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ORIGINAL PAPER

Study of the correlation between newborn and fetus ages and some morphometric cervical vertebral arches indices

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Abstract

Establishing the newborn and fetus age by taking into account of cervical vertebral bony parts dimensions is useful in anthropology and anthropometry as well. In the present study, we tried to determine some morphometric indices of fifth bony part's cervical vertebral arch in both fetus and newborn. We analyzed their correlation with the age of the subjects studied. We used a set of five newborn and five fetuses of six-seven months. We removed the fifth right cervical vertebral hemiarch from each subject. Images of vertebral bony parts hemiarches were acquisitioned, processed and measured by a morphometric *Lucia M* specialized soft. We measured the bony parts surface area, we traced the hemiarch frame triangle, and we measured the angles, the sides and the frame-triangle surface area, for each hemiarch. By analyzing the data we succeeded in revealing that the ratio between the anteromedial angle value and the opposite side length of that angle correlates to the fetus and newborn ages. Therefore, we consider this ratio as being an anthropometric index useful in deciding upon the fetus and newborn age.

Keywords: fetus, newborn, cervical vertebra, morphometry.

Background

Establishing the newborn and fetus ages by having into consideration the dimensions of cervical vertebras bony parts is useful in anthropology and anthropometry in the study of incomplete skeletons. Many authors tried to establish correlations between the newborn and fetus ages and different morphometric indices of their cervical vertebral column [1–3].

The first vertebras ossification centers appear in the 8th week of development enlarge their size and change their forms during ontogenesis [4, 5].

In the present paper, we suggested performing morphometric analyses of the fetus and newborn cervical vertebral hemiarches in order to determine a possible correlation between their morphometric characteristics and the age of the subjects studied by us.

Material and methods

A set of five newborn and five fetuses aged 6–7 month were available for our study; their ages were determined based on the vertex–coccis length [5]. From them we removed the right vertebral hemiarches of the 5-th cervical vertebra, by dissection. Then the bony preparations were controlled decelated at cold and warm temperatures and/or after that, they underwent corrosions in 1% sodium hydroxide solution.

Cold decelation: the preparation was introduced in a cold-water pool where it is kept up to the decelation. We controlled decelation for each 12 hours.

Warm decelation: the preparation was introduced in a warm water pool (about 50^0C) then it grew cold. The water pool was rewarmed 4–5 time daily; we controlled decelation from six to six hours up to the total removing of the soft tissue.

Corrosion with 1% sodium hydroxide solution consists of the following: the preparation is boiled in 1% sodium hydroxide solution and it is checked at each 5 minutes (to avoid the deterioration of the bony tissue) up to the superjacent soft tissue saponification. That method allows the rapid removing of the soft tissues but the control periods must be rigorously guarded in order not to deteriorate the subjacent bony tissue.

For all the tree methods, it is necessary for the soft already decelated tissue should be removed at each control period. This is performed either by water jet or by means of the dissection devices.

The bony parts images of the vertebral hemiarches, necessary for our study were acquisitioned by a Sony camera connected to a computer by means of a Matrox–Comet acquisition plate. Then, the images were processed by *Lucia M* soft dedicated by morphometry. We have the binarized image of the projection in plane of the bony parts belonging to the vertebral hemiarch.

We tried to frame the plane image projection of the vertebral hemiarch within different geometric figures in order to establish certain morphometric indices easily to reproduce and measured.

The geometric figure having the least variability degree considering reproducibility is the frame triangle. The latter was defined such us: we traced tangents through the pairs of local extreme points of anterolateral, posterolateral and medial parts respectively, of the vertebral hemiarch.

By means of *Lucia M* soft morphometric functions, we measured the area of the plane projection surface of each vertebral hemiarch (Ap), the frame triangle surface (A), the "α" angle made up lateral to the vertebral arch and lengths (mm) of the sides framing the triangle, the "β" angle (made up between the anterolateral and the medial sides of the framed triangle), the A/Ap and β/L values (Figure 1).

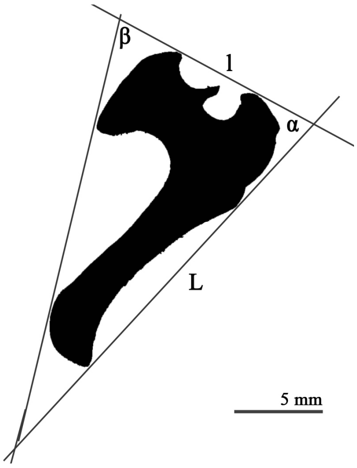

Figure 1 – ***Binarized image of a right cervical vertebral hemiarch and the tracing way of the vertebral hemiarch framing triangle: L – posterolateral side of the triangle; l – anterolateral side; α – the angle between L and l; β – the angle between "l" and the medial side of the framing triangle***

Results

After performing measurements, we have the following values:

▪ the value of "α" angle is of an average 62.906^0 (±8.28) for the newborn set and 63.132^0 (±7.99) for the fetus set;

▪ the value of "β" angle is of an average 87.447^0 (±8.32) in newborns and 83.28^0 (±9.16) in fetuses;

▪ the length of the side marked "l" of the framing triangle is of an average value 12.463 mm (±0.59) in newborns and 9.833 mm (±1.21) in fetuses;

▪ the length of the side marked "L" of the framing triangle is of an average 23.659 mm (±1.23) in newborns and 17.364 mm (±1.77) in fetuses studied by us;

▪ the surface of the framing triangle marked "A" is on average 137.836 mm^2 (±13.27) for the newborns set and 59.239 mm^2 (±16.1) for the fetus set;

▪ the area of the projection surface of the cervical vertebral hemiarch marked "Ap" is of an average 70.802 mm^2 (±9.31) in newborns and 43.194 mm^2 (±3.88) in fetuses studied by us;

▪ the average value of "A/Ap" rapport is of 0.514 (±0.044) in newborns and 0.756 (±0.125) in fetuses;

▪ the average value of "β/L" rapport is of 3.697 (±0.301) for the newborns set and 4.759 (±0.198) in fetuses;

The data obtained by measurements in the two sets of vertebral hemiarches are presented in Table 1 (for newborns) and Table 2 (for fetuses).

The diagrams of the morphometric indices value variations measured in the two sets of vertebral hemiarches are presented in Figure 2 (for newborns) and Figure 3 (for fetuses).

Table 1 – ***Determinations by newborns***

Newborn	α [^{0}]	β [^{0}]	l [mm]	L [mm]	Ap [mm^2]	A [mm^2]	Ap / A	β/L
1.	52.840	96.070	12.710	24.610	63.820	140.352	0.455	3.903
2.	63.240	81.790	12.485	21.500	65.340	121.973	0.536	3.804
3.	63.680	88.480	12.280	24.235	64.430	134.229	0.480	3.650
4.	75.510	76.460	11.610	23.930	75.150	134.274	0.560	3.195
5.	59.260	94.430	13.230	24.020	85.270	158.351	0.538	3.931
Mean	62.906	87.446	12.463	23.659	70.802	137.836	0.514	3.697
Standard deviation	8.279	8.320	0.593	1.235	9.3194	13.270	0.044	0.301

Table 2 – ***Determinations by fetuses***

Fetuses (6–7 months)	α [^{0}]	β [^{0}]	l [mm]	L [mm]	Ap [mm^2]	A [mm^2]	Ap / A	β/L
1.	65.660	84.800	8.360	16.530	37.000	41.583	0.890	5.130
2.	70.840	74.140	9.450	15.890	43.160	51.358	0.840	4.665
3.	50.080	95.180	11.510	19.960	47.700	84.961	0.561	4.768
4.	61.800	88.180	9.310	18.420	44.400	59.993	0.740	4.787
5.	67.280	74.100	10.534	16.019	43.709	58.301	0.750	4.625
Mean	63.132	83.280	9.833	17.364	43.194	59.239	0.756	4.795
Standard deviation	7.986	9.161	1.213	1.770	3.885	16.100	0.125	0.198

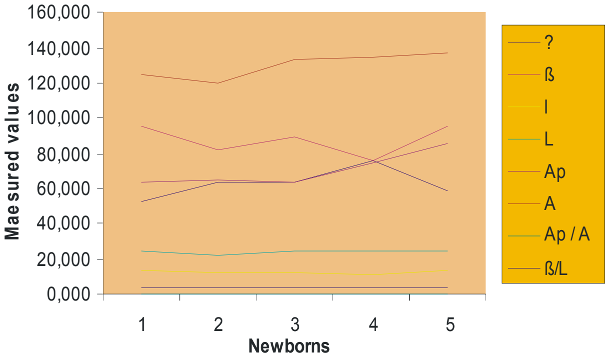

Figure 2 – *Variation of the morphometric indices values of the vertebral hemiarches in newborns*

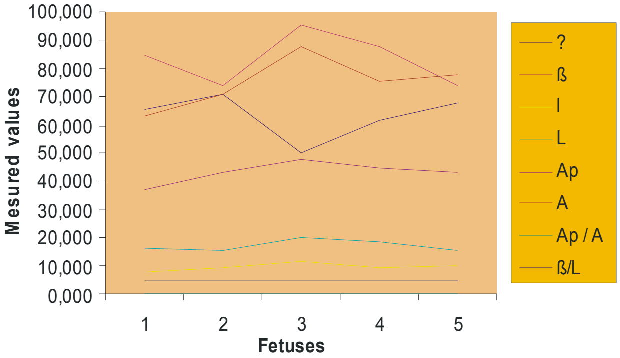

Figure 3 – *Variation of the morphometric indices values of the vertebral hemiarches in fetuses*

Discussion

Fetal age and conception date, by wild population have been estimate by fetal weight [6, 7]. To precise estimate fetal age, from bone length and the appearance of ossification is more suitable than fetal weight as done in many studies of domestic animals [8, 9].

By animals, the bone length and the appearance of ossification centers can be said to be reliable indices available from fetuses to estimate the fetal age [10].

The numerical survey of ossification centers provided a possible parameter for the determination of the fetal developmental age [11].

It was also demonstrated that in sheep the gestational age between 12–13 weeks correlates to the cervical, thoracic and respectively lumbar region lengths of the vertebral column and to the chronology of the vertebral ossification centers appearance [12].

Castelana C and Kósa F [13] studied the newborn and fetus vertebral morphology. A correlation between the fetus or newborn ages and the morphology of axis and atlas could not be established. Therefore, we noticed that the sizes and form of the axis tooth are useful in establishing the fetus viability [2].

Between 5 and 18 years of age, the best morphological vertebral parameter to estimate maturation is the concavity of the lower border of the vertebral body [14].

In an anterior study, we showed that the bony parts of a newborn vertebras present many morphometric specific features that can be useful for their regional framing [15].

By the analysis obtained, we could notice that "β/L" value depends in a direct manner on the ossification degree and the vertebral hemiarch shape, is specific to age in both the groups studied by us.

The other measured values have relatively great variations and they are not predictable for determining the age of the subjects.

Conclusions

In these cases studied by us, the morphometric index best correlated to the newborn and fetus age was "β/L" rate, which showed the existence of some relationship between the vertebral hemiarch shape and its ossification degree. It is necessary that the study should be extended upon a larger number of fetuses and newborns in order to establish the evolution normogram of the values of that morphometric index.

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