Proper Use of Child Safety Seats

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Motor vehicle crashes continue to be the leading cause of death in children one to 14 years of age. Used correctly, child safety seats significantly reduce child morbidity and mortality. Although many parents know child safety seats are important, more than 80 percent of seats are misused. Increased education of parents regarding proper use of child safety seats can protect children from potentially fatal crash forces. Parents may also be educated about community resources and the several types of child safety seats. (Am Fam Physician 2002;65:2085-90. Copyright© 2002 American Academy of Family Physicians.)

A tremendous amount of force is exerted on the human body in a vehicle collision. A car moving at 40 miles per hour strikes a wall with the same force as a car hitting the ground after driving off a 50-foot cliff.[1] Parents should be educated to realize that even low-speed crashes can seriously injure or kill children. In 1998, the National Highway Traffic Safety Administration (NHTSA) reported that every day an average of seven children die and 866 children are injured in crashes.[2]

Used correctly, child safety seats are 71 percent effective in reducing infant deaths in passenger cars and 54 percent effective in reducing toddler deaths. They reduce the need for hospitalization by 69 percent.[2] Efforts to improve child safety seat use have reduced child morbidity and mortality, but further improvement is needed. Despite recent advancements in technology and education, the NHTSA recently reported that 51 percent of children younger than five years are riding in vehicles unrestrained,[2] and that eight out of 10 child seats are misused.[3] If 100 percent of children younger than five years had been protected by properly used child safety seats, an estimated 472 lives could have been saved in 1998.[2] Counseling our patients about the proper use of child seats and learning to detect and correct misuse will help save lives.

To fit properly in an auto seat belt, a child's legs should bend over the edge of the seat when the buttocks are against the seat back, the shoulder portion of the belt should cross the midclavicle and center of the chest, and the lap belt should be tight over the upper thighs or pelvis.

Importance of Proper Fit

To properly fit a child in an auto seat belt, three elements must be present: (1) the child's legs should bend over the edge of the auto seat with the buttocks against the seat back; (2) the shoulder portion of the belt should be over the midclavicle and center of the chest; and (3) the lap belt should be tight over the upper thighs or the pelvis. A child should have a sitting height of 29 inches (74 cm) to have a proper belt fit. This sitting height roughly correlates to a standing height of 58 inches (147 cm) and a weight of 81 lb (36.5 kg).[3] If the shoulder-lap seat belt is not properly positioned, the child may slip forward under the belt (termed submarining); the child's abdomen and neck then bear the force of the crash. Submarining can cause the lap belt to rupture or lacerate internal organs.[4]

Shoulder-lap belt systems are designed to work as a unit, so placing the shoulder portion behind the child's back is not a safe option. Lap-belt-only systems (usually found in the center-rear seat position of a car) can cause abdominal injury from submarining and can also act as a fulcrum, causing severe back flexion injuries. Children heavier than 81 lb and taller than 58 inches may use an adult seat belt. All others should use some sort of child restraint device.

The rear-facing position should be used until the child is one year of age and weighs 20 lb (9 kg).

Backward Is Best

If a child faces forward in a crash, the force is distributed via the harness system across the shoulders, torso, and hips, but the head and neck have no support. Without support, the infant's head moves rapidly forward in flexion while the body stays restrained, causing potential injury to the neck, spinal cord, and brain. In a rear-facing position, the force of the crash is distributed evenly across the baby's torso, and the back of the child seat supports and protects the head and neck.[5] For these reasons, the rear-facing position should be used until the child is one year of age and weighs 20 lb (9 kg).

For example, a 13-month-old child who weighs 19 lb (8.6 kg) should face rearward, and a six-month-old child who weighs 21 lb (9.5 kg) should also face rearward. Some rear-

TABLE 1
Summary of Types of Child Seats

Seat type	*Child size**	*Benefits*	*Cautions*
Car bed	Premature infants until they are able to maintain their airway while sitting semi-upright	Only seat that allows supine transportation	A child outgrows this seat rather quickly
Infant seats	Less than 20 to 22 lb (9 to 10 kg)	Lightweight, usually less expensive, these seats can be used as infant carriers outside of the car	Must always face the rear of the car; not designed for bigger infants; need to be reclined to 45 degrees to maintain the airway
Convertible seats	Rear facing: to one year of age, weight limits 20 to 30 lb (9 to 13.5 kg), depending on the manufacturer Forward facing: older than one year, weight limits 20 to 40 lb (9 to 19 kg)	Can be used for a larger age/weight range; some seats are now designed to convert to booster seats	Seats can be bulky; when rear-facing they need to be reclined to 45 degrees; when forward-facing, the seat should be upright; harness straps need to be at or below the child's shoulders when rear-facing; harness straps need to be above the reinforced position or above the shoulder when forward-facing
Forward-facing seats	Older than one year, 20 to 40 lb	Designed for children older than one year	Not for children younger than one year
High-back boosters with and without harness	Older than one year With harness: 20 to 40 lb Without harness: 40 to 80 lb (18 to 36 kg)	Can be used for a larger age/weight range; removable harness makes this seat useable past 40 lb	Not for children younger than one year; the weight and height limits of the seat and the harness should be checked to ensure that the child is the appropriate size for the seat or harness
High-back belt-positioning boosters	40 to 80 lb	Lightweight, usually less expensive; designed for older children, so the child does not feel like a "baby"	Only for use by older children who have outgrown the convertible or harnessed seats; ensure the seat belt placement is correct (over the midshoulder and midchest, and tight across the thighs) when using a booster

**—This is general information. Seat-specific weight, height, and age limits should be obtained from the seat's label or instruction manual.*

facing seats have a weight limit of 20 lb, so a different seat may be needed for heavier infants. The American Academy of Pediatrics (AAP) Car Safety Seats: A Guide for Families 2002[6] is an excellent resource for parents, and it identifies the rear-facing weight limits of currently available seats.

Types of Child Safety Seats

Specifics about a particular type of child safety seat are found in the owner's manual for each seat. If the owner's manual cannot be located, a copy can be obtained by calling the manufacturer. *Table 1* summarizes features of the common child safety seats.

CAR BEDS

The AAP recommends that infants born at less than 37 weeks of gestation be monitored in a semi-upright position before hospital discharge to detect apnea, bradycardia, or oxygen desaturation.[7] If these conditions are present, the child should be transported in a supine position. A car bed is the only child safety seat that allows transportation in the supine position.

INFANT SEATS

Infant seats face rearward only. Infants outgrow these seats when their head is within 1 inch (2.5 cm) of the top of the seat or when they pass the height or weight limit of the seat (usually 20 to 22 lb [9 to 10 kg]).

CONVERTIBLE CHILD SEATS

These seats face forward or backward. The rear-facing position is used until the child is one year of age and weighs 20 lb. Each seat is labeled (by law) with its height and weight limits. Parents should be instructed to check those labels to ensure that the child is not too small or large for the seat. Specifically, not all rear-facing seats will accommodate a child heavier than 20 lb. A child outgrows a convertible seat when the ears are above the back of the seat or when the child passes the height or weight limit of the seat (usually 40 lb [18 kg]).

FORWARD-FACING CHILD SEATS

These seats face forward and are for children heavier than 20 lb and older than one year. A child outgrows this seat when the ears are above the back of the seat or when the child passes the height or weight limit of the seat (usually 40 lb).

HIGH-BACK BOOSTER SEATS

High-back booster seats face forward and have removable harnesses. They are meant for use with children heavier than 20 to 30 lb (9 to 13.5 kg), depending on the manufacturer, and older than one year. The high back protects the head and neck in a rear-end collision. The harness should be used until the child exceeds the weight limit of the harness system (usually 40 lb). Once the child is heavier than 40 lb, the harness is removed, and the seat is used to position the vehicle seat belt correctly (over the midclavicle and midchest, and tight over the upper thighs). It is not safe to use the child seat harness and the seat belt because this may hinder the proper function of the auto seat belt.

HIGH-BACK BELT-POSITIONING BOOSTER SEATS

These seats boost the child up so that the vehicle seat belt fits correctly. They can only be used with a shoulder-lap belt system. High-back booster seats are for use with children heavier than 40 lb and can be used until the child fits properly in the vehicle seat belt system.

LOW-BACK BOOSTERS

Low-back boosters are designed for use with children heavier than 40 lb, but they offer no head or neck protection for rear-end crashes. Because safer restraint systems are available for children weighing more than 40 lb, the use of low-back booster seats is not recommended.

INTEGRATED CHILD SEATS

Some vehicles offer a child seat that folds down from a regular automobile seat. These are only for use with children older than one

year and heavier than 20 lb. Instructions on their use can be found in the vehicle's instruction manual.

AFTER-MARKET SHOULDER BELT POSITIONING DEVICES

These items are marketed to help position the auto seat belt more comfortably on a smaller occupant (so that the shoulder belt does not rub on the neck). These items are not crash tested. Most of these items connect the shoulder belt to the lap belt and pull it up onto the abdomen, thus increasing the risk for submarining injuries. For these reasons, the use of shoulder belt positioning devices is not recommended. If a vehicle seat belt does not fit a child properly, a belt-positioning booster seat should be used.

Common Misuses of Child Safety Seats

If used correctly, child seats save lives and prevent injury. Unfortunately, because they are complicated, they are commonly misused. The following points summarize important aspects of child seats:

- Rear-facing seats should not be used in front of an airbag. The airbag can cause fatal injury to the child in the event of a crash that deploys the bag.
- Children are safer facing to the rear until they weigh 20 lb and are at least one year of age.
- The child's height and weight should be appropriate for the seat. Each child seat is labeled with its weight and height limits.
- Infant seats can only be used in a rear-facing position.
- Convertible safety seats are designed to face rearward or forward, but each direction has weight limits. The child seat manual or the seat's label lists its rear-facing weight limit.
- A child seat should not be used in a side-facing seat (some trucks have side-facing rear seats).
- The parents should ensure that the correct seat-belt path is being used. When the seat is rear-facing, there is a different place to put the seat belt than when the seat is forward-facing.
- Car seats are often too loosely attached to the car. There should be no more than 1 inch of side-to-side motion when the seat is pulled forcefully at the seat-belt path.
- Tether straps decrease motion of a child's head by attaching the child seat-back to an anchor in the car. These straps can only be used in newer cars that have tether anchor sites (the automobile instruction manual should point them out).
- To maintain the infant's airway, the back of a rear-facing child seat should be at a 45-degree angle from the ground. Many seats have a positioning needle to assist in finding this angle.
- Infant seats often have a carrier handle or sun shield; these options should be in the down position while traveling.
- Harness straps should be snug enough that you cannot pinch the harness strap (lengthwise, not crosswise).
- To maximize their strength, harness straps should be flat and free of knots. Straps should not be ironed or placed in a dryer; the heat makes them brittle.
- The harness clip should be at the arm-pit level. If the clip is lower, the infant may slip out of the harness.
- In a child seat that is facing rearward, the harness straps should be at or below the level of the shoulder.
- In a child seat that faces forward, the har-

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ness straps should be in a reinforced harness slot position. Only the reinforced position is able to withstand the force of the forward crash without ripping the plastic. If there is more than one reinforced position, the harness straps should be at or above the level of the shoulder when the child is forward facing. Slots in the seat back allow for this adjustment.

- Bulky clothes (such as winter coats) create slack in the harness. They should not be worn under the harness straps. After the harness is secured, a blanket can cover the child.
- Replacing a child-seat part or altering the seat may weaken the device. Missing or broken parts should be obtained only through the manufacturer.
- Parents should be taught how to check the seat for recalls. Even relatively new seats may have a dangerous flaw *(Table 2)*.
- Child seats that have been in a crash should be discarded (in a way that prevents them from being reused by anyone else) and replaced, even if they look fine.
- A seat that is more than 10 years old should not be used, and it is best practice not to use a seat that is more than six years old. Older seats are not designed to the same safety standards as current seats.

Community Resources

A physician's office should be a resource of child seat information for patients. Resources include advice, pamphlets, and Web site addresses. A physician should be aware of the local community's safety seat experts. The NHTSA offers a four-day Standardized Child Passenger Safety Training Program, and trained technicians are located in every state. These technicians can be found by calling the NHTSA or using their Web site *(Table 2)*. Representatives from the community or the physician's office can obtain this training.

Child safety-seat check-up clinics are available in most communities to help with correct installation of child seats. Parents can be told of upcoming check-up events to help with seat-specific questions and installation problems. These clinics can be located by contacting state community experts or through the National SAFE KIDS Campaign *(Table 2)*.

Infants should never be placed in a vehicle seat with an airbag in front of them because fatal injury can result if it is deployed.

The physician's office should be equipped with current and accurate handout materials. The critical and complex nature of this topic, as well its liability potential, makes it advisable to use materials generated by several organizations. These organizations offer Web sites with instructions for correct child-seat use, tips on choosing a child safety seat, and current recall lists. *Table 2* provides telephone numbers and Web addresses for material and information resources. Knowing community resources and making liberal use of them are often the most valuable services a physician can provide to a parent.

TABLE 2
Car Safety Seat Materials and Resources

NHTSA Auto Safety Hotline: 1-888-DASH-2-DOT (1-888-327-4236); information about child safety seat recalls, fitting/inspection stations, technician contact locator, Child Transportation Safety Tips and One-Minute Safety Seat Checklist (reproducible handouts); NHTSA provides materials in limited quantities without charge. Reproducible masters are available for organizations desiring larger quantities. Fax requests to 202-493-2062, or order via the Web site at www.nhtsa.dot.gov/people/injury/childps/
American Academy of Pediatrics: 847-434-4000; www.aap.org; Publication orders for Car Safety Seats: A Guide for Families 2002
Center for Injury Prevention: 800-344-7580; www.childsafety.com; a Web site on national child passenger safety issues
National Safe Kids Campaign: 202-662-0600; www.safekids.org; organization for the prevention of all unintentional childhood injury
Safe Ride News Publications: 800-403-1424; www.saferidenews.com; publishers of Safe Ride News, a technical quarterly report with reproducible fact sheets
SafetyBeltSafe U.S.A.: 800-745-SAFE (800-745-7233), (in Spanish: 800-747-SANO [800-747-7266]); www.carseat.org; technically oriented Web site with recall lists and consumer pamphlets, help line for child restraint questions

Education and Counseling

Physicians should be comfortable counseling parents about child seats because these devices help prevent a major childhood health problem—vehicular injury. Correct child-seat use is difficult to achieve, but parents want to learn how to protect their children. Physicians need to use a multidisciplinary approach in educating parents about the correct use of child safety seats. The AAP recommends that staff who teach parents about child seats undergo periodic in-service education and that those responsible for training other hospital staff, parents, and guardians complete the NHTSA four-day course.[8] Physicians should be part of the education effort, yet they often have little training in the correct use of child seats. The AAP has helped in this regard by developing guidelines for selecting and using child safety seats.[9] Physicians should be aware of the current safety seat regulations and of any changes in the requirements. By knowing the proper use of child safety seats and by being aware of community resources in this field, physicians can help parents prevent significant childhood injury.

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