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Quantitative Intima-Media Relations in the Wall of the Major Leg Arteries and Veins During Childhood and Adolescence

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The goal of current study is to evaluate the dynamic quantitative changes in the wall of the main vessels (arteries, superficial and deep veins) of the leg during the childhood and adolescence. Transverse sections of isolated vessels taken from the leg of 26 cadavers (0 to 19 years). The sections, stained with hemalaun-eosin and orcein, were measured via ocular micrometer/object micrometer system. Data was analyzed by means of descriptive statistics, ANOVA, correlation and graphical analysis. The increment of the intima thickness of the superficial veins correlates stronger with the age (r ~ 0,91) while in the arteries and deep veins the intima thickness correlates only moderately to considerably with age (r ~ 0,61). The relationships are opposite when the media thickness is observed. Generally, the intima is more uneven along the circularity of the investigated vessel. This is established through the large differences between minimum and maximum values of the intimal thickness of the same vessel. The media in the three vessel types shows only weak irregularity during the entire investigated age span.

Key words: arterial wall, venous wall, remodelling, quantitative relationship, intima, media.

The quantitative relationships in the wall of the blood vessels deliver valuable information needed for the prediction, the recognition and the prognosis of the variable heavy pathology of the vessel wall. Recently several advanced noninvasive methods for the precise estimation of these relationships were developed through successful combination of contemporary imaging techniques and advanced digital image analysis — multicontrast MRI with multispectral analysis, duplex ultrasound imaging with pixel distribution analysis etc. [1, 2, 3, 5, 10, 14, 15]. The correct assessment of the results is impossible without the data on the normal quantitative relationships in the vessel wall. The data although rich is currently insufficient, which lowers the reliability of these new methods and hinders their universal appliance in the diagnosis of arterial and venous diseases [6, 7, 8, 9, 11, 12, 17, 19, 20, 21].

Aim. This study is part of a project to establish the quantitative relationships in the wall of the blood vessels of the lower limb during pre- and postnatal development, in health and disease and to compare them to the qualitative differences in the

structure of the investigated vessels [13, 18, 23]. The current goal is to describe the dynamic quantitative changes in the wall of the leg arteries and veins during the childhood and adolescence.

Materials and Methods

For data collection were used transverse sections of isolated:

— main arteries of the leg: *a. tibialis anterior, a. tibialis posterior, a. peronea;*
— superficial veins of the leg: *v. saphena magna, v. saphena parva* ;
— deep veins of the leg: *v. tibialis posterior,*

taken from the middle and, in some cases, the proximal and distal third of the leg of 26 cadavers in the age of 0 to 19 years. The sections, stained with hemalaun-eosin and orcein, were measured via ocular micrometer/object micrometer system mounted on microscope Zeiss. Data was analyzed by means of descriptive statistics, ANOVA, correlation and graphical analysis [4, 16, 22].

Results and Discussion

Our findings are demonstrated in Figs. 1—5.

The first chart (Fig. 1) shows the age dependent variance of the mean intimal thickness for the three investigated vessel groups. The data forms rare elongated clouds, which are only loosely grouped around the linear trend lines. The trend lines for arteries and deep veins show moderate to considerable tendency of the mean intimal thickness to increase with age. The intima of the superficial veins, however, shows clear tendency to rise with age — its trend line is steeper and the data is more closely packed around it. The trend lines for the arteries and deep veins are almost parallel, which means that the speeds of increment of the intimal thickness are almost equal in both vessel groups. The steeper trend line of the superficial veins data stands for higher speed of age dependent intimal thickening.

The data in the second chart (Fig. 2) is tightly grouped around the linear trend lines, which are more steep then the ones in chart 1. This distribution characterizes stronger tendency of the mean media thickness of the three vessel groups to increase with age. The media of the three vessel groups increases with similar speeds as can be seen from the trend lines (almost parallel).

In fig. 3, displaying the age dependent variance in the intima/media index, the data seems ungrouped especially in the age between 0 and 13 years. In the rightmost parts of the chart (18-19 years) a slight tendency for grouping around the trendlines for arteries and deep veins is denoted. This is not enough for conclusion, however it is perhaps a sign of a developing trend, which will become visible in the adult age. The intima/media index of the superficial veins shows clearer tendency for age dependent increment.

The correlation coefficients (Table 1) illustrate moderate to considerable correlation between age and intima (r_{intima}) and strong to very strong correlation between age and media (r_{media}) for the arteries and the deep veins. The superficial veins show opposite relationship — very strong age correlation of the intima and moderate to considerable correlation of the media. The intima/media index correlates only weakly with age (r_{index}).

Figures 4 and 5 illustrate the individual variance of the minimal and maximal

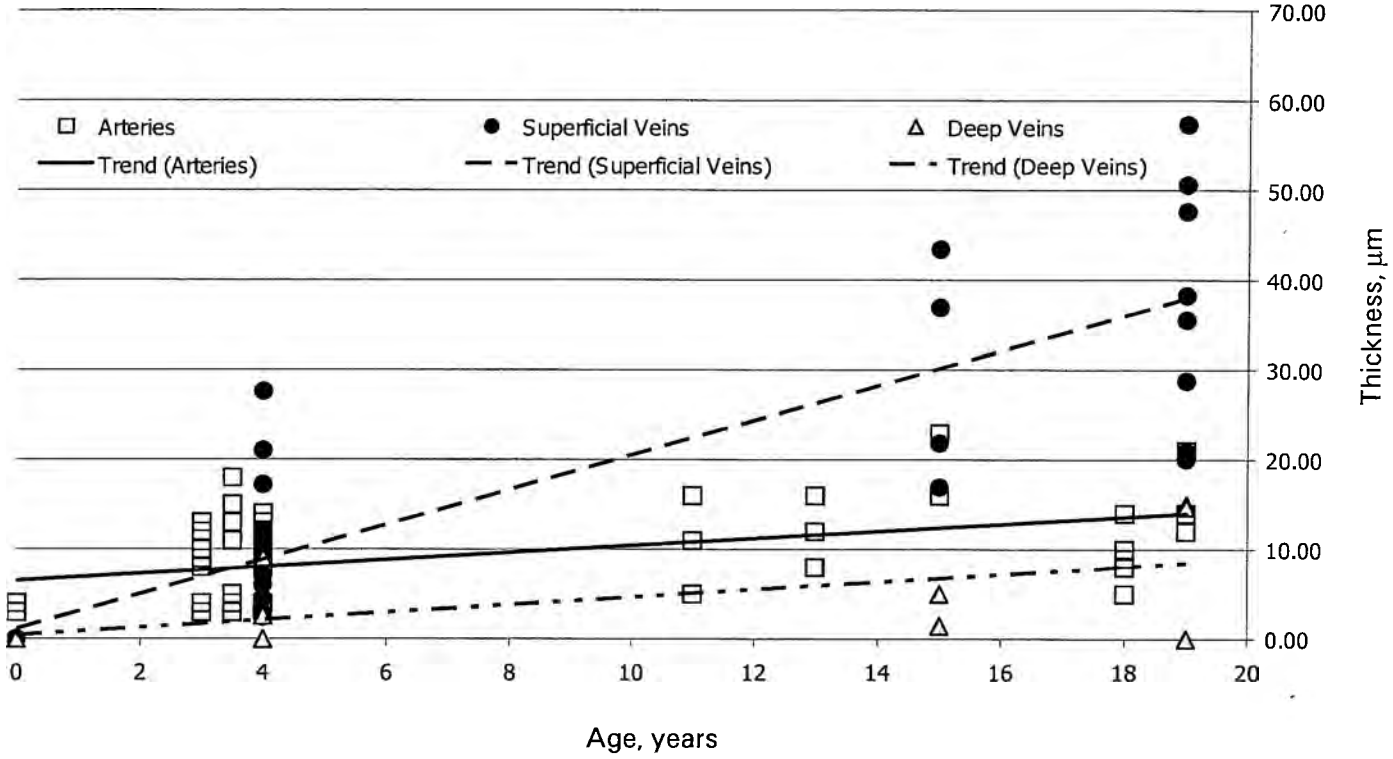

Fig. 1. Age dependent distribution of the intimal thickness. Explanations in text

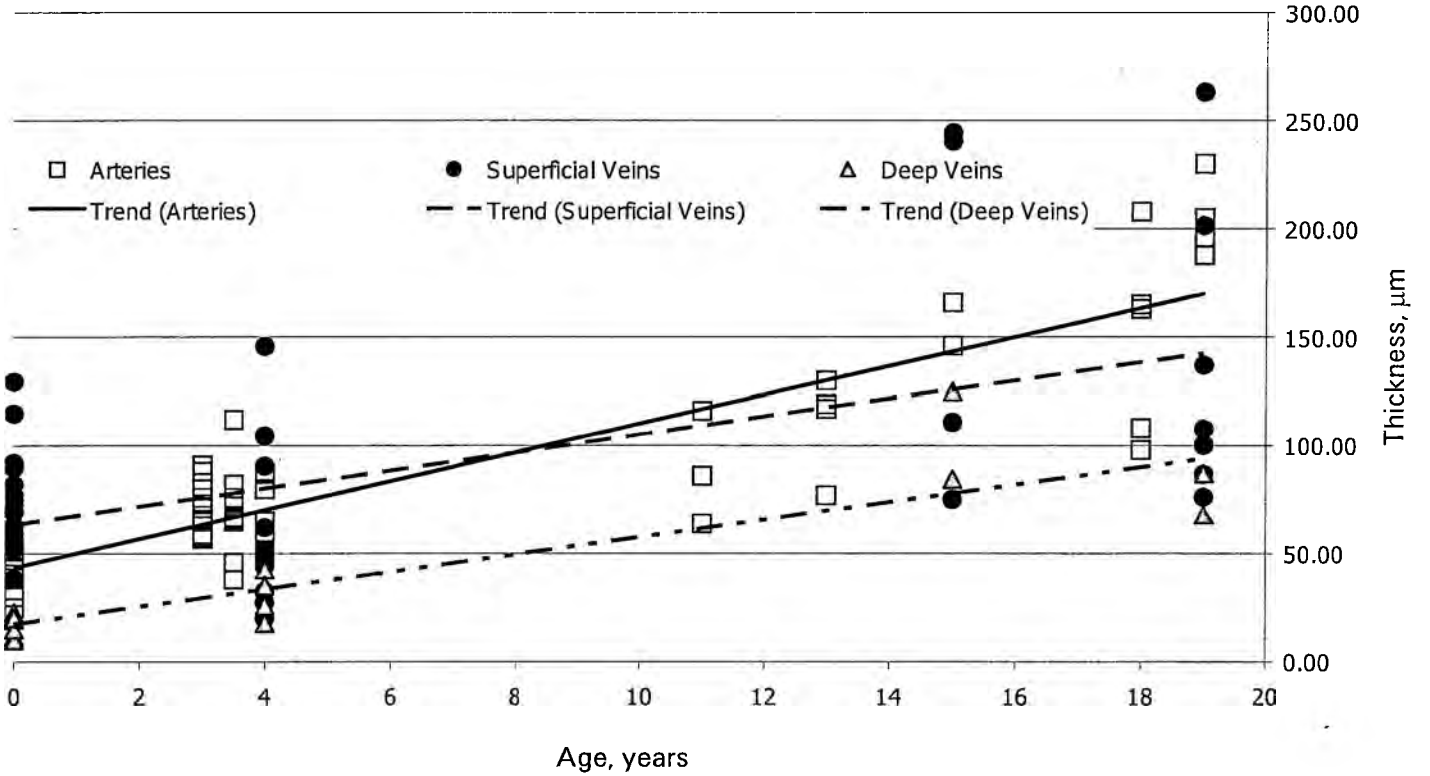

Fig. 2. Age dependent distribution of the media thickness. Explanations in text

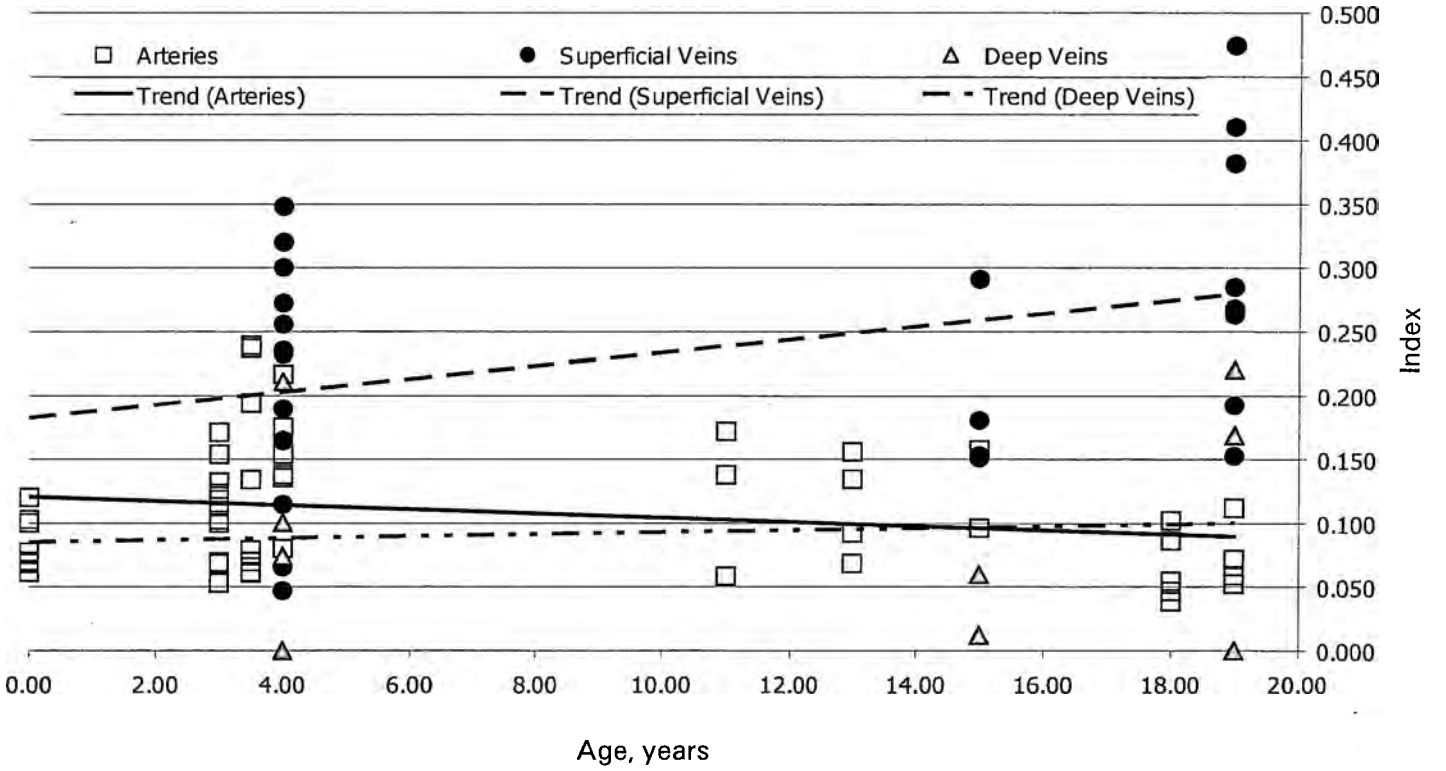

Fig. 3. Age dependent distribution of the intima/media index. Explanations in text

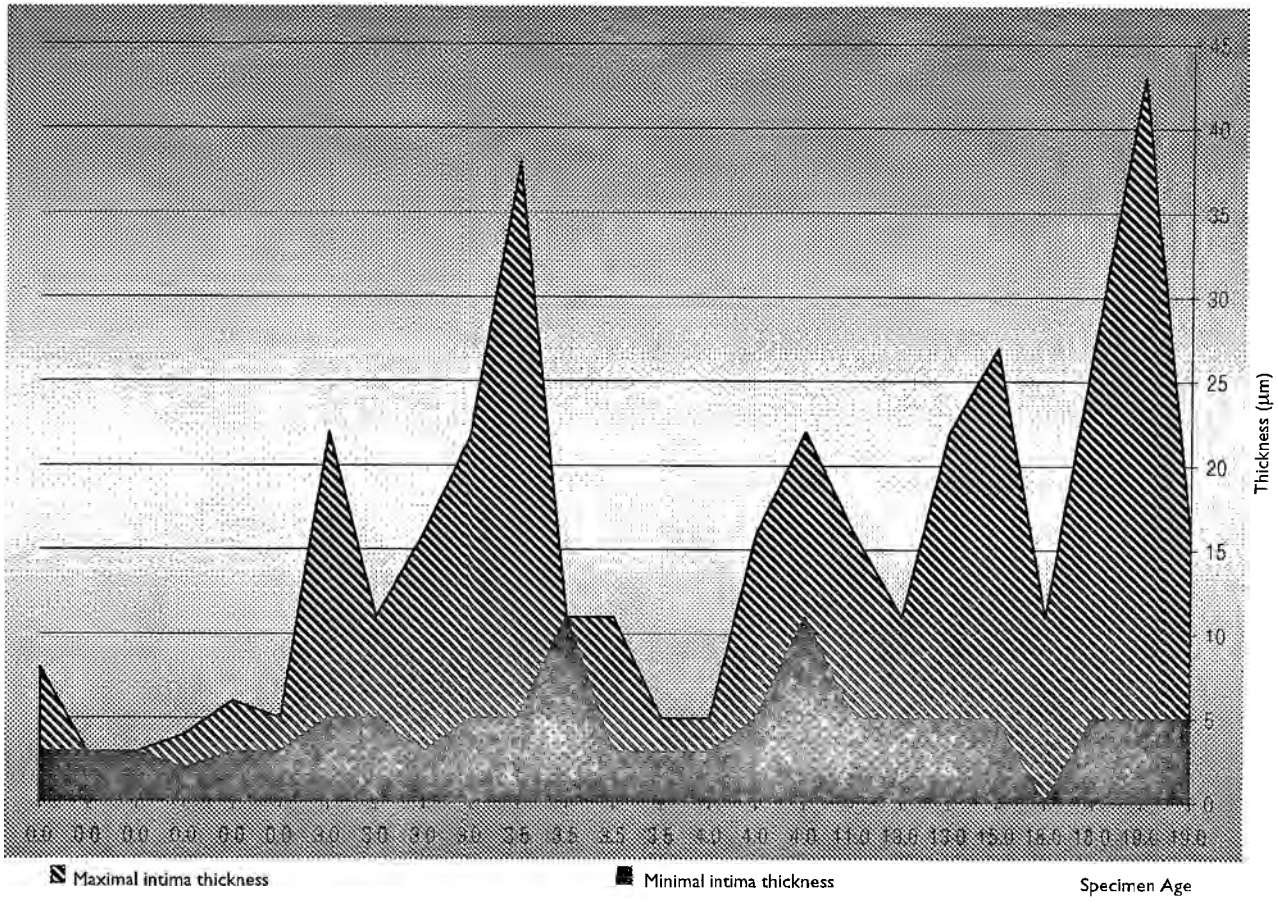

Fig. 4. Individual variance of the maximal and minimal intimal thickness. Explanations in text

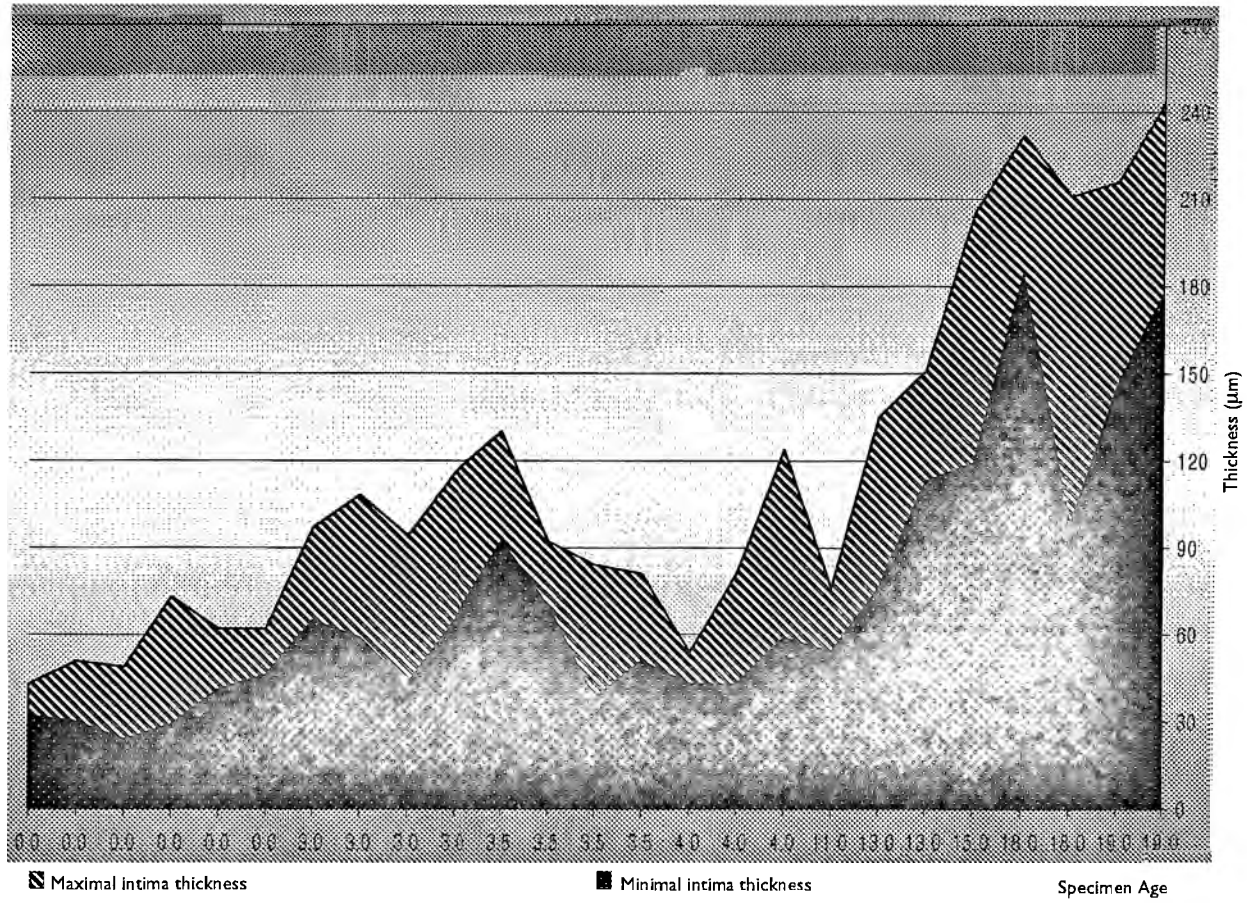

Fig. 5. Individual variance of the maximal and minimal media thickness. Explanations in text

Table 1. Correlation of intima, media and intima/media index with age

	r_{intima}	r_{media}	r_{index}
Arteries	0.51	0.88	- 0.22
Deep Veins	0.64	0.90	0.06
Superficial Veins	0.88	0.56	0.35

thickness of intima and media in arteries. As the minimal and maximal values were measured on different regions of the same transverse section, their variance characterizes the irregularity of the corresponding part of the vessel wall. Similar graphical analysis reveals almost the same relationships of the individual variance of the maximum and minimum values of the intima and media of deep and superficial veins.The minimal intima thickness remains thin throughout the entire age period. With increasing age in some regions of the intima appear sites of about 5 to 9 times thicker than the minimal intima. This is illustrated by the difference between the dotted and striped area and especially by the striped peeks in Fig. 5. The difference becomes greater with increasing age. Evenmore when comparing the variance of the maximal and minimal intimal thickness with the variance of the mean intimal thickness, it becomes clear that the age dependent increment in the mean thickness is a result of the increment in the maximal values.While these values are sign of irregularity of the intima along the arterial circumference, one draws the conclusion that these irregular places increase with age not only in thickness but also transversly, alias the irregularities spread over increasing portion of the vessel circumference.

Unlike the intima, the variances in the minimal and maximal medial thickness are almost parallel to each other, which creates the impression of regular, determined increase of the media thickness. The difference between maximal and minimal values is relatively small. Thus the conclusion can be drawn that the media thickness changes little and gradually along the vessel wall circumference. Similar graphical analysis reveals almost the same relationships of the individual variance of the maximum and minimum values of the intima and media of deep and superficial veins.

Whether this conclusions are true and what is the exact morphology of these irregularities in the arterial wall, remains to be established through a qualitative histological examination of the described material.

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