hands-on manipulation. When paired with QR-coded digital presentations, they create a comprehensive educational tool that bridges the gap between traditional specimen study and modern digital education.

Anthropometric Differences Between Two Latvian Regions: A Comparative Analysis of Piebalga and Kurzeme

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Introduction. Anthropometric traits are highly plastic, varying significantly in response to genetic, environmental, and lifestyle determinants (Kozlov et al., 2022). From a biological perspective, skeletal dimensions and body proportions are sensitive indicators of a population's adaptation to its environment and historical lifestyle patterns. While global and national studies have identified nutrition and socioeconomic status as primary drivers of these physical differences, regional-scale variability within Latvia remains insufficiently characterised.

Aim. This study aimed to compare anthropometric characteristics between two distinct Latvian regions (Piebalga and Kurzeme) to identify significant regional variations across both sexes and throughout the lifespan.

Materials and methods. Anthropometric data were collected during two distinct field studies: the first in the Piebalga region (2024) and the second across three cities in the Kurzeme region (Kuldīga, Liepāja, and Ventspils) in 2025. The combined sample included 2055 participants aged 1–99 years. The measurements evaluated included standing height, arm span, head circumference (HC), chest circumference (CC), waist circumference (WC), shoulder length (SL), and hip circumference (HiC). Body mass index (BMI) was subsequently calculated as an indicator of nutritional status. Data were stratified by sex and age. Statistical analysis was performed using IBM SPSS Statistics 29.0. Descriptive statistics were generated, including means and standard deviations (SD) for normally distributed data, and medians and interquartile ranges (IQR) for non-normally distributed data. Minimum and maximum values were recorded to define the dataset's range.

Results. Across most anthropometric parameters, participants from the Piebalga region had higher mean values than those from the Kurzeme region for both sexes. Among men, the most pronounced difference was observed in arm span, with Piebalga participants averaging 181.5 ± 17.83 cm, compared with 173.28 ± 24.60 cm in Kurzeme. Additionally, male CC was notably larger in the Piebalga group, exceeding the Kurzeme mean by 6.77 cm. Also, SL in Piebalga was 39.21 ± 4.28 cm, whereas in the Kurzeme region it was 36.73 ± 6.84 cm. For women, the greatest disparity was observed in HiC, which was higher in Piebalga (104.37 ± 15.09 cm) than in Kurzeme (100.29 ± 14.88 cm). WC followed a similar trend, with Piebalga women averaging 3.20 cm more than their counterparts in Kurzeme. HC was the only parameter in women that was slightly higher in Kurzeme (55.24 ± 2.3 cm) than in Piebalga (55.17 ± 2.36 cm). Regarding body composition, mean BMI in the Piebalga region was 25.52 ± 6.39 kg/m² for men and 27.84 ± 7.42 kg/m² for women (estimated SD). In the Kurzeme region, BMI values were nearly identical between sexes (26.07 ± 11.63 kg/m² for men and 26.04 ± 6.27 kg/m² for women). Overall, no substantial regional variations in BMI were identified.

Conclusions

1. Participants from the Piebalga region generally exhibited larger anthropometric dimensions, particularly arm span and hip circumference, compared to those from Kurzeme across both sexes.
2. Despite regional variations in skeletal and circumferential measurements, BMI values remained relatively uniform across the two populations, suggesting similar overall weight-to-height ratios.
3. Subsequent studies should incorporate pediatric and young adult cohorts to enhance sample diversity and provide a comprehensive longitudinal understanding of regional anthropometric development in Latvia.

Assessment of Femoral Artery Branching Patterns

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Introduction. The femoral artery serves as the main arterial blood supply to the lower limb and is often used as an access point for diagnostic and therapeutic interventions, including angiography, catheterization, and endovascular procedures. In classical anatomical descriptions, the branching of the femoral artery is considered relatively constant; however, numerous variants have been reported in the literature that can affect surgical tactics and the risk of complications (Tzouma et al., 2020; De Villiers & Keet, 2025). A detailed study of branching variants of the femoral artery is essential in both theoretical and practical medicine.

Aim. The aim of this study was to identify and classify morphological variants in the branching of the femoral artery, determine their frequency of occurrence, characterize the origin and mutual relationships of the main branches – the deep femoral artery and the medial and lateral circumflex femoral arteries – and assess the clinical significance of different branching variants.

Materials and methods. The study was conducted using human cadaveric material provided by the Laboratory of Anatomy of the Department of Morphology of the Institute of Anatomy and Anthropology, Rīga Stradiņš University, as well as digital anatomy analysis using the “Anatomage” table. In total, the femoral regions of 5 lower extremities from 3 adult cadavers and 10 lower extremities from 5 digital cadavers were examined. Dissection was performed from the beginning of the femoral artery below the inguinal ligament to the popliteal fossa, where it continues as the popliteal artery. Femoral arteries on the “Anatomage” table were measured using digital markers, allowing accurate measurement of the distance to branch origin and comparison with cadaveric data. The level of origin, number, course, and mutual topographic relationships of the branches were documented and measured with a digital caliper. The results were recorded, systematized, and analysed to determine the frequency of various femoral artery branching variants.

Results. In most cases, a femoral artery branching pattern corresponding to classical anatomy was observed, with the deep femoral artery originating 35.17 ± 12.33 mm below the inguinal ligament. In some cases, variations were found: high origin of the deep femoral artery, a common trunk with one of the circumflex arteries, direct branching of the medial or lateral circumflex femoral artery from the common femoral artery, or differences in the number of branches or their level of origin. In the most common branching variant,

the medial and lateral circumflex femoral arteries arose from the deep femoral artery. This pattern was observed in most of the analysed cases and corresponds to the classical anatomical model. In addition, less common branching variants were identified: the lateral circumflex artery arising from the deep femoral artery and the medial circumflex artery arising directly from the femoral artery. The angle of origin of the deep femoral artery varied from 18° to 54° , with an average of $32.96^\circ \pm 10.49^\circ$, with a tendency towards a larger angle on the left side.

Conclusions

1. While the classical model, in which the deep femoral artery originates approximately 35 mm below the inguinal ligament, is the most frequent, the significant diversity in the number and level of branches indicates that it is not universal.
2. The most common branching configuration features both the medial and lateral circumflex arteries arising from the deep femoral artery, although they may occasionally originate directly from the common femoral artery.
3. The deep femoral artery typically branches at an average angle of approximately 33° , with data suggesting a tendency for this angle to be wider on the left side of the body.
4. Identifying these variations, such as high origins or common trunks, is clinically critical for reducing the risk of complications during invasive procedures such as angiography or endovascular interventions.

Characterization of Tissue Immunity in Adults with Chronic Periodontitis

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Introduction. Periodontitis is a severe gum infection that can lead to tooth loss, bone loss, and other serious health complications. Immune factors modulate the immune response, inflammation, and healing; therefore, they are vital in the patient's immunological assessment and in understanding the morphopathogenesis of periodontitis.

Aim. The aim of this study was to assess the distribution of cytokines IL-1 α , IL-4, IL-6, IL-12, IL-13, IL-17A, and the PTX3 gene, and to perform immunohistochemical and chromogenic *in situ* hybridization analyses of periodontitis-affected

gingival tissue samples. This study furthers an ongoing research effort to identify new links between cytokine profiles, genes, and the features of periodontitis-affected tissues.

Materials and methods. Tissues were obtained from 7 patients with chronic periodontitis during surgical treatment to reduce periodontal pockets. Five controls were used for comparison. Immunohistochemistry, chromogenic *in situ* hybridization, light microscopy, semi-quantitative evaluation (from 0 to ++++), and statistical analyses (Fisher-Freeman-Halton exact test and Spearman's rank correlation) were used to evaluate the data, their statistically significant differences, and correlations between the groups.

Results. Immunohistochemical evaluation of chronic periodontitis tissue showed a statistically significant decrease in IL-4 expression in both epithelial and connective tissues when compared to controls. Other cytokines – IL-1 α , IL-6, IL-12, IL-13, and IL-17A – demonstrated variable distribution patterns, but without statistically significant differences between the groups. IL-17A in the epithelium showed only a tendency towards lower expression in the patient group, suggesting a possible early shift in local inflammatory signalling, although not confirmed statistically. The epithelium and connective tissue presented similar PTX3 expression. CISH evaluation revealed an absence of a significant shift in score distribution but showed isolated cases of PTX3-rich samples.

Conclusions. Reduced IL-4 expression indicates diminished anti-inflammatory signalling and suggests impaired immune regulation in chronic periodontitis, potentially contributing to sustained tissue inflammation. The absence of significant differences for IL-1 α , IL-6, IL-12, IL-13, and IL-17A highlights IL-4 as the principal cytokine deviating from normal patterns in this cohort, emphasizing its possible diagnostic or mechanistic relevance in disease progression. PTX3 gene positivity in chronic periodontitis gingiva appears low and heterogeneous; nonetheless, the tight coupling of epithelial and stromal scores and the presence of focally high PTX3 expression in individual lesions suggest that PTX3 may persist in chronic inflammation.

Comparative Analysis of Bigonial Width and Height Development in Children Aged 1–18 Years

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Introduction. Human growth is an essential marker of optimal child development. Human growth occurs at different rates in different body regions (Liu et al., 2018). Tissues and organs grow at different rates to ensure specific regional maturity when needed. The brain matures faster, resulting in earlier craniofacial development in children (Rashmi et al., 2017), whereas in normal development, the limbs experience the greatest growth spurts during puberty, influenced primarily by hormonal changes. In scientific studies, growth can be characterized by standardized measurements in which adult (18-year-old) measurements are equivalent to 100%; this allows direct comparison of growth patterns.

Aim. This study aimed to compare the relative growth rates of bigonial width and body height throughout development in children aged 1–18 years.

Materials and methods. The data for this study were obtained from an ongoing longitudinal study started in 2006 comprising individuals aged 1–18 years, where 100% represented the age of total development (adulthood). A total of 183 participants were included at age one; however, the number of participants decreased progressively with increasing age. All data were obtained using a digital Vernier caliper and non-stretchable measuring tape. The data were analysed using Microsoft Office Excel and IBM SPSS (version 31.0.1.0) to obtain descriptive statistics.

Results. Multiple observations were made during this study. Firstly, at age one, bigonial width was significantly more developed than height, with bigonial width measuring 77.2%, whereas height measured only 44.2%. Secondly, observations about developmental stages could be made. During early and later childhood, at ages 1–9, both bigonial width and height grew the most. Bigonial width increased by 14.6% (77.15% to 91.75%), while height increased by 33.85% (44.15% to 78.0%). In adolescence, bigonial width reached a plateau, while height continued to increase steadily. Bigonial width plateaued at age 15, reaching 99.3%, whereas during adolescence height increased by 18.95%. Regarding the specific ages at which both measurements increased the most, age 1–2 showed the greatest increase, with height increasing by 6.75% and bigonial width increasing by 3.7%. Lastly, the proportional index indicates that bigonial width is significantly more developed than height in early childhood and gradually decreases, reflecting convergence toward proportional growth. At age 15, growth between both measurements becomes almost proportional.

Conclusions

1. At age one, bigonial width is significantly more developed than height.
2. Bigonial width reached a developmental plateau at age 15, while height did not reach a plateau until age 18.
3. Both height and bigonial width increased the most during early and later childhood, whereas during adolescence height continued to increase until age 18, but bigonial width plateaued at age 15, representing almost completely developed craniofacial features.
4. The greatest development in height and bigonial width occurred at ages 1–2, showing that early childhood is the most critical developmental period for craniofacial dimensions and height.
5. The proportional index continuously declined from 174 at age 1 to 100 at age 18, showing that bigonial width is more developed in early childhood, but height exhibits a faster overall growth rate, reaching almost proportional alignment at age 15.

Anatomical Assessment of *A. Gastrica Sinistra* During Hiatal Hernia Repair Simulation

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Introduction. Hiatal hernia (HH) repair is a common laparoscopic procedure that requires precise dissection of the esophageal hiatus and mobilization of the gastroesophageal junction. During surgical procedures in this region, including fundoplication and mesh-reinforced HH repair, *a. gastrica sinistra* (AGS) may be exposed or manipulated (Bazira, 2023). Given its proximity to the lesser omentum and the hiatus, it is highly susceptible to injury during mobilization of the esophagus and the gastric fundus. Variations in its course and branching patterns may increase the risk of intraoperative vascular injury. Therefore, detailed anatomical knowledge of the vessel and its relation to surrounding structures is essential (Zhu, 2020).

Aim. The aim of this study was to observe the anatomical position of the AGS during simulated HH repair and to evaluate its relationship with the esophageal hiatus and surrounding structures.

Materials and methods. Materials for dissection were provided by the Laboratory of Anatomy of the Department of Morphology at the Institute of

Anatomy and Anthropology. A detailed anatomical dissection was performed on a single formalin-fixed adult cadaver. The abdominal cavity was opened to expose the supracolic compartment. Using microdissection techniques, the peritoneum of the lesser omentum was reflected to identify the celiac trunk, the origin of the AGS, and the surrounding anatomical structures. The esophagus was then mobilized from the diaphragmatic crura to simulate the standard steps of hiatal reconstruction. The course of the AGS was documented during the HH simulation. High-precision morphometric measurements were recorded using a digital caliper (accuracy ± 0.01 mm), focusing on three primary coordinates: the distance from the AGS origin to the gastroesophageal junction, the distance to the medial border of the right crus, and the length of the esophageal branches. Finally, manual cephalad and caudal traction was applied to the stomach to observe the vessel's displacement.

Results. This study demonstrates that the AGS maintains a consistent morphometric profile and spatial trajectory relevant to hiatal hernia repair. The AGS was found to originate directly from the celiac trunk, presenting a basal diameter of 3.7 mm. From its origin, the vessel travelled a distance of 7 cm within the gastropancreatic fold before reaching the lesser curvature of the stomach. During the surgical dissection, the AGS was located 3 cm from the medial border of the right diaphragmatic crus, a measurement that is significant for defining the proximity of major vascular structures to the primary site of hiatal mobilization.

Following the theoretical completion of hiatal hernia repair, the AGS maintained a specific anatomical relationship with the reconstructed site. It remained anterior and medial to the repaired esophageal hiatus and stayed positioned within the lesser omentum along the lesser curvature. Furthermore, the vessel was situated inferior to the fundoplication wrap and remained distinct from the surgical mesh, typically lying posterior or lateral to it. These findings suggest that, while the AGS is in close proximity to the operative field, its natural course within the gastropancreatic fold generally keeps it protected from the immediate mechanical constraints imposed by hiatal closure and prosthetic reinforcement.

Conclusions

1. The AGS originates directly from the celiac trunk and traverses the gastropancreatic fold for a significant distance before reaching the lesser curvature of the stomach.
2. During the dissection phase, the artery is consistently positioned at a specific distance from the medial border of the right diaphragmatic crus, providing a reliable anatomical landmark during hiatal mobilization.
3. Following completion of the repair, the vessel typically remains anterior and medial to the reconstructed hiatus, situated within the lesser omentum and inferior to the fundoplication wrap while staying distinct from the surgical mesh.

Comparative Analysis of Pulmonary Hypertension-Related Molecular Markers in Human Lung Tissue Across Diverse Patient Cohorts

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Introduction. Pulmonary hypertension (PH) is a progressive vascular disorder characterized by increased pulmonary arterial pressure, endothelial dysfunction, vascular remodelling, inflammation, and impaired angiogenesis. Several molecular regulators play critical roles in these processes, yet their comparative expression across patient groups remains insufficiently understood. This study focuses on five key factors – Gremlin-1, BMP-2/4, VEGF, IL-10, and CD163 – that are directly or indirectly involved in PH morphopathogenesis.

Aim. This study aimed to investigate the distribution and expression of the aforementioned factors as potential contributors to pulmonary hypertension across diverse age groups, including young, cardiac, and elderly patients.

Materials and methods. Lung tissue samples were analysed immunohistochemically for Gremlin-1, BMP-2/4, VEGF, IL-10, and CD163. The results were evaluated semi-quantitatively and analysed using the independent-samples Kruskal–Wallis test and Spearman’s correlation coefficient.

Results. VEGF expression was upregulated in geriatric lung tissue compared with young adult and cardiovascular disease groups, whereas IL-10 expression was highest in young adult patients and progressively downregulated with age. A highly positive correlation was observed between IL-10 and CD163, and between BMP-2/4 and VEGF, in young adult groups. In cardiovascular patients, VEGF revealed a very strong positive correlation with CD163. No statistically significant correlations were observed within the elderly group.

Conclusions. The present study demonstrates distinct and opposite expression patterns of VEGF and IL-10 across patient cohorts. The significantly increased VEGF expression in cardiovascular and geriatric patient groups indicates enhanced, but likely dysregulated, angiogenic signalling associated with chronic vascular injury. In contrast, IL-10 expression was highest in the young adult patient group and significantly reduced in older individuals, suggesting a decline in anti-inflammatory and immune-regulatory capacity within lung tissue. In young patients, correlations between IL-10 and CD163, together with those between BMP-2/4 and VEGF, indicate coordinated anti-inflammatory and

vascular regulation. In cardiovascular patients, the correlation between VEGF and CD163 suggests linked angiogenesis and macrophage-mediated tissue remodeling. The absence of significant correlations within geriatric group tissue may reflect an age-related decline in coordinated molecular regulation.

Morphometric Analysis of the Aortic Bifurcation and Venous Confluence: Clinical Implications for Iliac Vascular Management

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Supervisors – Acting Assistant Arta Grabčika; Dr. med., Associate Professor

Dzintra Kažoka

Introduction. The abdominal aorta originates at the 12th thoracic vertebra and bifurcates at the level of the 4th–5th lumbar vertebra into the right and left common iliac arteries (CIA) at an angle of approximately 40–60° (Deswal et al., 2014). An abdominal aortic aneurysm (AAA) is a local dilatation of the abdominal aorta exceeding 30 mm in diameter or increasing by at least 50% (Shaw et al., 2025). Available clinical CT imaging studies suggest that aneurysms with a bifurcation angle of less than 45° or greater than 90° may grow faster (Zhao et al., 2025). Understanding these anatomical variations is important for assessing AAA development and optimizing endovascular aneurysm repair (EVAR) treatment and outcomes.

Aim. The aim of the study was to dissect and measure aortic bifurcation and venous confluence angles and common iliac vessel lengths, and to evaluate their potential significance in AAA development and endovascular aneurysm repair planning.

Materials and methods. This study utilized 11 specimens: five digital models (two female, three male) sourced from the “Anatomage” virtual dissection table, and six natural human cadavers (one female, five male) provided by the Institute of Anatomy and Anthropology at Rīga Stradiņš University. The angles of the common iliac artery (CIA) bifurcation and the venous confluence into the inferior vena cava (IVC) were measured using a protractor. Additionally, the lengths of the right and left common iliac arteries and veins were recorded from their origin at the aortic bifurcation or venous junction using a metric tape measure.

Results. The data reveal a consistent pattern of anatomical asymmetry between the arterial and venous systems. The average angle between the right and left common iliac arteries (CIA) was $50.06 \pm 0.37^\circ$ (range: $36.30\text{--}69.37^\circ$), with males at $49.60 \pm 0.40^\circ$ and females at $51.28 \pm 0.27^\circ$. No aortic bifurcation angles associated with an increased risk of aortic aneurysms were observed. The mean right CIA length was 6.80 ± 0.10 cm (range: $4.53\text{--}9.33$ cm), averaging 7.02 ± 0.07 cm in females and 6.72 ± 0.12 cm in males. The left CIA was shorter, averaging 6.70 ± 0.11 cm (range: $4.47\text{--}9.03$ cm), with a value of 6.90 ± 0.10 cm in females and 6.63 ± 0.11 cm in males. The mean venous junction angle was $69.95 \pm 0.29^\circ$. The right common iliac vein (CIV) averaged 5.55 ± 0.14 cm, while the left CIV averaged 6.70 ± 0.14 cm.

Conclusions

1. The observed anatomical variability in the mean angle between the common iliac arteries may significantly influence the morphology of aneurysmal involvement at the aortic bifurcation.
2. Notably, the measured arterial angles remained within a range suggesting a low architectural predisposition for turbulent flow, a key mechanical factor in the development of iliac aneurysms.
3. The documented lengths of the common iliac arteries provide essential morphological data for the precise planning of EVAR.
4. While the right common iliac artery was generally longer than the left, the venous system exhibited the opposite trend, with the left common iliac vein consistently exceeding the length of the right.
5. Across all specimens, the venous confluence angle was found to be notably more obtuse than the corresponding arterial bifurcation angle.
6. The results also indicate subtle sexual dimorphism, as females generally presented with wider bifurcation angles and longer common iliac arteries compared to their male counterparts.
7. Ultimately, the specific venous confluence angles and relative lengths underscore the intimate relationship between arterial and venous structures, emphasizing the need for meticulous dissection to minimize iatrogenic venous injury during surgery.

Expression Patterns of Gene Products in Lung Tissues of Relatively Healthy Individuals Across Specific Ontogenetic Periods

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Introduction. Lung diseases are highly prevalent worldwide and represent a significant global health burden. Chronic respiratory diseases affect hundreds of millions of people globally. Transcription factors and signalling pathway components from the Wnt and Hedgehog pathways may be significant in the development of histologically normal postnatal human lung tissue. Such data are of critical importance, as they may provide deeper insight into the gene products involved in lung tissue maintenance.

Aim. The aim of this study was to quantitatively assess the number and distribution of gene products – Pax7, Pax9, Sox9, Irf6, Wnt family members 9b, 1, and 3a, Sonic Hedgehog (Shh), and Indian Hedgehog (Ihh) – in lung tissue samples obtained from healthy individuals, and to evaluate potential associations among these factors in order to explore regulatory networks in the adult lung.

Materials and methods. Lung tissue samples were obtained from 10 deceased individuals (17–29 years) without pulmonary pathology. Tissues were used for biotin–streptavidin immunohistochemistry to detect Pax7, Pax9, Sox9, Irf6, Wnt1, Wnt3a, Wnt9b, Shh, and Ihh. The number of factor-positive cells in lung structures, including bronchioles, alveoli, and vasculature, was evaluated semi-quantitatively on a scale from 0 to +++. Statistical analysis was performed using SPSS 27.0, with scores converted into numerical values and associations assessed using Spearman's rank correlation coefficient. A p-value < 0.05 was considered statistically significant.

Results. A novel finding of this study is the consistent presence of Sox9-positive cells in bronchial cartilage, indicating its selective and sustained role in lung hard tissue formation and maintenance in postnatal life. In contrast, Pax7, Pax9, Wnt-1, Wnt-3a, Shh, and Ihh factor-positive cells were negligible or absent, suggesting that these factors are not involved in normal lung tissue homeostasis. Irf6 demonstrated moderate and stable presence across most lung structures, supporting its importance in postnatal lung function, likely related to cell differentiation and regulatory homeostasis. The presence of Wnt-9b-positive cells in unchanged postnatal young human lung tissue was observed in connective tissue, suggesting the significance of connective tissue cells in maintaining local tissue homeostasis.

Spearman's analysis revealed several strong positive associations between Pax and Hedgehog pathway components. The strongest correlation was observed between Pax9 expression in glandular tissue and Shh expression in the epithelium ($\rho = 0.92$), suggesting a close functional link. Pax7 in glandular tissue strongly correlated with epithelial Shh ($\rho = 0.90$), supporting coordinated activity between glandular Pax genes and epithelial signalling. A strong correlation between Pax9 and Pax7 within glandular tissue ($\rho = 0.89$) indicates possible co-regulation. Epithelial Pax7 showed strong correlations with both epithelial Shh and glandular Pax9 ($\rho = 0.88$), pointing to interconnected regulatory interactions between epithelial and glandular compartments.

Conclusions. Consistent localization of Sox9 in bronchial cartilage underscores its key role in postnatal lung hard tissue maintenance. The absence of Pax7, Pax9, Wnt-1, Wnt-3a, Shh, and Ihh limits their involvement in normal lung homeostasis. Stable Irf6 expression across lung tissues indicates its role in maintaining postnatal cellular function. Wnt-9b in connective tissue highlights its potential contribution to local tissue homeostasis. Strong correlations between Pax and Hedgehog pathway components point to coordinated regulatory interactions, particularly between glandular and epithelial compartments.

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