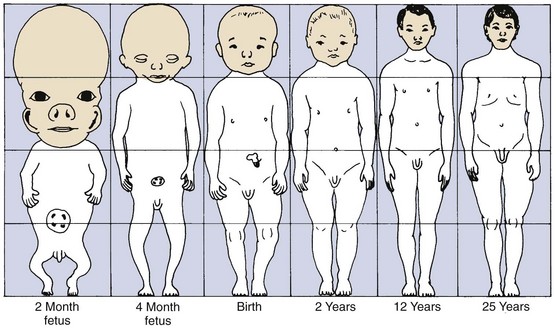
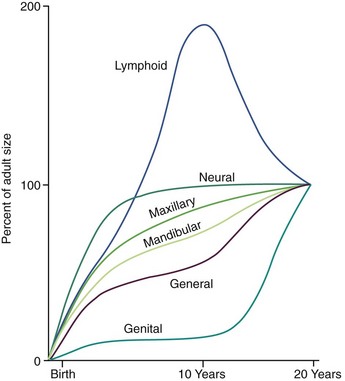
Sheet orthodontics Num. 2  
Done by: Louai Haddad and Noor Khadeeri  
Corrected by: Louai Haddad and Noor Khadeeri  
  
First of all you have to be able to know the normal growth and development to be able to diagnose problems and to know what the etiology is and to build a treatment plan.

The difference between growth and development:  
When we say **growth** it means increase in size, so it's an anatomic phenomenon. It could be an increase in the number of cells or size of the cells or the extra cellular fluid.  
**Development** on the other hand is a physiological behavior; it's an increase in complexity and specialization not in size.  
  
The zygotic phase which occurs after fertilization (from day 0-14 "the first two weeks intrauterine"), where in this phase there are a small mass of cells which have an accelerated increase in size "growth".  
The phase which is from week 2-8 intrauterine is called the (she said intra-embryonic phase I think because I didn’t hear it, but I think it’s the embryonic phase that’s what Google says) where a very critical differentiation happens, then from 8 weeks till birth there will be an increase in growth and organ formation. So the fetus starts with a small mass of cells that will differentiate into three layers on the third week, we call this **gastrulation**. These three layers are the trilaminar disc "The ectoderm, mesoderm and the endoderm".   
  
After that what happens is a very important stage in the craniofacial development, where the ectomesynchymal cells found in the middle of the ectoderm layer will start to differentiate and grow inward forming the neural groove which will eventually form a neural tube, around this tube we will have a differentiated mesynchymal cells called neural crest cells that will start to increase in number and migrate laterally (they will travel to other places), as they travel to other places they start forming the pharyngeal arches which are derivatives to most of the craniofacial structures.   
Then she showed a table about derivatives of the germ layers "page 6 in the slides".   
Slide 8: pharyngeal apparatus where we can see the pouch and the decrease in size of the arches as we go caudally, every arch has its own nerve, cartilage and artery. Each one is responsible for certain derivatives of certain areas in the body. The ones that concerns us is the branchial arch number 1 and 2 which are explained in the book page 36 chapter 4.  
  
Postnatal growth: we call the baby from day zero till the first year an infant and then the phase form 1-6 we call it the early phase of childhood, 6-10 middle phase of childhood, 10-15 is the late phase of childhood "10-15 roughly, due to the variability in the puberty stage", the adolescence phase for males roughly is from 14-20 and for females from 13-20.  
  
You need to understand the pattern of growth and the variability of growth between individuals and for the same individual over time.  
-We are going to start with the pattern of growth: Which is the spatial orientation of different parts of the body at a certain time, so the physical arrangement or orientation of body parts at any time we call it a pattern (the way things are oriented and related to each other).  
The doctor was referring to a graph/picture and said:  
The overall proportions of the body changes over time, before birth "2 months intrauterine" the area of the head accounts for 50% of the total body length (the area of the cranium will be more than half of the total head length) and then these proportions will change, the total length of the head will be about 30 % of the total body length and the cranium is less than half of the head length so it's actually reducing relative to the facial proportion, on the other hand the length will occupy about 1/3 of total body length.  
During adulthood the head will account for only 12% of the total body length.  
  
In children you can see the area of the cranium is dominant relative to the area of the face, this will gradually change over time and we will have about 50% or more of the face proportion occupying the head.   
  
The growth of extremities is less and with time it increases with time. This axis of increase in growth as we from the cranium all the way caudally is called the **cephalocaudal gradient of growth**.   
So as we go from the head to the foot, growth increases. The areas at the top will finish first in terms of growth and areas more caudally (downward) will finish later. This gradient is a part of the normal pattern of growth.  
If we apply the same principle "the same gradient" only to the head, then the cranium will finish first and then the maxilla and the last thing to finish is the mandible, so the mandible will continue growing for a longer time than the cranial part and the maxilla. This is a very important note to keep in mind.  
  
**Scammon's curve**: is a curve that looks at different patterns of growth for a different type of tissues (lymphoid, neural, genital, somatic "general")   
The X-axis of this curve is the time (at birth, 10 years of age, and 20 years of age) and the Y-axis is the percentage of adult size.  
  
  
Neural tissues: Soon after birth we will have a peak of acceleration of growth, and then this acceleration will reach a plateau at about the age of 6-7 years. So by this time the size of the neural tissues is the same as that in the adult. The 100% of size of the neural tissues is reached at the age of 6-7 years.  
General tissues: This represents the muscles, bones, etc. Those tissues has actually two acceleration peaks "S-shaped curve", one peak occurs soon after birth and then you have a steady growth, then the other peak occurs at the pubertal age at about 11-12 years of age, where at the end they reach the 100% of the size of the adult's tissues.  
Genital tissues: Their growth actually starts very slow, then at the pubertal age we have a huge acceleration then it stops. So we have one peak of growth acceleration.  
Lymphoid tissues: They have a steady increase in growth and size all the way to 10 years of age where it reaches twice as the size of the adults lymphoid tissues and then eventually will shrink back to the size of tissues of the adults.   
The maxilla will be between the general and neural tissues but is closer to the neural tissues, and the mandible is also in between the general and neural but closer to the general tissues.  
  
The adolescent growth spurt is a very important stage in general where physiological changes will occur at that time. Spurt means a sudden acceleration of growth of many parts of the body. Why is this important in dentistry?   
Because during this stage (as this acceleration occurs), changes occur from the mixed dentition to the permanent dentition which is a very important stage in occlusal development, also its important because here in this spurt we will have a facial growth where the growth of the mandible and maxilla is accelerated too where the mandible will grow faster here. Knowing when this spurt starts can help you in occlusal treatment and in cases where occlusal mal-development occurs.   
When does that happen? When does this spurt start? Actually there is a biological variation, but we know for girls it's about "10-12" years and for boys its two years later "12-14", but does every patient follow this average? No, because we know that any curve that represent a population has a mean (where around it are the rest of the scatter of the population) and a standard deviation, where the mean +/-1 standard deviation represents about 68.5% of the population and 2 standard deviation represents about 97% of the population, so not everyone is following the mean, actually everyone is around the mean.   
The further we go from the mean, more abnormalities can occur. So there will be a problem if someone is above 2 standard deviation from the mean, so as far as people are within the area of the mean then that’s normal.  
  
Standard growth chart: This represents the age, height and weight. Every time the patient comes to the clinic you measure his weight and height and you put a mark. The dark line "the one in the middle" represents the mean, and one line above and one line below represents the standard deviation and then two standard deviation and then three.    
So if the patient comes at 7 years of age, you can notice that he is ahead of the other children where he is heavier and taller than the others but this is not alarming and there is no problem.  
  
At 8 years of age, the patient comes and again you measure his weight and height, although the measurements are above the mean, he's still following the same pattern (one standard deviation above the normal).

They usually have large number of children, they measure their weights and heights over time and then they have norms for those children in terms of weight and height and they collect the results so that they'll compare any patient that comes to the normal, you do your analysis, you have your own measurements then you compare them to the norms.

So, the line in the middle represents the mean, the above lines represent 1 standard deviation, 2 standard deviation and 3 standard deviation, also the lower lines represent 1 standard deviation, 2 standard deviation, 3 standard deviation. So that should include most of your population, as we said, we can't know what's wrong with the patient from only one visit, we have to follow him up, but at least from the first visit I can know that this child is ahead of his peers. The next visit he's still following one standard deviation above and the visit after also, that means he's heavier and taller than the other children but normal..

NOTE: the red line is the patient's growth pattern and the black one is the normal (AVERAGE).

Another example:

The doctor showed us a graph and said that the patient's first visit when he was 7.5 years old, the weight is a little bit below, the height is normal, the next visit, weight is still a little bit lower (a standard deviation), the height is perfect, then the next visit then the next visit, what's happening is that there's a deterioration of growth and development, there's a problem happening here; he's not following the same growth, it's not because he's above or below but because he started with a certain pattern and then the pattern changed, this is a standard growth chart, you compare your patients with other children( norms ) and with HIMSELF.

There's this another graph that the doctor showed, we have the age of the patient (at birth, 2 years, 4 years..), the black line represents the height (the total height) so when the patient comes you measure the height, what's happening over time is that the patient is getting taller, the red line represents the change in height, so if he comes and has gained 2cm relative to the last visit, I record them, so as you can see after birth we have an accelerated growth gaining cms is fast, but then we have a steady growth, and then at the pubertal stage there's what we call the peak height velocity (accelerated growth) and this coincides with adolescence growth spurt, so which one is more informative; the red line or the black line?

THE RED LINE, everyone will have the same black line +- but everyone has a unique red line because everyone has a special adolescence growth spurt, ..we call the black line : the speed curve and the red line we call it the velocity curve and this is called the peak-height velocity.

The doctor showed another curve and said, this is the age, this is the height (total height) so this is the speed curve and this is (pointing at the line) the change in height (the velocity curve) and she showed us the weight (total weight) and the gain in weight. (Note: the black line represents boys and the dashed line represents girls). These two speed curves are telling you that over time, children are getting taller and heavier, everyone is getting taller and heavier, it's not that informative, BUT, the second line is telling you how much CHANGE in height and in weight over time, here for example (she points at the graph) we see a peak soon after birth (accelerate growth) and then a steady growth and then suddenly we have another peak of growth, this the pubertal (adolescence growth spurt). Girl's growth spurt is earlier than boys (2 years on AVG).

Which is more informative ?the velocity curve.

What do we call this peak ?peak-height velocity.

Which is more important, the biological age or the chronological age?

The biological age, because each individual has a different age on terms of biological age but everyone has the same counting of years over time.

Again, chronological age is only counting of years, and not everyone is following the average years in terms of adolescence growth spurt, but the biological age will tell you more, for example, the dental age, we can have an OPG and tell how old the patient is dentally,for example by looking at the root tips of the erupted teeth, and it doesn't have to coincide with the patient's chronological age, for example the patient can be 10 years old DENTALLY, but 12 CHRONOLOGICALLY, sexual age is the sexual maturity, the skeletal age; not long ago they used to have a hand-

wrist radiograph for every patient with the small bones there, and they had an atlas (a standard atlas) that had different stages of development for those small bones and then they'll compare the patient with the atlas n terms of size and shape of bones and then you can tell roughly the skeletal age of the patient and this is important but we don't do it anymore (not justified) because its extra radiation the patient is exposed to.

Morphologic age; the peak-height velocity is important so if you use any of the standard charts you can actually reach to acquaint where is the peak-height velocity. So there is variability between individuals.

As we said, growth is an increase in size and number, the increase in number we call it hyperplasia and it is the most prominent procedure that happens in terms of growth, while hypertrophy is the increase in size and it's not that prominent (doesn't happen regularly).A third way of increase in size is extracellular secretions and fluids, this is important because we know that hard tissues they don't increase in size by increasing cells what they do is that they secrete extracellular fluids and then they become calcified and then another layer and so on (layer by layer), this is an important way of growing for the skeletal tissues (bone,calcified issues)

The difference between soft tissues and hard tissues is that soft tissues can grow at any point, at the same time, nothing can stop them, they just push the other components away, on the other hand the hard tissues can't, the only way to grow a bone is to have a direct appositionof bone on that piece (reshape, resorption, apposition) what we call bone remodeling. We can't have an interstitial growth, this is only for soft tissues, and as long as the extracellular fluids has been secreted by the osteoblast yet not calcified, this can happen, they can increase in size but as soon as they're calcified and rigid then that's it, you can't have interstitial growth, it's impossible, it's only a direct apposition of bone now.

More concepts to understand is bone formation, bone formation could happen by endochondral ossification or intramembranous ossification.

Endochondral ossification is the change of cartilage tissues into bone, first of all we have cartilage then this cartilage becomes infiltrated by blood and vascular elements, and then we have plenty of cells necessary to grow bone (most importantly osteoblasts) and then this osteoblasts will start secreting extracellular fluids that'll calcify. Then we'll have within the cartilage islands of bone, and eventually those islands of bone will become larger and the cartilage will continue getting smaller until it disappears and then we'll have a piece of bone, this is called ENDOCHONDRAL OSSIFICATION. For eg: the brain as we know is covered by the calvarium and it rests on the cranial base, the cranial base is formed by endochondral ossification, the floor below the brain used to be cartilage and then it eventually changed into bone so this happens to the cranial base, another example is the cartilage and bone of epiphyseal plates.

The other way of bone formation doesn't need cartilage we just have soft tissues (connective tissues)and then we have growth cells infiltrating these tissues and eventually we have plenty of cells necessary to build bone (osteoblasts,etc) and then we'll have secretion of extracellular fluids, calcification,…WE DON'T NEED CARTILAGE. For eg: the calvarium, the area that cover the brain and the maxilla and the mandible. It's called INTRAMEMBRANOUS OSSIFICATION.

-If the growth only happens in a certain location but we need distant areas to control this growth we call this SITE OF GROWTH.

-If the growth happens and is controlled in the same area (the genes and other controlling factors) , growth is happening independently, we call this CENTER OF GROWTH.

How do scientists know? They isolate the growing part and put in the lab if it continues to grow then it's center of growth, if not then it's site of growth. So this is how they understand what's happening and what controls what. And accordingly they classified the cartilage into two types ; the primary cartilage where growth center happens, if we take the primary cartilage , isolate it from the body and put it in the lab it will continue to grow. Secondary cartilage, like the head of the condyle for example, if you isolate it and put it in the lab, it will not grow, because it's a site of growth.

When we say bone remodeling it’s a continuous process of bone resorption and apposition. Why? Because once the bone is formed it's not a permanent process, for eg: a square piece of bone will not stay a square it will reshape and remodel according to the function and needs, it's a selective and continuous process of bone resorption and apposition like reshaping, a nice example is the brain : after birth, the brain will grow in size until 6-7 years of age, if the calvarium that's covering the brain is fixed in size and form then basically, the brain will grow and have no space but because the calvarium has a continuous process of remodeling then it'll accommodate the new size and shape of the brain.

-primary translation or displacement is when the growing part it is actively growing and it's the reason that it's moving because it is the one that is growing. It's changing position because there's growth happening.

-but for example if there is two pieces of bone one hanging with the other, one is actively moving and changing and the other is just hanging there, but because the first one is moving so the other is actually moving with it, this is called secondary translation so it is a reactive or a passive change in position as a result of change in the position in the surrounding tissues so sometimes there's a change because there is an ACTIVE MOVEMENT (PRIMARY TRANSLATION). And sometimes because of a REACTIVE/PASSIVE MOVEMENT (SECONDARY TRANSLATION).

For example the maxilla is sutured with the rest of the cranial bone, if the cranial bone is moving (growing) what happens to the maxillaa? It's carried with it (PASSIVELY). So we call this secondary translation!

The bone that is covering the brain like the calvarium and the cranial base we call it; **neurocranium**.

But the rest of the facial skeletal is called the **viscerocranium**.