STATUS REPORT
INSURANCE INSTITUTE FOR HIGHWAY SAFETY
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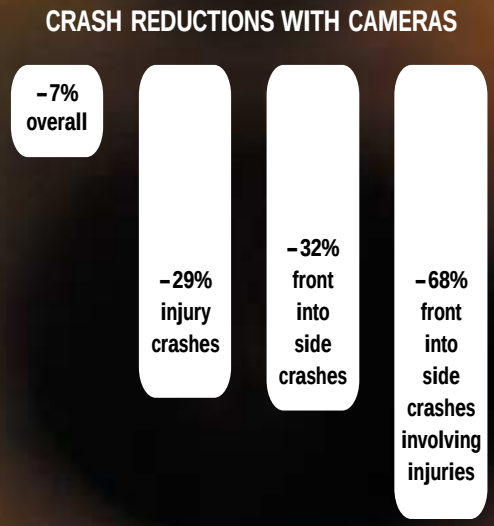
RED LIGHT CAMERAS
yield big reductions in crashes and injuries

Significant citywide crash reductions have followed the introduction of red light cameras in Oxnard, California. This is the main finding of new Institute research. It's the first scientific study of the crash effects of camera enforcement in the United States.

Front-into-side crashes at intersections with traffic signals — the collision type most closely associated with red light running — fell 32 per-



cent in Oxnard after camera enforcement began in 1997. There were 68 percent fewer front-into-side crashes involving injuries.

These results represent more than a single community's success story. They represent the first hard evidence that red light camera enforcement is making U.S. intersections safer. Earlier studies showed that cameras reduce the offense of red light running by about 40 percent (see *Status Report*, Dec. 5, 1998; on the web at www.highwaysafety.org). But except for a few studies conducted in Australia, there had been little research on how red light cameras influence the risk of a crash.

Now there is. Crashes declined throughout Oxnard even though only 11 of the city's 125 intersections with traffic signals are equipped with cameras. Previous studies of red-light-running violations in Oxnard and elsewhere found similar spillover effects. That is, the violations dropped in about the same proportions at intersections with and without cameras, attesting to the strong deterrent value of red light cameras and their ability to change driver behavior.

The cameras, which are being used to enforce traffic laws in more than 40 U.S. communities, photograph vehicles whose drivers deliberately run red lights. Violators then are ticketed by mail.

"Red light cameras provide the certainty of enforcement, 24 hours a day, 7 days a week," the Institute's senior transportation engineer, Richard Retting, explains. "This has changed the way drivers behave with regard to red light running, and now we know the behavior change is affecting the bottom line, which is crash likelihood. With the well-publicized use of camera enforcement, communities can substantially reduce the number of crashes and injuries that occur at busy intersections."

A temporary increase in rear-end crashes might be expected with any enforcement method that increases compliance with traffic signals. So the fact that rear-end crashes didn't significantly increase in Oxnard is yet another positive finding.

In calculating the crash reductions, researchers took into account changes in crashes at intersections without signals in Oxnard plus crash trends in three other California cities used as controls — Bakersfield, San Bernardino, and Santa Barbara.

The mayor of Oxnard, Manuel Lopez, welcomes the results. "The sole purpose of installing cameras in Oxnard was to reduce the number of community residents injured at busy intersections by drivers who carelessly run red lights. We're delighted that the Institute's independent evaluation identifies such positive results."

For a copy of "Crash reductions associated with red light camera enforcement in Oxnard, California" by R.A. Retting et al., write: Publications, Insurance Institute for Highway Safety, 1005 North Glebe Road, Arlington, VA 22201.

PUBLIC FAVORS CAMERAS but legal barriers impede use

Oxnard residents favored red light camera enforcement even before it produced positive effects on crashes (see p.1). Once the enforcement got under way at city intersections, support increased. Similar support prevails nationwide. Opinions about camera use are favorable in communities with and without enforcement programs, according to a recent Institute survey in 10 cities.

PERCENT OF DRIVERS WHO FAVOR CAMERAS

CITIES WITH CAMERAS:	
Fairfax, Virginia	84%
Charlotte, North Carolina	82%
Oxnard, California	79%
Mesa, Arizona	78%
San Francisco, California	77%

CITIES WITHOUT CAMERAS:	
Fort Lauderdale, Florida	82%
Raleigh/Durham, North Carolina	76%
Arlington, Texas	74%
Charlottesville, Virginia	74%
Fresno, California	72%

Despite this support, officials in many U.S. jurisdictions aren't able to implement camera programs. Only nine states and the District of Columbia have laws either granting the use of cameras statewide or allowing them in specific communities. Without explicit authorization, camera use may not be possible (see *Status Report*, Dec. 20, 2000; on the web at www. highwaysafety.org).

"The effectiveness of cameras plus the clear public support for using them should persuade state lawmakers to remove the legal hurdles," says Institute president Brian O'Neill.

YELLOW LIGHTS GET ATTENTION TOO (SEE P.7)

ALLOW RIGHT TURN ON RED
but not 24/7, new study indicates

Drivers are allowed to turn right during red lights 24 hours a day at most urban intersections with traffic signals in the United States. The practice, intended to reduce delays and fuel consumption, also increases the risk of crashes and injuries, especially to pedestrians.

Strategies to reduce the risk of pedestrian crashes start with banning the whole practice of turning right on red. Other possibilities include prohibiting the practice during certain hours or prohibiting it when pedestrians are present. Institute researchers evaluated these options, finding that time of day restrictions have the potential to reduce crashes. Signs giving drivers discretion aren't as effective.

For the study, 15 intersections in Arlington, Virginia, were randomly assigned to three groups — one where right turn on red was prohibited during specified hours, one where the turns weren't permitted when pedestrians were present, and a control group of intersections where right turn on red continued to be allowed as before. To judge effectiveness, the researchers considered the number of drivers who failed to stop before turning and the number who stopped at designated stop lines. The number of pedestrians yielding to turning vehicles also was considered, because yielding increases the risk that a pedestrian still will be in the crosswalk at the end of the allotted crossing time. This increases the risk for elderly people who walk slower.

Signs prohibiting right turns on red from 7 a.m. to 7 p.m. increased the percentage of drivers who stopped at stop lines from 21 to 40 percent and reduced the number of drivers who turned right on red without stopping (32 to 13 percent). The number of pedestrians who yielded to turning vehicles decreased from 17 to 7 percent. At sites posted with signs prohibiting right on red when pedestrians were present, there was little change overall.

For a copy of "Field evaluation of two methods for restricting right turn on red to promote pedestrian safety" by R.A. Retting et al., write: Publications, Insurance Institute for Highway Safety, 1005 North Glebe Road, Arlington, VA 22201.

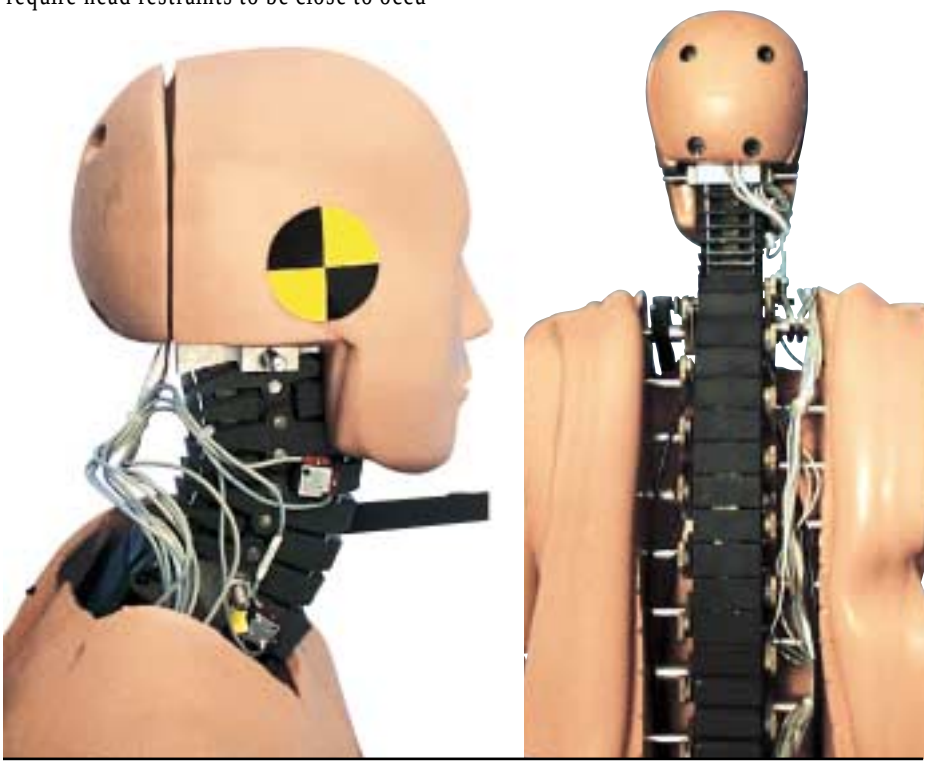
NEW HEAD RESTRAINT rule would prevent many whiplash injuries, but proposed dynamic tests could compromise safety

The head restraints in most cars are inadequate, neither high enough nor close enough to many people's heads to prevent whiplash injuries or associated neck disorders in crashes. Now a proposed upgrade of the federal safety standard covering head restraints would impose new geometric requirements expected to improve restraint effectiveness.

The mandate for higher head restraints would bring U.S. rules in line with height requirements of the tougher European standard. In addition, the U.S. rule would require head restraints to be close to occupants' heads. Several studies have shown that an effective restraint must be close to the head horizontally as well as vertically.

"The proposed revisions should result in fewer whiplash injuries," says Institute president Brian O'Neill. "Overall the proposal would greatly strengthen a standard that was weak when it was first issued over 30 years ago."

High enough and close enough: Current federal rules require head restraints to be adjustable to a height 27½ inches above a vehicle's so-called seating reference point, defined by a test machine placed in the seat. But when head restraints are adjusted to this height, they aren't high enough to protect many adult occupants from whiplash injuries. Restraints left in the lowest, or "down," position often *(continues on p.6)*



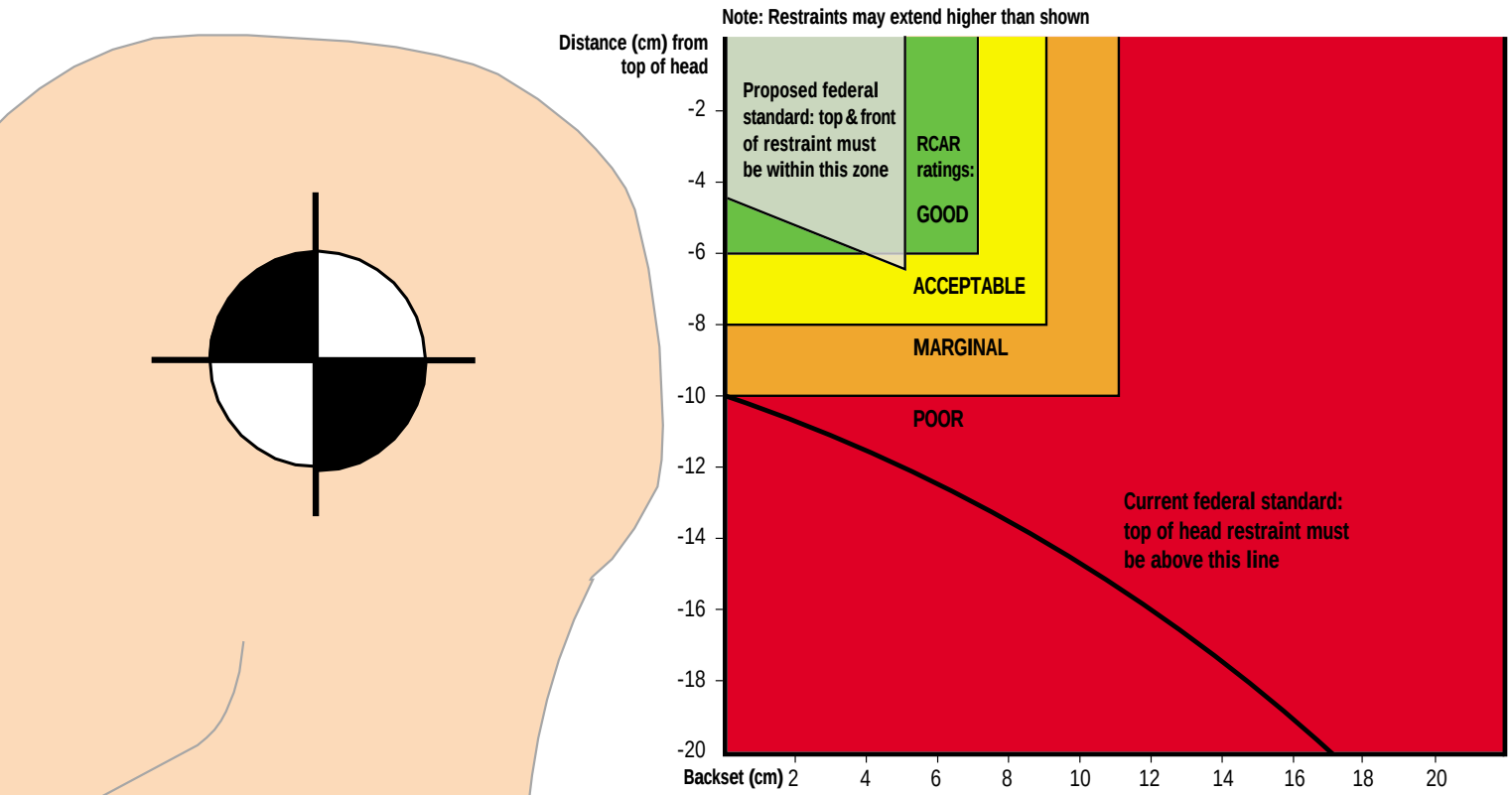
BioRID's segmented neck and flexible spine (above) are more like a human's than the neck and spine of Hybrid III, designed for frontal testing. Another rear impact dummy option is RID2 which, like BioRID, has a segmented neck and spine but not as many joints.

GLOBAL STANDARD to prevent whiplash injuries is quest of international groups

The geometry of head restraints is important but not, by itself, a full indicator of restraint effectiveness. Dynamic testing provides more information, especially about the active head restraints some auto manufacturers are providing in newer cars. Because both static (geometric measurement) and dynamic head restraint evaluations are important, work is afoot to refine the evaluation procedures for use internationally.

How RCAR assesses geometry: Since 1995, the Institute has been publishing model-by-model ratings of head restraint geometry, based on a set procedure for taking the geometric measurements. The purpose is to facilitate head restraint comparisons among vehicle models. Now a modification of this procedure has become an international standard available from the Research Council for Automobile Repairs (RCAR; on the web at www.rcar.org/papers/rcar.pdf), a consortium of research centers associated with insurers in 17 countries.

The RCAR procedure evaluates restraint height by measuring the vertical distance between the top of a 50th percentile male head form mounted on a standard H-point machine and the top of the head restraint. This is different from the method specified in the federal standard, which measures along the torso line from the H-point on the vehicle seat to the point at which the torso line intersects an orthogonal line that's tangent to the top of the head restraint. The standard is scheduled for revision, but no changes in this measurement method are planned.



HEAD RESTRAINT GEOMETRY:
RCAR ratings compared with current and proposed federal standards

Dynamic tests become more important: Good geometry is only the first step toward designing an effective head restraint. Other characteristics count, too, and some active restraint designs that move into position on impact cannot be evaluated without dynamic testing. Such designs include Saab's active head restraint and the whiplash injury prevention system in Volvos (see *Status Report*, May 22, 1999; on the web at www.highwaysafety.org).

The problem is that the dynamic test specified in the federal standard for more than 30 years is inadequate. An international working group has been charged with finding new dynamic tests that could lead to a global standard for assessing whiplash injury prevention.

The International Insurance Whiplash Prevention Group includes representatives from four insurer-supported research centers, including the Institute. This group will develop procedures for dynamic tests to evaluate and compare seat/head restraint designs. Members of the group say the procedures most likely will be based on sled tests.

Already the international group has ruled out using Hybrid III dummies because of their rigid spines. Both BioRID (see photos on facing page) and RID2 are being considered. And recognizing that women are at greater risk of whiplash injuries, the group is discussing long-range steps that include modifying 50th percentile male dummies or developing a new dummy to represent average-size females. Final test procedures are planned for late this year.

Most people don't adjust their head restraints, leaving them in the "down" position. In most cases, this means the restraints provide little or no protection from whiplash injuries. But even in the unadjusted position, the head restraints still meet the federal requirements that have been in effect for 30+ years. As shown above, the proposed federal standard will require higher head restraints — in fact, as high as restraints currently must be to earn a good, or at least acceptable, rating under procedures specified by the Research Council for Automobile Repairs (RCAR).

(continued from p.4) are 2 to 4 inches lower than 27½ inches. This means the restraints are of no benefit to most people.

Furthermore, most car occupants don't adjust their head restraints. Research shows they leave the restraints in the "down" position. The proposed new rule would mandate restraints at 29½ inches above the seating reference point even when unadjusted. The backset, or distance between the back of an occupant's head and the front of the head restraint, would be limited to two inches.

Head restraints come in a variety of shapes and sizes. The ones that provide the most effective protection against whiplash injury extend to the top of an occupant's head and fit close to the back of the head.

Two compliance options: Manufacturers may demonstrate compliance with current head restraint requirements by static testing — that is, by meeting certain measurement criteria — or by demonstrating a certain level of performance in a dynamic sled test. The proposed rule would maintain these options, a decision that's opposed by the Institute and others. Although a dynamic test could encourage automakers to develop active head restraint systems that deploy on impact, the proposed test option could have unintended negative consequences.

A problem is that average-size and larger male Hybrid III dummies would be used in the test, and "dynamic tests with dummies representing heavy adult males could result in active restraint designs that don't work for lighter occupants, especially women, who are most at risk of whiplash injury," explains Adrian Lund, the Institute's chief operating officer.

Quest is on for new test procedures: Whatever their size, the Hybrid III dummies present a problem in testing whiplash risk because their rigid spines don't interact with vehicle seats the way people's spines do. The Institute and others, including Volvo, recommend the development of a dynamic test using crash dummies especially designed to measure the parameters most predictive of whiplash injury risk. In fact, the Institute is a member of a newly formed working group, the International Insurance Whiplash Prevention Group (see p.5), to develop dynamic test procedures to evaluate and compare different seat/head restraint designs.

Right now at least two test dummy designs appear more appropriate than Hybrid III. BioRID, or biofidelic rear impact dummy, was designed by a consortium of Chalmers University in Sweden, restraint manufacturer Autoliv, Saab, and Volvo to study relative head/neck motion in rear crashes. BioRID's spine is composed of 24 vertebra-like pieces (see photos, p.4). Its neck moves more like a human's, compared with the Hybrid III neck, and its segmented spine interacts with vehicle seats in a more humanlike way. BioRID II is in production from Denton ATD, a U.S. manufacturer that collaborated with Chalmers to develop the dummy.

A second dummy, RID2, is another possibility for rear impact testing. Originally developed by a European consortium led by TNO, a Dutch research group, this dummy has been taken over by First Technology Safety Systems, a U.S. company that expects a production version of RID2 in May.

"The development of an appropriate dynamic test procedure will require additional time and effort, and we think it's better to wait than go with a test procedure with possible deleterious consequences," Lund says. "Meantime, we strongly support the government's proposal to require better head restraint geometry, which research indicates would significantly reduce whiplash injuries among both women and men."

YELLOW LIGHTS:
Small changes in the timing of signal lights could reduce crashes at urban intersections

More than one million crashes occur annually at U.S. intersections with traffic signals. To reduce these, officials in many cities are using red light cameras to reduce deliberate signal violations (see p.1). New research indicates that retiming yellow signal lights also would reduce crashes.

The yellow light phase plus the very short all-red phase that follows the yellow light at many intersections is known as a change interval. Research has established that the duration of this interval can affect the chance of inadvertent red light running. Based in part on research conducted by the Institute during the 1980s (see *Status Report*, July 14, 1984), the Institute of Transportation Engineers (ITE) adopted a proposal for establishing the duration of traffic signal change intervals. A recent Institute study shows the recommendations are effective.

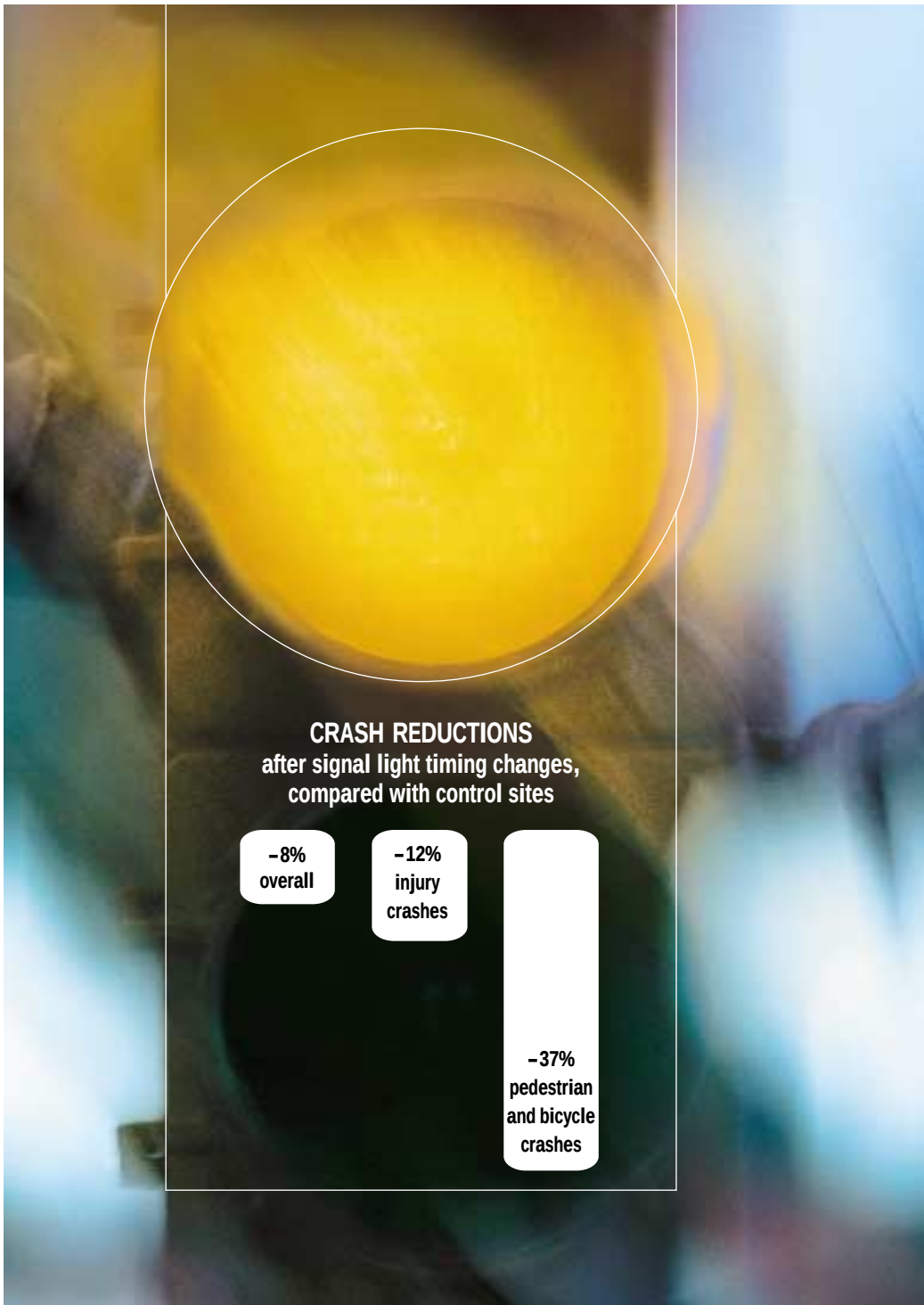
In particular, modifying change intervals in accordance with ITE's proposed recommendations can reduce the risk of crashes involving pedestrians and bicyclists. Such modifications also may reduce the overall risk of multiple-vehicle crashes, particularly crashes involving injuries.

Working with state and local transportation officials in New York, Institute researchers identified 122 standard four-leg intersections on Long Island. For the study, roughly half of these intersections were designated as controls and half were considered for signal retiming. Application of the ITE formulas indicated that the duration of the change intervals should be modified at 40 of the 51 experimental sites.

Eight percent fewer reportable crashes — that is, crashes with injuries or $1,000+ damage — were recorded during the 36 months after the signal lights were retimed, relative to the control sites. Crashes involving pedestrians and bicyclists dropped 37 percent relative to the control group of intersections. The researchers found a 12 percent reduction in injury crashes. The experimental sites were 9 percent less likely than the controls to report multiple-vehicle injury crashes.

"Such benefits suggest that many urban intersections could benefit from similar modifications," says Richard Retting, the Institute's senior transportation engineer. The ITE formula computes the yellow interval timing as a function of approach speed and grade, along with assumed values for perception-reaction time, deceleration rate, and acceleration due to gravity.

For a copy of "Changes in crash risk following the retiming of traffic signal change intervals" by R.A. Retting et al., write: Publications, Insurance Institute for Highway Safety, 1005 North Glebe Road, Arlington, VA 22201.



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