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The Superior Trunk of the Brachial Plexus in Man

Pień górny splotu ramiennego u człowieka

The purpose of this work was to investigate both external structure of the superior trunk of the brachial plexus, and some features of its internal texture. The study was done on material obtained bilaterally from cadavers of 33 males (♂) and 34 females (♀) who died at the age between the 11th day and the 86th year of life. Six age groups were distinguished. They were described in the previous publication (8). The first, second and sixth group contained 5 males and 5 females each. The third group included 5 ♂ and 8 ♀, the fourth group — 5 ♂ and 6 ♀, and the fifth group — 8 ♂ and 5 ♀. The roots of the superior part of brachial plexus, superior trunk and its teminal ramifications were visualized by the preparation method. The sections taken from the roots and the trunk were fixed in a glass frame and they were preserved in formalin. Next bearing with the sections, staining of slides and determination of trunks' thickness and fascicles' thickness, the number of fascicles and the index of fascicles' area were presented in the previous papers (8, 9).

RESULTS

The superior trunk of the brachial plexus was present in 132 cases which makes 98.5 per cent of 134 plexuses studied. In 2 cases — 1.5% (bilaterally in the same woman aged twenty-two years) the absence of trunk resulted from division of the roots of the brachial plexus from C_5 and C_6 into anterior and posterior branches. The trunk was formed by the junction of two or three roots. The trunk made of two roots was observed in 96 cases (72.7%), the trunk made of three roots was present in 36 cases (27.3%). The superior root in two-rooted trunks was formed by the anterior branch from C_5 in all cases. The inferior root was made by the anterior branch from C_6 in 95 cases (71.9%), and it was made only by part of the anterior branch from C_6 in 1 case (0.8%). In 91 cases (68.9%) the inferior root was thicker than superior one, in 4 cases (3.0%) the superior root was thicker, in 1 instance (0.8%) both roots had similar thickness. In three-rooted trunks the superior root arose from the anterior branch C_4 and joined the middle root before it reached the inferior root. The middle and the

inferior roots made extensions of the anterior branches of C_5 and C_6. The superior root was the thinnest in all the cases. The inferior root was the thickest in 33 cases (25.0%), and the middle root was the thickest in 3 cases (2.3%).

Thickness of the superior trunk

The dimension of the cross-section area of the superior trunk ranged between 1.334 and 34.336 sq mm. It did not correlate with the number of roots forming the trunk. The thickness of the trunk was the same on both sides of the single body in 4.5%. It was greater on the right side in 51.5%, and it was greater on the left side in 43.9% of the cases. The average values of the cross-section area of superior trunk are presented in Table 1. In the examined material the mean value was 13.224 sq mm, on the right side 13.216 sq mm, on the left side 13.232 sq mm, in males it was 13.572 sq mm, in females 12.876 sq mm. It had the lowest value in the first age group, and the highest in the fourth, fifth and sixth groups.

Table 1. Mean cross-section area of the superior trunk of the brachial plexus

Sex	Side	Age groups					
		I	II	III	IV	V	VI
♂	R	3.909	12.361	15.350	16.085	16.749	19.027
	L	3.699	8.410	15.284	14.213	16.111	18.239
	R+L	3.804	10.386	15.317	15.149	16.430	18.633
♀	R	6.784	8.329	14.158	15.673	14.789	12.387
	L	5.834	8.057	17.950	17.097	15.422	14.081
	R+L	6.309	8.193	16.054	16.385	15.105	13.234
♂+♀	R	5.346	10.345	14.655	15.861	15.995	15.707
	L	4.766	8.233	16.840	15.786	15.846	16.160
	R+L	5.056	9.289	15.747	15.823	15.921	15.934

Explanation: R — right side, L — left side, R+L — right+left.

Number of fascicles

In the initial segment of the superior trunk 2 to 41 fascicles were observed. The trunks formed by 5 or less fascicles constituted 15.9% of the cases, from 6 to 10 made 33.3%, from 11 to 15—28.0%, from 16 to 20—16.7% and trunks formed more than 20 fascicles — 6.1% of the total. The same number of fascicles on both sides of one body was found in 9.1%, the greater number on the right side appeared in 39.4%, and on the left side in 51.5% of the cases. The mean number of fascicles of the superior trunk was 11.5, while on the right side it was 11.2, on the left side — 11.8, in males — 11.6, and in females — 11.4. In respective age groups it was as follows: in age group I 9.1, in group II 12.2, in group III 13.3, in group IV 12.0, in group V 11.4, and in group VI 10.6.

Size of the cross-section area of fascicles

In the whole material the thickness of an individual fascicle ranged between 0.001 and 12.924 sq mm. Five groups of the fascicles with different thickness were distinguished. They were described in the previous paper (9). Very thin fascicles made 19.2% (19.6% on the right side, 18.8% on the left side, 17.1% in men, 21.4% in women), thin fascicles made 23.8% (22.1% on the right side, 25.5% on the left side, 22.6% in men, 25.1% in women), medium-thick fascicles made 14.9% (14.7% on the right side, 15.0% on the left side, 16.9% in men, 12.8% in women), thick fascicles made 19.6% (20.3% on the right side, 19.0% on the left side, 19.9% in men, 19.3% in women) and very thick fascicles made 22.4% (23.3% on the right side, 21.7% on the left side, 23.5% in men, 21.4% in women) of all the fascicles of the trunk. The occurrence of the fascicles with different thickness in the examined trunk of the brachial plexus varied in respective age groups. The percentage participation of differently thick fascicles come out as follows: in age group I — very thin fascicles — 28.0%, thin — 31.9%, medium-thick — 23.6%, thick — 9.3%, and very thick — 7.1% of the total, in age group II, respectively — 31.4, 26.9, 15.1, 15.5, and 11.0%, in age group III — 15.6, 23.1, 12.8, 20.9, and 27.5%, in age group IV — 15.2, 19.8, 11.4, 25.5, and 28.1%, in age group V — 15.5, 20.9, 16.6, 22.6, and 24.3%, in age group VI — 13.1, 23.5, 12.2, 19.7 and 31.5%.

The cross-section area of all the fascicles of the superior trunk ranged between 0.979 and 20.268 sq mm. The cross-section area of all the fascicles in the examined trunk was greater on the right side of the body in 50.0% of all cases and it was greater on the left side in 50.0% of the cases too. The average dimension of the cross-section area of the fascicles in the examined trunk equalled 8.514 sq mm. It was 8.572 sq mm on the right and 8.455 sq mm on the left side, 8.720 sq mm in males and 8.308 sq mm in females. The value mentioned above equalled 3.437 sq mm in age group I, 5.913 sq mm in age group II, 10.087 sq mm in age group III, 10.060 sq mm in age group IV, 10.321 sq mm in age group V, and 10.252 sq mm in age group VI.

Index of the cross-section area of fascicles (IAF)

The value of the index of the area of fascicles ranged between 41.5 and 81.7. The value was similar on both sides of the single body in 7.7%, it was greater on the right side of the body in 48.5% of cases, and on the left side in 43.9% of cases. Mean value IAF was 64.4 in the entire material. It was 64.9 on the right side, and 63.9 on the left side, 64.2 in males, and 64.5 in females. The value mentioned above ranged as follows in the age groups: 68.3 in group I, 63.7 in group II, 63.3 in group III, 63.6 in group IV, 64.8 in group V, and 64.0 in group VI.

DISCUSSION

The superior trunk of the brachial plexus appears almost constantly in man and most often it is formed by the union of two roots: the superior one coming from C_5 and the inferior one — from C_6 (2). In the presented material the superior trunk was observed in 98.5% of cases. It was formed by connection of the anterior branches from C_5 and C_6, and only in 0.8% of the cases it was formed by the anterior branch from C_5 with the anterior part of the anterior branch from C_6. In 27.3% of cases the anterior branch of C_5 was joined by the thin root arising from C_4. The internal texture of the superior trunk, compared with little mutability of its external structure, is characterized by a great individual variability of all the examined features. These observations are confirmed by the reports of numerous authors, who examined peripheral nervous system, its variability and asymmetry structure of the nerves (1—11). The performed studies showed that thickness of the superior trunk, the number of fascicles, size of the cross-section area of fascicles and index of the fascicle's area were different in the majority of cases in the coresponding sections not only in individuals belonging to the same age group and being of the same body height and similar body weight, but also in the same person on both sides of his body. The same or similar values of all the examined features were not found even on both sides of one body. Similar values of a single characteristic on both sides of one body were found rather seldom: the thickness of the trunk was similar in 4.5%, the number of fascicles was similar in 9.1% and the index of the fascicle's area was similar in 7.6% of cases. The cross-section area of fascicles was different on both sides of the body in all the cases. In the single body: the thickness of the superior trunk was greater on the right side in 51.5%, and on the left side in 43.9%, the number of fascicles was greater on the right side in 39.4%, and on the left side in 51.5%, the size of the cross-section area of fascicles was greater on the right side in 50.0%, and on the left side in 50.0% too, the index of the fascicle's area was greater on the right side in 48.5%, and on the left side in 43.9% of cases. The values corresponding to the discussed features were greater by at least 50% on one side of the single body in more than $^1/_4$ of cases in reference to the thickness of the trunk, and more than in $^1/_3$ of cases in reference to cross-section area of the fascicles, and in the half of cases according to the number of fascicles.

The mean values of some examined features differed a little between the sides of a single body and in relation to sex. The thickness of the trunk and the dimension of the cross-section area of the fascicles showed similar values on both sides of the single body, but mean values were greater by at least 5% in males than in females. The number of fascicles was greater more than 5% on the left side than on the right side, and the index of the fascicle's area was greater by 1.6% on the right side than on the left side. The mean values corresponding to these features had similar values in both sexes.

There were differences in participation of the fascicles of different thickness in the structure of the superior trunk, related to the side of the body and to sex. Thin fascicles occurred more often on the left side than on the right side of the body, but thick and very thick fascicles were present more often on the right than on the left side of the body. Medium-thick and very thick fascicles were found more often in males than in females, but very thin and thin fascicles were present more frequently in females than in males.

The examined features of the superior trunk underwent changes during postfetal life with the exception of the number of fascicles. The thickness of the trunk increased by 3.2 times, and the size of the cross-section area of fascicles — by 3 times, whereas the index of the fascicle's area decreased by about 8%. During the postnatal life the participation of fascicles of different thickness in the structure of the superior trunk changed too: the participation of very thin, thin and medium-thick fascicles decreased, while the share of thick and very thick fascicles of the cross-section area greater than 0.5 sq mm increased. The above changes appeared mostly at the age of up to the 22nd year of life.

REFERENCES

1. Corbin K. B., Gardner E. D.: Decrease in number of myelinated fibers in human spinal roots with age. Anat. Rec. **68**, 63, 1937.
2. Hirasawa K.: *Plexus brachialis* und die Nerven der oberen Extremität. Arbeiten aus 3. Abt. Anat. Instit. Kaiserl. Univ. Kyoto, Serie A, H. 2, Kyoto 1931.
3. Иосифов Г. М.: Топография пучков образующих нервные стволы плечевого, поясничного и крестцового сплетения. Русский Арх. Анат. Гистол. Эмбриолог. **7**, 207, 1928.
4. Mustafa G. Y., Gamble H. J.: Observations on the development of the connective tissues of developing human nerve. J. Anat. **127**, 141, 1978.
5. Sunderland S., Bradley K. C.: The perineurium of peripheral nerves. Anat. Rec. **113**, 125, 1952.
6. Sunderland S., Ray L. J.: The intraneural topography of the sciatic nerve and its popliteal divisions in man. Brain **71**, 242, 1948.
7. Szczepińska-Sobutka J.: Budowa wewnętrzna nerwu łokciowego w życiu pozapłodowym człowieka. Doctoral thesis. Lublin 1979.
8. Urbanowicz Z.: Femoral nerve fascicles in the human postfetal life. Folia Morphol. (Warszawa) **39**, 283, 1980.
9. Urbanowicz Z.: Fascicular structure of the root of the brachial plexus from C_6 in man. Ann. Univ. M. Curie-Skłodowska, Lublin, Sectio D **47**, 61, 1992.
10. Urbanowicz Z., Załuska S.: Internal structure of the lateral cutaneous nerve of the thigh in postfetal life in man. Folia Morphol. (Warszawa) **36**, 293, 1977.
11. Załuska S., Załuska E.: Fascicles of the lateral cutaneous nerve of the forearm in postfetal life in man. Folia Morphol. (Warszawa) **39**, 417, 1980.

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STRESZCZENIE

Pień górny, stwierdzony w 98,5% wśród 134 badanych splotów ramiennych, tworzyły dwa korzenie w 72,7%, a trzy — w 27,3% przypadków. Występowały w nim zawsze włókna z C_5 i C_6, a w ponad $^1/_3$ przypadków także z C_4. Wewnętrzna struktura pnia nie była związana z liczbą jego korzeni. Przeciętne liczby charakteryzujące badane jego cechy wykazywały tylko niewielkie różnice związane ze stroną ciała i płcią. Grubość pnia i wielkość powierzchni poprzecznego przekroju jego pęczków miały podobne wartości po obu stronach ciała, a większe przynajmniej o 5% u osób płci męskiej niż żeńskiej. Liczba pęczków była większa o ponad 5% po lewej stronie, a wskaźnik powierzchni pęczków o 1,6% większy po prawej stronie, natomiast cechy te miały podobne wartości u osób obojga płci.

W życiu pozapłodowym badane cechy pnia górnego, poza liczbą pęczków, ulegały zmianom. Grubość pnia zwiększała się 3,2 razy, a wielkość powierzchni poprzecznego przekroju jego pęczków 3 razy, natomiast wskaźnik powierzchni pęczków zmniejszał się o ok. 8%. Zmieniał się również udział pęczków o różnej grubości w budowie pnia: zmniejszał się pęczków o powierzchni poprzecznego przekroju do 0,5 mm^2, a zwiększał — pęczków o grubości ponad 0,5 mm^2.