

Predicting growth of children's feet

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The problem of harm to growing children's feet is a serious issue to which sufficient attention has not yet been devoted. A child's foot differs proportionally from that of an adult primarily in the fact that it is wider. Furthermore, the bones are not fully ossified and its cushioning function is different. The main distinction, however, rests in the fact that it is growing. In other words, children's footwear may be worn only for a limited length of time and, if worn longer, may become a cause for

deformation to occur.

If recommendations exist for establishing the safe length of wear of newly purchased children's footwear, they originate from a time when domestically produced footwear predominated in retail shops and local manufacturers tended to work from anthropometric measurements of feet in the child population. It has often been argued that precisely because local manufacturers used these anthropometric measurements in order to produce designs that satisfied the ethnic

characteristics of the local population, this was somewhat of a guarantee for healthy footwear.

Formerly closed markets limited the import of children's shoes and thus the shape and quality of children's footwear could be controlled at the national level. In the last decade of the last century, within a very short period of time, a shift occurred in production from industrially advanced countries to those of the Far East. Relatively effective national activities concentrating on education during the purchase of children's



footwear immediately began to lose effect.

Attempts at unifying opinions and proposals for a common approach within the EU have failed in practice with the result that the selection of shape, dimensional proportionality and use of material for children's footwear has been left to the will of manufacturers. Globalisation in footwear production has led to a deterioration of the conditions necessary for healthy children's footwear.

Another complication is the violation of rules for traditional systems of labelling shoe sizes where the orientation numbering of footwear manufactured in other size systems has created chaos in the labeling of shoe sizes. In practice, this has made it all but impossible for parents to select and purchase footwear dimensionally and proportionally suitable for their children.

Studies conducted in Germany and

Austria show that currently, the number of children wearing dimensionally inappropriate footwear is as much as some 40% to 60%. Other studies have shown that, while educational events have succeeded in reducing the occurrence of dimensionally inappropriate footwear, it is always for the short-term only.

LAWS OF CHILD FOOT GROWTH

Unlike an adult foot, a child's foot is growing. According to various studies, the average values for the lengthening of a child's foot over the period of one year fluctuate around 12mm. In fact, the annual individual growth in a child's foot length is varied and depends on a number of factors. In one of our studies, we monitored how much a child's foot length grows over a period of one year. Some 300 children aged between 3 and 16 split equally between boys and girls

were measured (*Figure 1*).

Two conclusions can be drawn from these results; annual growth decreases with age and annual growth oscillates around 10-12 mm (spurts around 20mm are negligible). While these facts are naturally known, the reaction of experts is surprising as shown by their recommendations in regard to the control periods for checking foot length and shoe size for children's feet (*Figure 2*).

ANALYSING CHILD FOOT GROWTH

From a series of performed anthropometric studies, various tables and graphs have been constructed. One problem lies in the fact that these results were completed on the basis of extensive measurements. In professional publications, longitudinal studies could not be obtained that focused on the base dimensions of the foot. On the other hand, there is however a series of



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detailed studies focused on the growth of a child's body. Particularly interesting from this standpoint is the so-called Carlberg model. This renowned Scandinavian anthropologist distinguished three characteristic and mutually distinct courses of growth in children.

1. Prenatal course of growth, which is insignificant for footwear producers.
2. Standard (normal) course of growth which is very important and has hitherto been considered during the construction of footwear lasts.
3. Pre-pubescent growth spurts that have not yet been resolved.

One of the highest correlation coefficients for the dimensions of the human body applies to foot length values and body height. It is used, for example, in criminal investigations. We therefore applied the Carlberg model originally developed for the course of body height growth to the growth of children's feet. From this, it is more or less possible to draw the conclusion that growth in a child's foot is primarily influenced by the genetic disposition acquired from its parents, the composition and quality of nutrition and the degree of movement. The main major complication is additional foot growth that is difficult to forecast.

From extensive studies, we have succeeded in establishing how long a child's foot will become once it is fully grown from the foot length of its genetic parents. On the basis of the knowledge of the actual size of a child's foot and the anticipated final foot size after the completion of growth, it is possible to establish with relative precision, the speed of growth over the next few years. If the precise foot length and functional length of newly purchased shoes are known, we can determine how long the shoes may be worn without the risk of foot deformation.

MEASUREMENT

Actual foot length can be acquired in several ways. Today, for publication in professional journals, a contact-free scanner is required as this significantly reduces the deviations caused during manual measurement. Manual devices were once constructed in such a way that it was possible to acquire data about foot length in the French, English and metric systems. But, at the same

Figure 1: Differences between measured foot lengths December 2009 and December 2010.

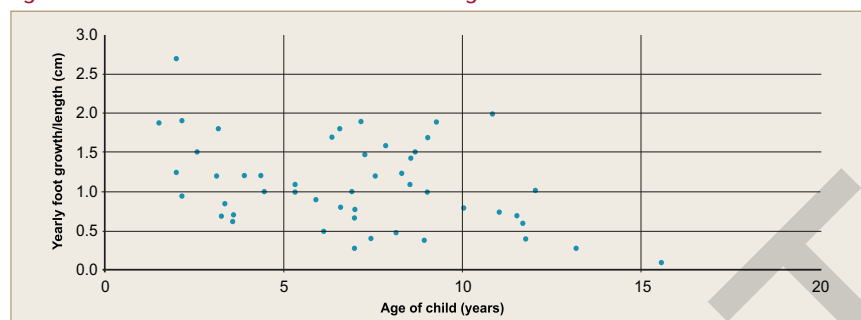


Figure 2: Recommended periods for control for new children's shoes.

Age		Recommended period	
Years	Months	Cheskin et al	Rossi, Tennant
	12 to 17	Every 2 months	
	17 to 29	Every 3 months	
2 to 6			Every 1 to 2 months
	30 to 47	Every 4 months	
6 to 10			Every 2 to 3 months
10 to 12			Every 3 to 4 months
12 to 15			Every 4 to 5 months
15 to 20			Every 6 months
20 plus			Each purchase of footwear

time, this is the main limiting factor because transfer between individual systems is not uniform. To increase the probability of acquiring objective data, it is necessary to start from the outline (not from a print) and to measure in millimetres.

The functional length of footwear is understood as the distance acquired after deducting the values of toe allowance from the length of tensile insole in worn footwear. This is the length needed so as not to restrict the function of the shoe in wear and to avoid foot deformation. Compared to foot length, this measurement is more complicated and requires more experience.

Toe allowance is usually comprised of two parts, the space that will be filled gradually by the growing foot and which should not be less than 6mm and the aesthetic space (also fluctuating around 6mm) that allows a pleasing toe shape. There must also be sufficient vertical height and the toe must not extend into it. The lowest overall recommendation for toe allowance in children's footwear should therefore be 12mm.

FOOT LENGTH VS. FUNCTIONAL LENGTH

In textbooks and manuals, a theoretical time period is recommended for parents to review the length of worn footwear with that of the growing feet at given intervals. But, even then, there are differences. A major deficiency lies in the fact that, today, there is no easy

gauge of a child's foot as far too few shoe shops are equipped with quality devices for measuring feet. Furthermore, consumers (in this case the parents of children) are unable to acquire sufficiently precise information about the functional length of worn footwear. Another factor which routinely prevents the use of these values is that all theoretical recommendations originate from an assumption that for newly purchased footwear, a child's toes do not extend into the toe allowance.

Options for prediction are based on acquiring precise data about a child's foot length, the functional length of the footwear's insoles and values for toe allowance. From these data, it is then possible to establish the length at which it is possible for a child's foot to grow without causing harm to the foot. Current facilities in retail shops for children's footwear using cashiers with computers and operational memory would make it possible to introduce a simple system providing important information that could contribute to reducing the occurrence of deformities in children's feet. 📌

Petr Hlavacek regretfully passed away in January (Obituary on page 4). World Footwear has nevertheless decided to publish Petr's article as a mark of respect and a tribute to his major technical contributions to the footwear industry over the years.