

Brain Injury during Childhood

Infancy – Birth to 12 Months

Normal infancy development

An infant's brain is not a smaller version of an adult's brain. Although the brain has many functions at birth, the main focus is survival, that is, to regulate blood pressure, breathing and body temperature. Transformation of the brain takes place rapidly as the baby moves from reflexive or involuntary actions such as sucking or grasping, to being able to demonstrate purposeful activities such as tracking, controlled movement, memory and language. After a child is born, you can see the intense emotion in their face as they try to make sense of the world around them. Babies need to be fed, comforted and rested as they do the *work* of growing and developing. Making an infant feel loved and cared for is the best thing a parent can do to get their child off to a good start.

During the first weeks of life, babies expect to be fed in regular intervals and cry when this does not happen. They become interested in the faces of their caregivers—particularly around the eyes. By week five or six they discover their own hands and gaze at their fingers as they move them in front of their eyes. As an infant's vision matures, they begin to show a preference for faces. About this time, they also begin to smile. Babies tend to *smile* with their whole body and typically a caregiver finds this irresistible.

Many babies begin to roll over by five months of age. They take pleasure in this activity and some babies even use this as a means of going from one place to another. They can grasp a toy and drop it to pick up another. Things really start coming together at the mid-year point when a baby reaches one of the benchmarks of motor development—sitting up. The world looks different as a baby can sit for about a half-hour and uses both hands to turn, manipulate and examine a toy. Strings of sounds are vocalized and babies express pleasure with these sounds and laughter. At this time, children recognize their own name and will turn when called—a behavior that may be eliminated by the time that they are teenagers!

First words are a wonderful milestone of child development as children learn to say words such as *dada*, *mama* or *hi*. Babbling occurs and babies appear to enjoy their own sound production as well as that of others. Facial expressions are varied and babies express humor and joy. They laugh at older brothers and sisters



and bob their heads to music as they cling to a table *dancing*.

By the seventh month, a baby knows that an object exists even if it is hidden. This is the important concept of object permanence. Babies will actively search for toys if you remove them from a room or cover them with a cloth. The baby shows that there is an attachment to a caregiver and may cry when mom or dad leaves the room.

Almost nothing is safe from eight-month-olds as they are determined to move, crawl, reach, pull up, grab and lunge. They eagerly explore the world of small objects—a prerequisite for higher forms of thought. They respond to noises, lights and other stimuli and are quick to act as mini-detectives investigating the scene. Babies can imitate an action such as putting on a hat, even though they have not been directly shown how to do this behavior. The first signs of problem solving begin as a child learns how to use a pull toy and understands one-step commands such as *up*. The child may attempt his or her first steps at this time, too. As a child approaches the year mark, the growth and development that have occurred over this first year are remarkable. The baby has memory for objects and will look for toys or recognize cues in the environment. One-year-olds know that when the family gets their coats on, someone is going outside. If they hear the sound “ruff” they can point to a picture of a dog. Responses to several word commands and questions are evident. Babies will nod when asked if they want a drink or give a kiss when asked to do so. They will happily point out the different parts of their bodies and

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imitate behaviors that they see the *big people* at home doing. The three basic interests of one year olds are curiosity, motor-skill challenges and their primary caregiver.

Infants with traumatic brain injuries

When children receive a traumatic brain injury during the first year of life, it is usually due to a fall, car accident, some form of abuse or a near drowning episode. Impairment in function may occur in one or more of the following areas:

- Arousal – ability to awaken or show action
- Information processing – the ability to understand the meaning of written, verbal or visual communication
- Orientation – knowing your place in time (day, hour, month and year) and space
- Speech and language
- Difficulties paying attention
- Short and long-term memory
- Reasoning – logic and planning
- Emotional growth – child may be stuck emotionally at the age of injury
- Motor abilities
- Social behavior – lack of certainty about how to behave in society
- Sensory abilities – difficulty with one or more of the senses (touch, taste, smell, hearing and seeing)
- Problems with mood – increased sadness or irritability

Because a child who is injured early on is in a rapid spurt of growth and development, an injury may affect the growth that has already occurred and any future development. Unlike older adolescents or adults who are injured, babies don't have the luxury of years of practice or learned skills to fall back on. The process of rehabilitation is difficult and ongoing. The brain injury will be with them for the rest of their lives.

1 – 3 Years of Age

Normal toddler development

A great deal of growth and development takes place in the toddler years. Although children grow at their own pace, during the toddler stage most children learn to walk, talk, solve toddler-sized problems and relate to others. A major task of this phase is learning to be independent. This is why toddlers want to do things for themselves, have their own ideas about how things should happen and say NO! many times throughout the day.

Shaken Baby Syndrome

Shaken Baby Syndrome (SBS), a form of child abuse, results when a small child is violently shaken. In the United States, an estimated 1,200 - 1,400 children are treated for SBS every year and about 30% of these victims die as a result of their traumatic brain injury. The ones who survive will have lifelong complications.

Because infants and small children rarely have any external evidence of trauma when suffering from SBS, it is possible that there are many more survivors than statistics show.

Pediatric brain injuries are unique in that the injury affects a system that is not fully developed. Long-term effects may not be apparent until much later when the child attempts to use damaged tissue to learn new skills. Because no two brain injuries are alike, it is important that family and educators understand a child with shaken baby syndrome may need Early Childhood Intervention (ECI) services.

Reference: Excerpt of article by Bonnie Armstrong – National Center on Shaken Baby Syndrome www.dontshake.com



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After their first birthday, children become focused on comprehension, moving, pretending and expressing themselves. They understand simple sentences such as “time for sleep” or “get your blankie.” As speech develops, they can name people and things, imitate animal sounds and point to objects that they want. One year olds begin to use the pronouns *me* and *mine* and put two words together to make a basic sentence. They try to hold a pencil and imitate drawing or coloring with a scribbling motion. Toddlers may eat less, but tend to eat frequently throughout the day. They get better at feeding themselves, but spills are common. Most children walk without support by fourteen months and are able to stack blocks at this age, too. By the end of the first year, skills in physical development and intellectual development combine as toddlers solve problems. No counter is too high, bookcase too tall or chair too heavy for an independent toddler.

Anyone who has watched a toddler knows that when it’s too quiet, the child is typically doing something they shouldn’t. Toddlers may ask for their parents and become possessive of them. They may also readily show affection and have favorite responses to words, songs or snuggles associated with a particular parent. Underneath this loving response and ability to show affection lies the dreaded temper tantrum. Somewhere between the age of one and two, tantrums appear as a response to not getting their way. Routines are very important to toddlers as they begin to learn and accept simple rules.

From 12 to 24 months, children practice important skills for future growth. A child’s memory allows them to remember past events and think about things that are not in their view. They can carry on conversations and answer questions. As the two year olds move into their third year, they are ready for action! Three year olds impress everyone around them with all that they know. At this age, children begin to add words to their sentences, including action words and descriptors such as big, fast or hot. They can respond to what, where and why questions. *No!* transforms into won’t, don’t or can’t.

Children of three can memorize rhymes and repeat them or open a book and pretend to read a passage. They memorize songs or parts of songs and like to entertain the family with their own version of toddler idol.

Three year olds can express feelings and wishes. Although they have trouble making choices, they still want to make them. They may try to bargain with their parents instead of having a tantrum, and this may be even more challenging. They try very hard to figure out the world around them and ask many *why* or *what if* questions.

Three year olds may play near other children, but most of their play is active—not interactive. Their play is more imaginative, and you can see this when they play with action figures, cars or dolls, and when listening to their stories. Sharing is still difficult, and children of this age still need security and reassurances from their parents.

As children grow out of being a toddler, their vocabularies contain from 1000 to 1500 words. Although they have a great deal of words at their command, they are still confused by the way in which adults speak. Meanings get mixed up and they don’t have a clue about sarcasm. It is important to be clear when you are explaining things to a toddler.

At this age, children may begin to misbehave intentionally to test limits. This may be dangerous and disruptive. Try to provide a safe environment and distract the toddler from the action that he or she wants to do. Speak calmly and set firm limits (*no means no*). Avoid yelling, hitting or getting worked up when your child misbehaves, and walk away if you feel like you will lose control.

Try to reward and praise good behavior. Pay lots of positive attention to a toddler and give them hugs and kisses. Rewards don’t have to involve money—paying attention, reading a story, playing a game, a bright smile and hug mean more to a toddler than anything that money can buy.

When toddlers (1 – 3 years) have a brain injury

Like an infant, when toddlers receive a traumatic brain injury, it is usually due to a fall, car accident, some form of abuse or a drowning/near drowning episode. Impairment in function may occur in one or more of the following areas:

- Arousal – ability to awaken/show action
- Information processing – the ability to understand the meaning of written, verbal, or visual communication
- Orientation – knowing your place in time (day, hour, month and year) and space
- Speech and Language
- Difficulties paying attention
- Short and long-term memory
- Reasoning – logic and planning
- Emotional growth – child may be “stuck” emotionally at the age of injury
- Motor abilities
- Social behavior – lack of certainty about how to behave in society
- Sensory abilities – difficulty with one or more of the senses

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(touch, taste, smell, hearing, seeing)

- Problems with mood – increased sadness or irritability

Because a child who is injured as a toddler is in a rapid spurt of growth and development, a brain injury may affect growth that has already occurred and any future development. Unlike adolescents or adults who are seriously injured, toddlers don't have the luxury of years of practice or learned skills to fall back on. The process of rehabilitation is difficult and ongoing. Sadly, a brain injury will likely be with them for the rest of their lives.

4 – 5 Years of Age

Normal childhood development

Knock. Knock. Who's there? Anita. Anita who? Anita new bike. And so goes the humor of a four year old!

Four year olds discover humor and spend a great deal of time telling adults in their world "jokes." They enjoy rhyming and will laugh at words that they have made up. For example, four-year-old conversations may go like this, "You're a boo-boo. You're a poo-poo" followed by peals of laughter. This is the time when children may try a "bad" word, too. Try not to overreact if your child does this. Remember that they are trying to make sense of the world around them, and it is very hard to understand why adults can say some words but they cannot. Give them a different word if they are using words that you do not like.

At this age, children are often great conversationalists and love to talk about scientific details and how things work. They ask a lot of questions, and some may be difficult to answer. Try to respond as simply and honestly as you can. Four year olds can tell long stories, some of the details are true and some are made up. They understand the concept of past, present and future. They also begin to recognize cause and effect relationships.

Four year olds have a lot of energy. They are able to control their bodies better so that running, stopping, starting and turning are skills that they can manage. They can turn somersaults, hop on one foot and gallop away. They can play catch, throw and bounce a ball, climb, ride tricycles and try bicycles. Four year olds are developing confidence in their physical ability, and at the same time, their imagination develops. They may be too bold or timid and need to be supervised in physical play.

During this stage of life, children are learning to understand about the feelings and needs of others. Their behavior shows that they can feel sympathy, take turns, share and cooperate—at least



part of the time. They can use words to express anger rather than act on this emotion. Four year olds can sometimes feel jealous. Parents can help children by reassuring them how important they are. Four year olds will continue to occasionally tantrum when they don't get what they want. They can be bossy, and sometimes their behavior is over the top.

Four years olds love adult interaction, so it is important to provide lots of positive attention. Parents can play word games or sorting, matching, and counting games. Talk to your child, listen to their stories and tell them stories about what it was like when you were growing up. Provide play space and play time and opportunities for your four year old to play with other children. Supervise their activities and show them that you can set limits so the world is not a scary place for them. Smile and hold them and tell them that you love them. They will respond similarly!

A five year old is typically more energetic, cheerful and responsible than a four year old. This is a big year, as they will likely start kindergarten. School may be an extension of childcare for your child, or it may be a first separation for a stay at home parent. You can help ease them into kindergarten by going to the school before they start, buying a new book bag, and listening to all the stories about the wonderful new world of school.

Five year olds enjoy planning and spend time discussing who will do what. They like dramatic play and enjoy mimicking adult roles and playing dress up or make believe. Five year olds know

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right from wrong and honest from dishonest. They enjoy showing off how strong they are and how well they can play games. They are not really emotionally ready for all the rules of competition and may have trouble being good sports.

By the time children are five, they typically speak fluently and correctly use plurals, pronouns and tenses. They are able to use complex language and understand about 13,000 words! Good luck to all caregivers because 5 year olds talk frequently and like to argue and reason using words like “because.” They are able to memorize their address and phone numbers, know the days of the week, and can name coins and money.

At this age, it is important to give your child the chance to make choices, when appropriate. Try to limit television time to one to two hours per day and encourage conversation, storytelling, cutting, drawing and active play. Provide lots of praise and verbal encouragement so that pro-social behaviors are reinforced. Most of all, have fun with your five year old.

When 4 – 5 year olds have a brain injury

Every year traumatic brain injuries result in 300 deaths, 29,000 hospitalizations and 400,000 emergency room visits for children between the ages of birth to 14 years. You can help to prevent injuries by making sure that your child wears a helmet for bike riding, roller blading and other sports activities, assess your house for hidden dangers such as loose carpeting or objects that are not balanced and can fall. Make sure that your child is in the car seat or booster, and supervise sledding, skating, skiing and other winter sports.

Beyond infancy, children may survive head injury in larger numbers than adults and may experience good physical recovery. However, they may have very serious cognitive and behavioral difficulties. When treating children, it is very short sighted to think in terms of the here and now, because there is so much more growing and developing to be done. It is very important to try to project the future needs of the child.

Young children with brain injuries may have injured a part of the brain whose functions are not seen until later in life. For example, the frontal lobe is the center for **executive functions**. This area controls judgment, decision-making, planning, organizing and attention. A young child may not show signs of serious difficulty in the executive functions until they reach adolescence where these qualities become evident. Emotional difficulties and trying to make and maintain friendships may also become obvious as an injured child reaches adolescence.

When children have a brain injury impairment in function may occur in one or more of the following areas:

Arousal – *ability to awaken/show action*

Information processing – *the ability to understand the meaning of written, verbal, or visual communication*

Orientation – *knowing your place in time (day, hour, month & year) and space*

Difficulties paying attention

Short and long-term memory

Reasoning – *logic and planning*

Emotional growth – *child may be “stuck” emotionally at the age of injury motor abilities*

Social behavior – *lack of certainty about how to behave in society*

Sensory abilities – *difficulty with one or more of the senses (touch, taste, smell, hearing, seeing)*

Problems with mood – *increased sadness or irritability*

6 – 11 Years of Age

Normal childhood development

Why did ...? Why? Why? Why? In the early school years (grades 1 through 3) you will notice an increase in the amount of questions a six, seven, or eight year old will ask. This is the way that they learn to understand the world. The questions are continuous and kids seem to be pros at asking. In these grades children have a longer attention span and begin to display serious and logical thinking. They try to solve more complex problems and parents will be able to see the individual learning style that each of their children use. Conversations improve and at the end of third grade a child almost converses at an adult level (almost!) Reading may be a major interest and a six, seven, or eight year

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old will begin to understand the concept of reversibility ($4+2=6$ is the same as $6-2=4$).

Children in the early elementary grades can be helpful and cheerful, but their emotions may change quickly and then they may be bossy, rude or selfish. They tend to be obsessed with money and this becomes a big motivator especially by the time that they are in the third grade. Kids of this age typically make friends rather easily and like to have close friendships with the same gender. They like to feel a part of the group and early elementary children are usually engaged in group play on the playground at recess and lunch. Early elementary school children will begin to experience peer pressure. This may be the first time that they “try on behaviors”. They may pick up a behavior from a friend and try it out at home. This could be a different way of laughing or responding, or using a new saying. Early elementary school children have a strong need for love and understanding and want approval and attention from their parents.

Upper elementary children (9 and 10 year olds) show intellectual, emotional and physical change. Skill level and endurance improve. Children of this age have excellent fine motor control, can manipulate tools well and draw pictures with a large amount of detail. They may stay with an activity until they are exhausted and are typically active and energetic. At the end of their eleventh year many children begin showing their first signs of puberty. Girls may have softening and rounding of their features as well as the first signs of breast development. They may also shoot up in height. Boys may start to have more muscle development. Boys and girls in this age group are developing their conscience but may not always tell right from wrong and still rely on parental guidance. Kids are typically happy but may act silly. Friendships are very important, and by the end of the eleventh year they may start to show an interest in the opposite sex. Kids of this age are still respectful and affectionate towards their parents, so enjoy this time because middle school is right around the corner!

A great deal of a child's time is spent in play, walking, or riding bikes. These areas are often the most fun, but can also be the most dangerous for children. Inadequate use of bicycle helmets is associated with many motor vehicle related injuries or deaths. Proper use of bicycle helmets can eliminate 65-88% of bicycle-related brain injuries and 65% injuries to the upper and middle regions of the face (fractures and lacerations.) As parents it is important to protect your child by insisting that they wear a bicycle or sports helmet. Remember that you must also wear yours when engaging in sports with your children. In-line skating,



skate boarding and scooter use without helmets pose substantial injury risk. Hospitalization data indicates that skateboarders are more likely to sustain head injuries than roller bladers or scooter riders. However, since the lightweight foot propelled scooters were introduced to the United States in 2000, 42,500 people sought emergency room care for injuries (most of these were not brain injuries.)

When elementary school-age children incur a brain injury

Pedestrian (motor vehicle) injuries are the most common cause of serious head trauma in the lower elementary age group. This is typically due to the mid-block dash/dart into the street or the attempt to beat traffic at an intersection. These account for 60-70% of the injuries to children under the age of ten. Children are more frequently injured in heavily populated urban areas due to the large volume of traffic. It is important to teach your child to never cross between parked cars. When crossing at the light, remind them to look both ways before stepping into the street and watch for turning cars.

When an early elementary school-aged child suffers a brain injury there may be personality or behavioral changes. Their emotions may increase in intensity to the point that they become out of control. Dramatic or rapid shifts in behaviors may also occur. These are usually not related to or in agreement with the event that triggered them. A child who has had a brain injury may

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become whinier, irritable, or upset with the smallest issue. If the child has a frontal lobe injury, then inhibition of the behavior may become difficult. Once a child engages in a behavior, they may be unable to stop or curtail it without intervention. Other changes that may be observed include:

- Inability to get along with siblings
- Changes in play habits
- Changes in coloring and handwriting
- Changes in understanding and following parental direction
- Changes in developmental milestones (e.g. bed-wetting may reappear)
- Change in sleeping and eating habits.
- Little ability to soothe themselves or be comforted
- Upset if corrected at school or at home about mistakes

Pediatric brain injury also affects a family in the following ways:

- The brain injured child becomes the center of attention
- Needs of other siblings may not be met due to the care and energy put into treating the injured child
- Parental needs may not be met because of the overwhelming amount of time spent on the needs of all of the children
- Time becomes a commodity that no one has
- Parents may feel guilty or that they are failures
- There may be a feeling of overall unhappiness
- There may be a diminished quality of life for the entire family.

The Teen Years

Normal adolescent development

Adolescence may be defined as the time in a person's life when characteristics move from what is typically considered childlike to what is considered to be adultlike. For adolescents, this period requires adjusting to changes in their body, way of thinking, emotions, and changes in their family and peer group. These changes are challenging for them and for those around them – just ask any parent of a teen! Teenagers struggle with the desire to be independent while being dependent on their parents. They are pressured to fit in and do well in school and other activities. Risk-taking behaviors exist that may have life-long consequences as some adolescents discover the effects of experimenting with drinking, drug use and exploring their sexuality.

As young teens (13-15) move toward independence, they

may become moody trying to figure out who they are and which groups they fit in. Their peers become important and influence clothing styles and other tastes. As their body changes, they may become uncomfortable with the changes. One day they may be on top of the world, and the next they struggle with poor self-esteem. Relationships with parents also change as teens realize that their mom and dad are not perfect. With the improved ability to express themselves, they are often willing to say this. They may not show affection to their parents like they used to and complain that their parents are interfering with them or more dramatically *"ruining their life."* As grown up as they like to believe they are, they often revert back to much younger behaviors when they are stressed.

This is the age in which serious rule and limit testing begin. Experimentation with sex, cigarettes, alcohol and drugs may also start. However, there is increased and consistent evidence of a conscience. There is concern about appearing attractive to others, and relationships may change quickly. There are a lot of concerns about being normal.

As the youth enters the older teenage years (16-19), parents will begin to see a young adult emerging on a regular basis as the question *"Who am I?"* is answered satisfactorily and happily.



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But remember, even the best and most well-adjusted adolescents will experience times of confusion. The older teen is more able to think things through and compromise on solutions. There is decreased conflict with parents, and although friends remain important, they take an appropriate place among other interests. There is an increased concern for others and increased self-reliance. As the young person's depth of character develops they become able to have serious relationships. They set goals, are insightful and place an emphasis on personal dignity and self-esteem.

In a study of teens that left high school for careers or further education it was found that positive factors influencing teens included a supportive family and friends, making money, satisfying leisure activities, realizing personal achievements and educational success. The adolescents reported that negative factors included relationship problems, career confusion, financial difficulties and a difficult adjustment to post-secondary educational demands. As a teen navigates this time of life, there are things that parents can do to make the journey easier. It is very easy to notice the irritating and negative behaviors and comment on these. Remember to reinforce the good ones, too. This will likely keep them coming back. Work with your teenager to keep the lines of communication open. Don't ignore the first signs of a problem and hope it will go away. It is easier to fix something small. Ask for help if you need it!

When teens incur a brain injury

By far, the most common cause of traumatic brain injury in teens is due to motor vehicle accidents. Teens are four times more likely to be involved in a motor vehicle accident and three times more likely to die from it than older adults. Teens make up seven percent of the population but are involved in 14 percent of the crashes. Teens with peers as passengers take more driving risks. There is typically an interaction between the driver's behavior, the car and the weather or highway conditions. Gender is also an important factor, as the incidence of severe injury among males is much higher than females. Overall, the most important factor associated with an increased risk of a car crash involving teenage drivers is the use of alcohol. Lack of driving experience with challenging weather conditions, nighttime driving or high-volume traffic combined with alcohol can be deadly. Again, statistics show that teenage males are more likely to be involved in alcohol-related accidents compared to teenage females.

Concussions are a fairly common form of brain injury that can occur with teenagers. A concussion is a temporary loss of

normal brain function. One of the most common reasons teens get concussions is through sports injuries. High contact sports such as football, boxing and hockey pose a higher risk of head injury, even with the use of protective headgear. Teens can also get concussions from falls, bicycle and roller blading accidents, as well as physical assaults.

When a teenager suffers a brain injury there may be personality or behavioral changes. Similar to what is seen in younger children, their emotions may increase in intensity to the point that they become out of control. Dramatic or rapid shifts in behaviors may also occur. Many teens remember their former selves and have difficulty adjusting to the changes caused by their injury. Some may use substances, such as marijuana or alcohol, in an attempt to increase their ability to cope. Some teens may look the same as they did pre-injury and deny the fact that they have an injury. They may also have limited or no insight into their injury. In addition, parents may be in denial, believing that their child has fully recovered and everything will be the way it used to be.

Other changes in behavior that may be observed include the following:

- Social awkwardness
- Difficulty learning new information
- Difficulty planning and organizing
- Decreased self-control
- Inability to recognize problems
- Dangerous risk-taking
- Possible psychiatric problems
- Academic difficulty or possible academic failure
- Difficulty succeeding in work or after school placement ❖

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