The Medical and Legal Problems Arising From the Failure to Wear Seat Belts

Stephen G. Fischer

Follow this and additional works at: http://repository.law.miami.edu/umlr

Recommended Citation
Stephen G. Fischer, The Medical and Legal Problems Arising From the Failure to Wear Seat Belts, 27 U. Miami L. Rev. 130 (1972)
Available at: http://repository.law.miami.edu/umlr/vol27/iss1/7
THE MEDICAL AND LEGAL PROBLEMS ARISING FROM THE FAILURE TO WEAR SEAT BELTS

STEPHEN G. FISCHER*

I. INTRODUCTION ............................................................ 130

II. CURRENT LEGISLATION—STATE AND FEDERAL .......................... 131

III. COURTS HOLDING SEAT BELT EVIDENCE INADMISSIBLE ................ 132
    A. No Duty .......................................................... 132
       1. No Common Law Duty ....................................... 133
       2. Matter for the Legislature .................................. 141
       3. Duty to Provide ............................................. 141
    B. Not Cause of Accident ........................................... 142
    C. Doctrine of Avoidable Consequences Does Not Apply .......... 143
    D. Not Admissible in Mitigation of Damages .................... 144
    E. Assumption of Risk Does Not Apply ............................ 145

IV. COURTS HOLDING SEAT BELT EVIDENCE ADMISSIBLE .................. 146
    A. Duty .......................................................... 146
    B. Proof of Causal Connection Required .......................... 146
       1. Substantial Evidence that Non-Use Caused Injury ......... 146
       2. Speculation and Conjecture Insufficient ................... 150
       3. Expert Testimony Required ................................... 151
          a. Quantum of Proof Necessary ............................. 151
          b. The Necessary Qualifications for Experts ............. 152
    C. Doctrine of Avoidable Consequences Does Not Apply .......... 143

V. SEAT BELT TECHNOLOGY .................................................. 154
    A. Quality and Effectiveness of Seat Belts ....................... 154
    B. Defective Seat Belts ........................................... 155

VI. NO-FAULT INSURANCE .................................................... 156

VII. "THE SEAT BELT SYNDROME"—THE SEAT BELT AS A CAUSE OF INJURY .... 157
    A. Value and Effect as a Preventative Mechanism ................ 157
    B. Seat Belt Trauma to the Abdomen ................................ 159
       1. Lap Belt Injuries ........................................... 159
       2. Shoulder Belt Injuries ....................................... 167
       3. Mechanism of Injuries ....................................... 168
    C. Lumbar Injuries Caused by Seat Belts .......................... 171
       1. Lap Belt Injuries ........................................... 171
       2. Shoulder Belt Injuries ....................................... 174
       3. Mechanism of Injuries ....................................... 175

I. INTRODUCTION

The purpose of this article is to provide a complete analysis of developments in the law concerning the seat belt defense. In addition, due to the close relationship of medicine and law in this area, the seat belt will be explored as both a preventative mechanism and a cause of injury.

The first reported case on the subject, Sams v. Sams,1 correctly set forth the issue that is currently plaguing the courts:

[S]hould the defendant be allowed to prove, if he can, that the

---

* Member, Editorial Board, University of Miami Law Review; Student Instructor in Freshman Legal Research & Writing.

130
failure of the plaintiff to use a[n] [available] seat belt, under the facts and circumstances of this case, [amounts] to a failure to exercise such due care as a person of ordinary reason and prudence would [exercise] under the same circumstances, and that such failure constitute[s] a contributing proximate cause of plaintiff's injuries.  

While there is certainly less than complete accord among the various jurisdictions, the courts are basically divided into two distinct groups: (1) those courts which hold that there is no duty to make use of an available seat belt, and thus refuse to admit any evidence concerning seat belts, and (2) those jurisdictions which recognize a duty to fasten seat belts, but require expert testimony to establish a causal connection between the failure to do so and the injuries sustained.

II. CURRENT LEGISLATION—STATE AND FEDERAL

Seat belts are designed to prevent the serious injuries caused by ejection from the automobile and by buffeting about in it. The purpose of seat belt legislation, both state and federal, apparently is to make seat belts available and to encourage their development as a safety measure without requiring their use as only three states presently require the use of seat belts and then only in limited instances. Florida's statute requires approval of the type to be utilized without making use of the available belts mandatory.

Since 1960, thirty-three states, plus the District of Columbia, have enacted legislation requiring the installation of seat belts in new model cars. However, no state requires (by statute) the use of available seat belts in private vehicles. In fact, five states which impose installation requirements specifically provide, either that failure to utilize the available seat belts is not contributory negligence, or that proof of the lack of their use is inadmissible in a civil action for personal injury damages.

2. Id. at 469, 148 S.E.2d at 155.
4. See, e.g., Mays v. Dealers Transit, Inc., 441 F.2d 1344 (7th Cir. 1971); Bentzler v. Braun, 34 Wis. 2d 362, 149 N.W.2d 626 (1967).
7. CAL. VEH. CODE § 27304 (Supp. 1970) (use required of driver and passenger in driver training vehicles); MINN. STAT. § 169.44(9) (Supp. 1970) (requiring bus drivers to wear seat belts); R.I. GEN. LAWS ANN. § 31-33-41 (1968) (every driver of a bus or emergency vehicle). In addition, in 1966, the City of Brooklyn, Ohio, enacted an ordinance requiring all persons riding in motor vehicles operated within the city to use available seat belts. 10 FOR THE DEFENSE 27 (1969).
9. Id. The typical state statute only requires that two sets of seat belts be placed in the front seat of vehicles manufactured after a set date (starting with 1962).
10. IOWA CODE § 321.445 (1970); ME. REV. STAT. ANN. tit. 29, § 1368A (Supp. 1970);
An interesting question arises as to the constitutionality of a state statute which would require the use of seat belts by an individual. In a closely analogous area, it has been held that a state statutory amendment requiring motorcyclists to wear crash helmets was unconstitutional. The court stated that in order for there to be a valid exercise of the police power, it was necessary for there to be a real and substantial relation between the exercise of the power and the public health, safety and welfare. Since the statute related only to the protection of the individual motorcyclist from himself, and not to the public health, safety and welfare, it was an invalid exercise of the police power.

However, in Florida, the supreme court recently decided that such a statute did not constitute an unconstitutional delegation of power. Rather, the legislature may impose a minor inconvenience which affords effective protection against the significant possibility of grave or fatal injury.

Pursuant to the National Traffic and Motor Vehicle Safety Act of 1966, the Department of Transportation has promulgated federal motor vehicle safety standards, effective January 1, 1968. The federal standards, binding on the states, require the installation of a lap belt for each seat position and a shoulder belt for each of the two outboard front seat positions in all new vehicles.

It should be noted that the federal standards do not make use of the available belts mandatory. However, the Federal Highway Administration's new regulations require installation and mandatory use of seat belts in the driver’s seats of all buses, trucks and truck tractors built after July 1, 1971, and used in interstate commerce.

III. COURTS HOLDING SEAT BELT EVIDENCE INADMISSIBLE

A. No Duty

1. NOT NEGLIGENCE PER SE

It is well established that unless there is a statute which makes seat belt use mandatory, no court will find a person negligent as a matter of


15. 49 C.F.R. § 571.208 (1972).

law for non-use. No court has yet decided that the failure to use seat belts is negligence per se. In fact, since most state statutes only require the installation of two sets of restraint devices, and then only in automobiles of "recent manufacture," it appears that the state legislatures have merely intended to make belts available and to encourage their development as a safety device. Thus, the statutes are not absolute safety measures. In view of the recent federal standards controlling seat belt installation, it is unclear whether this theory will still prevail. However, since the federal act does not require use of available restraints, it would not seem to alter the existing law.

A recent Oregon case explicitly set forth the reasons why non-use is not negligence per se under the installation statutes. The crucial factor was seen to be the failure of the legislature to expressly require use of available seat belts. The court explained that while the Oregon legislature at that time required motorcycle riders to wear protective headgear, it did not make mandatory the use of protective restraints in automobiles. Clearly, the legislature did not intend for such use to be mandatory, nor for non-use to constitute negligence as a matter of law.

The statutes generally fail to impose any sanctions for non-use, and there is nothing to prevent the removal of seat belts from a vehicle. Thus, it is apparent that the seat belt enactments are not absolute safety measures and that no statutory duty to use the belts can be implied from them.

Thus, if there be a duty to use an available seat belt, it is imposed by the common law.

2. NO COMMON LAW DUTY

a. Ordinary Care

As a general rule, automobile occupants are required to exercise ordinary care for their own safety. This raises the question, frequently before the courts today, as to whether the failure to utilize available seat belts constitutes a breach of this common law duty.

Due care is measured by the customary conduct of the reasonably prudent man. In spite of intensive programs designed to promote their use, statistics indicate that seat belts are not being used by the general public.

17. Id. This view has been taken by all of the courts which have considered this particular approach to the defense.
19. See notes 13-15 supra and accompanying text.
Safety belts are available to about two-thirds of all passenger car occupants [1968], but the belts are being used only about 40 per cent of the time, on the average. As a consequence, the net usage figure—the per cent of all exposure hours during which passenger car occupants are using belts—is estimated to be only about 25 per cent.25

In *Robinson v. Lewis*,26 the court held that there was no common law duty to utilize seat belts after declaring that the public apathy toward the use of seat belts is *not* controlling in determining whether a reasonably prudent man would utilize them.

Before a new safety device (e.g., the seat belt) can be said to modify the standard of ordinary care, there must be some consensus as to its utility. In *Petersen v. Klos*,27 the court explained that there is no common law duty to use seat belts although research indicates that seat belts are beneficial in *most* accident situations. In addition to the possibility that the lap belt may cause rather than prevent injury in certain crash conditions, the lack of consensus as to the utility of restraints is apparent from the finding that:

In spite of statistics, expert opinion, and safety campaigns, there is an indication that the general motoring public still does not consider seat belts a necessary accoutrement [sic] of safe driving.28

In addition, scientific treatises that establish seat belt *effectiveness* do not alter what constitutes "ordinary care" concerning seat belt *use*. Although the documents may indicate the safety features of restraints, they fail to establish (1) that the non-user knew of the findings at the time of non-use; (2) that the conclusions were a matter of "public record;" (3) that a reasonable man would never fail to "buckle up;" and (4) that use of seat belts is normal, natural, safety-oriented and generally accepted.29

The case of *Deaver v. Hickox*30 represented a novel attempt by the plaintiffs to establish that their decedent was exercising due care at the time of the accident, through evidence that he was wearing his seat belt. The court held that evidence concerning the use of an available seat belt was not competent to prove due care in the operation of the vehicle.

In spite of the well-known hazards of highway travel, most motorists do arrive safely at their destinations, and it appears that most people believe that the chance of being involved in an injury-producing accident

---

25. Id. at 56, 457 P.2d at 483, citing the 1968 edition of *Accident Facts*, published by the National Safety Council.
27. 426 F.2d 199 (5th Cir. 1970).
28. Id. at 204.
is relatively low. Although the reasonable man is aware of the general likelihood of accidents and that one might happen to him, he does not believe it is necessary to "truss himself up in every known safety apparatus before proceeding on the highway." Many people fail to use seat belts because of the fear of entrapment in a burning or submerged car. Such fear appears to be unwarranted, for statistics indicate that fire occurs in only two-tenths of one percent of all injury-producing accidents, and submersion in only three-tenths of one percent. Further, a person wearing a restraint in such accidents is more likely to remain conscious after collision so that he may be in a better position to remove himself from the area of danger.

However, the fact remains that a large percentage of the motoring public does not use available restraints. Most studies indicate that, on the average, the actual, consistent usage of seat belts for all types of driving, definitely does not exceed fifty percent. Further, the Department of Transportation's reason for proposing that "air bags" be required for the interior of automobiles by 1972 was that only about twenty five percent of the motoring public fasten their seat belts.

On the basis of the foregoing authorities and statistics, it would seem that the "reasonably prudent man" does not customarily use available seat belts during vehicular travel. Therefore, the failure to utilize the restraints would not constitute a breach of the common law duty to exercise "ordinary care" for one's own safety.

The social utility of wearing a seat belt must be established in the mind of the public before failure to use a seat belt can be held to be negligence. Otherwise, the court would be imposing a standard of conduct rather than applying a standard accepted by society.

b. Duty

Does the occupant of an automobile have a duty to use an available seat belt whenever he is on a public highway? In Miller v. Miller, the court answered this question in the negative and clearly explained the reasons for such a conclusion. At the outset, the court established that failure to "buckle up" is not negligence per se. Therefore, it could con-

32. Id. at 232, 160 S.E.2d 70.
36. Note, Seat Belt Negligence in Automobile Accidents, 1967 Wis. L. Rev. 288, 297 [emphasis supplied]. This conclusion has been followed and cited directly in two recent decisions: Petersen v. Klos, 426 F.2d 199 (5th Cir. 1970), and Miller v. Miller, 273 N.C. 228, 160 S.E.2d 65 (1968).
37. 273 N.C. 228, 160 S.E.2d 65 (1968) [hereinafter cited as Miller].
stitute contributory negligence *only* when the omission to utilize an available belt amounted to a failure to exercise the ordinary care which a reasonably prudent man would have used under the circumstances preceding that particular accident. Since the facts and circumstances preceding any accident necessarily vary, so must the conduct that would constitute due care.

Because a motorist who is not wearing his seat belt will not ordinarily have time to fasten it properly when the danger of an accident becomes apparent, the duty to use a seat belt—if there is a duty—must have existed prior to the accident. Until a person has, or should have, notice of another's negligence, he has no duty to anticipate it. Otherwise, one is entitled to assume that others will use due care for their own safety and for the safety of others.\(^8\)

The court in *Miller* described “special circumstances” where there conceivably could arise a duty to use one's seat belt. The test developed in *Miller* would hold one negligent for non-use *only* when he had prior knowledge of a specific hazard—one not generally associated with highway travel and one from which the seat belt would have protected him—and failed or refused to fasten his seat belt. For example, non-use would constitute contributory negligence in a factual situation where the driver tells his passenger to buckle his seat belt because the passenger door has a defective lock; the passenger fails to “buckle up,” and as a result falls out of the automobile when the door opens.

It is obvious that the court in *Miller* would impose liability for non-use only under very limited “special circumstances.” In fact, other than in a factual situation comparable to the one the court discussed,

> there are no standards by which it can be said that the use of seat belts is required for one trip and not another. Without a meaningful standard for judgment, the triers of fact cannot find the failure to fasten a seat belt to be negligence.\(^8\)

In *Remington v. Arndt*,\(^4^0\) the court held that there is no duty to anticipate that one will be involved in an accident. Consequently, there is no duty to take the precautions one ought to take if he did “see an accident coming.” Thus, it is not mandatory to utilize an available seat belt in the absence of “special circumstances” which require one to anticipate a collision or other mishap and afford one the opportunity to fasten the seat belt. Under this test, seat belt use by the passenger would be mandatory after the driver has warned him that the brakes have failed. Again, it is clear that the “special circumstances” that will create a duty to use one’s seat belt are very limited and require advance knowledge of a *specific* hazard.

\(^8\) Id.
\(^39\) Id. at 235, 160 S.E.2d at 71.
“Ordinary care” does not require the use of a seat belt unless there are “unusual circumstances” such as hazardous traveling conditions, an unsafe vehicle or a known incompetent driver. Thus, under ordinary driving conditions, the failure to fasten one’s seat belt will not bar an action by the non-user nor be admissible as evidence in mitigation of damages.41

Evidence of non-use is not admissible for any purpose since there is no duty to anticipate another’s negligent acts, nor is there a requirement to wear a seat belt in the absence of a legislative mandate. The underlying justification is that “the defendant takes the plaintiff as he finds him” and cannot assert that the plaintiff was not wearing his seat belt.42

Major advances by automobile manufacturers have significantly increased the extent to which car doors remain closed during accidents, thus providing a means for prevention or reduction of severe injuries and death. The latches, pillars and hinges which work together to keep the door closed during impact have been greatly improved. However, unless the safety lock is depressed, the safety features in the door do not come into full play.43

Unfortunately, most people do not lock their car doors from the inside—a simple procedure that would help prevent the doors from being unlatched in roll-over or side-impact accidents—and so fail to take full advantage of improvements in doors and related components.44

There is apparently no duty imposed on a vehicle occupant to lock his door from the inside. It is submitted that the failure to use this safety device, which is readily available to the motorist, constitutes an omission analogous to the failure to fasten one’s seat belt. There is federal legislation regulating installation and quality standards for door safety systems45 similar to the federal standards regulating seat belt installation.46 Yet, there is no legislative requirement that one use either one of these available safety features. Therefore, the reasons are unclear for the apparent legal distinction made by those jurisdictions which require use of available seat belts, without making it mandatory to utilize available door locks.

44. Id. at 369.
46. See notes 14-15 supra. Furthermore, there is no duty to properly utilize headrests provided in a vehicle to protect the motorist even though they are required in vehicles by federal regulation. There is no reason for imposing a duty to use seat belts any more than there is for the use of headrests. Derheim v. N. Fiorito Co., 80 Wash. 2d 161, 492 P.2d 1030 (1972).
As previously stated, the failure to wear seat belts does not constitute contributory negligence in Tennessee pursuant to statute. In a recent Tennessee case, the plaintiff was held to have contributed to the cause of the accident by driving on a slippery road with tires of a "worn condition." However, a finding of contributory negligence for the plaintiff's failure to use seat belts could not constitute contributory negligence in light of the statute.

There is no duty on the part of an automobile occupant to anticipate another's negligence, nor to provide for his own safety by such precautions as wearing an available seat belt, in the absence of a statute to the contrary. Even if there was general acceptance of the value and need for using a seat belt, there would be no legal duty to do so in the absence of a legislative mandate. Therefore, evidence of non-use is not admissible in an action for personal injuries arising out of an accident.

In fact, if the failure to wear a seat belt could be considered as negligence, and if the defendant was able to establish by competent evidence that a certain percentage of the plaintiff's injuries (no matter how slight) were caused by non-use, then under the doctrine of contributory negligence the plaintiff would be precluded from any recovery whatsoever. It would be a harsh and unsound rule which would completely bar an otherwise wholly innocent victim, whose mere failure to buckle his belt in no way contributed to the accident; and it would further serve to exonerate the active tort-feasor, but for whose negligence the plaintiff's omission would have been harmless.

Imposing an affirmative legal duty of wearing seat belts will have virtually no effect on the actual seat-belt wearing habits of automobile occupants. Its only effect would be to give an admitted wrongdoer a chance to dodge a substantial portion of his liability.

The law in Florida is clear that evidence pertaining to non-use of seat belts is not admissible. The foremost Florida case, Brown v. Kendrick, refused to allow the defendant to present to the jury any evidence of the plaintiff's failure to use his seat belt. The court held that there was no duty to use an available restraint.

The Florida Legislature has touched upon the subject only to the extent of requiring approval of the type to be used, if used.

47. See note 8 supra and accompanying text.
50. Id. It should be noted that in comparative negligence jurisdictions the plaintiff would be barred only to the extent non-use contributed to his injuries, if proven. But see Section III, B, infra.
53. 192 So.2d 49 (Fla. 1st Dist. 1966).
F.S. 317.951(1), F.S.A. It may be that after further research by various safety committees, the law may be changed to require the use of seat belts and to affix some element of negligence for failure to use same. This is not the law today and it is not within the province of this court to legislate on the subject. 

A 1969 Florida case held, on authority of Brown v. Kendrick, that no evidence regarding use of seat belts was admissible, thus indicating that the views set forth in Brown were still to be followed in Florida.

Another Florida case concerning seat belt use, Chandler Leasing Corporation v. Gibson, limited its decision by holding merely that defense counsel could not offer to the jury evidence of plaintiff's non-use, where the defendant failed both to plead contributory negligence and to seek an instruction regarding it. However, the court went further in stating that had the defendant done so, Brown would have precluded admission of such evidence.

In a recent Florida case, defense counsel argued that seat belt evidence was admissible to show contributory negligence and for mitigation of damages. The defendant offered "competent testimony" of a causal relation of non-use to damages so that the evidence was beyond the realm of speculation and conjecture. Further, the defense argued that the new federal legislation since Brown was controlling. The judge granted the plaintiff's motion to strike the seat belt defense, refusing to admit any evidence concerning seat belts.

A federal district court in Florida recently held that evidence was not admissible concerning failure to use seat belts because there is no legal duty to use them.

[T]here must be at least some indication that the plaintiff was under a duty to use a seat belt to provide for his own safety, and that failure to use it was a cause of plaintiff's injury, before the Court is required to submit the issue to the jury. The holding here is that, as a matter of law, there is no such duty, nor could such failure be a proximate cause of injury, and submission to the jury of the issue is not required.

In Mount v. McClellan, a curious Illinois decision, the court stated

---

54. Id. at 51.
55. Paschal v. Pinkard, 228 So.2d 633 (Fla. 1st Dist. 1969).
56. 227 So.2d 889 (Fla. 3d Dist. 1969).
57. Therefore, the Florida District Court of Appeal, Third District, follows Brown v. Kendrick in refusing to admit any seat belt evidence.
58. Parrish v. Arosemena, Case No. 70-17487 (Fla. Dade Co. Cir. Ct. 1970) (pre-trial conference). The case was later settled.
61. 91 Ill. App. 2d 1, 234 N.E.2d 329 (1968).
that evidence of non-use of seat belts, plus expert testimony in relation thereto, is admissible on the question of the plaintiff's due care. The rationale was that there is a duty based on the common law standard of ordinary care to use available seat belts. The court admitted seat belt evidence including evidence of non-use even though plaintiff's car was not equipped with belts.

However, a later Illinois decision clarified Mount, explaining that the decision is limited in effect to admitting evidence that the plaintiff's automobile was not equipped with seat belts. Further, a recent Missouri case held that evidence concerning non-use of restraints was inadmissible to show lack of due care as a matter of law, and interpreted Mount as having no influence on the duty to use a seat belt. Rather, Mount's determination as to the use of seat belts was obiter dictum only, because such was not the issue presented by the facts. Since in Mount the plaintiff's vehicle was not equipped with seat belts, the court could not rule on the duty to use seat belts because none were available to be used.

New York law does not require one to prepare for the possibility of an accident when he enters his automobile. A passenger's failure to use available seat belts, as related to the severity of injury, may or may not be admissible depending on the evidence at trial. However, it is a matter of evidence bearing only on the question of whether the plaintiff has a "duty to attempt to alleviate possible injury in the event of an accident and as such is highly speculative." Thus, it can be seen that there are so many questions that remain unanswered as to the efficacy of seat belts that many courts are unwilling to rule that a failure to use them is negligence. The courts cannot say that seat belts are so desirable as a protective device that they will impose a duty to use available restraints. Rather, the question of auto safety is one for the legislature which should spell out what constitutes due care. The legislature has an opportunity to investigate the effectiveness of safety equipment in order to determine whether there should be a duty to use it.

64. Id. In addition, Mount was decided while Illinois was a comparative negligence state. The court in Mount stated that evidence of seat belt use could go to damages only. Comparative negligence is no longer the law in Illinois, so Mount is of no value on the issue of duty to use seat belts because without comparative negligence, any lack of due care by the plaintiff would completely bar recovery.
66. D.W. Boutwell Butane Co. v. Smith, 244 So.2d 11 (Miss. 1971) (decided in a comparative negligence jurisdiction). The plaintiff testified that at the time of the accident she knew seat belts were in the car, and that if they were fastened they might contribute to her safety. However, the court refused to accept this as a defense even though it was a comparative negligence jurisdiction where the plaintiff would not have been completely barred by the defense.
3. MATTER FOR THE LEGISLATURE

The majority of jurisdictions are in accord that there is presently no duty to use available restraints. In addition, the determination as to whether an automobile occupant should or should not be required to wear seat belts is a matter for the legislature, which has yet to make general use mandatory. The legislature should prescribe the duty to use a seat belt, if there is a duty, since it was the legislature which required that seat belts be installed in motor vehicles.

It is generally concluded that if the legislature had intended for non-use to bar recovery, it would have said so. Since the intention is neither expressed nor implied by the installation statutes, and since they fail to provide for the enforcement of seat belt use, the legislature must not have intended to require the use of restraints.

There is great conjecture involved in a determination of what would have happened had seat belts been worn, and what actually happened as a result of failure to wear them. Thus, the question of whether there is a duty to wear belts is a matter best left for the legislature.

In a noteworthy California case, the court stated that the toll of highway injury and death was such that judicial policy should be against deferment to legislative inaction. The case involved the question of whether the carrier was negligent in failing to equip its passenger bus with seat belts. The court ruled that the judiciary should properly consider the issue until such time as the legislature decides to supervise such safety regulations.

However, it is submitted that the better view is that set forth in Robinson v. Lewis, wherein it was stated that

the task of investigating and testing the utility of safety devices and of determining when their use should be made mandatory can best be performed by the legislature.

The fundamental reason for this conclusion is that science and industry are continuously developing more effective safety devices so that a mandate of use might be a requirement to use an obsolete device. The legislature, not the court, is in the position to hold hearings, consider expert opinions, analyze empirical data and then make an informed judgment.

---

71. Lipscomb v. Diamiani, 226 A.2d 914 (Del. Super. Ct. 1967) where the court stated that evidence of the failure to use available seat belts was not admissible for any purpose.
73. 254 Ore. 52, 457 P.2d 483 (1969).
74. Id. at 57, 457 P.2d at 485.
4. DUTY TO PROVIDE

Apparently, there is complete accord that it is a question of fact for the jury whether the failure to provide (install) seat belts in a vehicle constitutes negligence. The problem arises most often with common carriers and in the employer-employee relation.

According to one court,\textsuperscript{75} it is now a matter of common knowledge that safety belts effectively reduce fatalities and minimize injuries in motor vehicle collisions. Therefore, it is for the jury to decide whether a carrier has been negligent in failing to equip its passenger bus with seat belts.

In an action for the death of an employee who was thrown from his employer's truck, the negligence of the employer for failure to provide seat belts was held to be a question for the jury.\textsuperscript{76} The test to be applied is whether a reasonable man would have installed seat belts to provide the employee with a safe place to work in light of the likelihood of injury.

Although the common carrier must provide, for the safety of its passenger, the best devices known and in general use, it need not adopt and use every known safety device. Thus where there is no statutory duty to provide seat belts, the issue of whether the failure to do so constitutes negligence is properly a question for the jury.\textsuperscript{77}

B. Not Cause of Accident

When the occupant of an automobile is injured in a collision, his failure to fasten his seat belt is not such negligence as to contribute to the cause of the accident.\textsuperscript{78} Therefore, non-use does not constitute the proximate contributing cause of the injury either, because that would require a showing that the accident could have been avoided by wearing seat belts.\textsuperscript{79} The plaintiff's negligence does not bar recovery unless it is the proximate cause of the accident. Since a person's failure to wear restraints is not related in any way to the cause of the accident, it does not constitute contributory negligence and should not bar recovery.\textsuperscript{80} In fact, one court\textsuperscript{81} has stated that:

In the absence of a statute prescribing that failure to use an available seat belt would be negligence per se, we can conceive

\textsuperscript{77} Tiemeyer v. McIntosh, 176 N.W.2d 819 (Iowa 1970) (taxi cab).
\textsuperscript{78} Miller v. Miller, 273 N.C. 228, 160 S.E.2d 65 (1968); accord, Kavanagh v. Butorac, 140 Ind. App. 139, 221 N.E.2d 824 (1966).
\textsuperscript{79} Brown v. Kendrick, 192 So.2d 49 (Fla. 1st Dist. 1966).
of no instance in which such failure could be considered a proximate cause of the accident.\textsuperscript{82}

Therefore, in view of the present statutes, the failure to utilize available seat belts could never constitute contributory negligence.

Therefore, it was interesting when the defendant in a recent Texas case\textsuperscript{83} attempted to prove that the failure to wear restraints was the cause of the accident. The defendant collided with a vehicle, driven by a woman who was not wearing available seat belts; the woman's vehicle subsequently struck the plaintiff's car. The defendant alleged that the woman's failure to wear seat belts caused her to lose control of her car and hence was the proximate cause of the second collision. The court held that the driver had no duty, as a matter of law, to have her seat belt fastened. In addition, she was not negligent because she could not reasonably anticipate that failure to fasten her seat belt would result in an inability to regain control of her car after it went out of control. Therefore, non-use clearly does not relate to liability.

In another Texas case it was held that where there is a duty to wear a seat belt, failure to do so should be considered in mitigation of damages, but should not bar recovery as contributory negligence. While reserving for the future the decision of the duty to use seat belts, the court stated that non-use may contribute to the injury itself, but certainly does not cause the accident.\textsuperscript{84}

Therefore, it is unclear why the court, in \textit{General Motors Corporation v. Walden},\textsuperscript{85} instructed the jury that if it found that plaintiff's failure to utilize his seat belts to be contributory negligence, and that it was the sole or contributing "cause of the accident," then it should find for the defendant. Obviously, the authorities are in agreement that failure to use seat belts does not cause the accident. However, in \textit{General Motors} the plaintiff was drinking. Perhaps the court was alluding to this when it referred to the "cause of the accident."

Thus, if one thing appears well-settled regarding the seat belt controversy, it is that: "The failure to use seat belts as a safety device cannot be said to constitute a contributing factor in the occurrence of an accident itself . . . ."\textsuperscript{86} and, thus, non-use does not constitute contributory negligence.

\textbf{C. Doctrine of Avoidable Consequences Does Not Apply}

Once a person is injured by another's wrongful act, he must exercise reasonable care and diligence to avoid or lessen the consequences of the

\textsuperscript{82} Id. at 786.
\textsuperscript{83} Quinius v. Estrada, 448 S.W.2d 552 (Tex. App. 1969).
\textsuperscript{84} Sonnier v. Ramsey, 424 S.W.2d 684 (Tex. App. 1968).
\textsuperscript{85} 406 F.2d 606 (10th Cir. 1969).
\textsuperscript{86} Myles v. Lee, 209 So.2d 533, 535 (La. App. 1968).
defendant's wrong. If he fails to do so, he cannot recover for any portion of his injuries incident to such failure. This rule is known as the doctrine of avoidable consequences or the duty to minimize damages. The doctrine provides that failure to minimize damages does not bar the plaintiff's remedy; it merely affects the amount of damages recoverable.87

The doctrine of avoidable consequences is to be distinguished from the doctrine of contributory negligence. Generally, they occur—if at all—at different times. Contributory negligence occurs either before or at the time of the wrongful act or omission of the defendant. On the other hand, the avoidable consequences generally arise after the wrongful act of the defendant.88

Therefore, it is clear that the doctrine of avoidable consequences should not be applied to the seat belt situation. The doctrine applies only to the duty to minimize damages after the accident, while the duty to wear seat belts (if there is a duty) arises prior to the accident.89 Obviously, since the plaintiff's failure to fasten his seat belt occurs prior to the defendant's negligent act and before the plaintiff's injury, the plaintiff has not breached his duty to minimize his injuries subsequent to the defendant's wrongful act.90

For the same reasons that the failure to utilize available restraints does not constitute negligence, such failure should not reduce the amount of damages recoverable by the plaintiff. Since there is no duty to fasten a seat belt, failure to do so cannot be held to be a breach of the duty to avoid consequences or minimize damages.91

D. Not Admissible in Mitigation of Damages

As a matter of law, the failure to use available seat belts is not appropriate as a damage-mitigating factor.92 Since there is neither a statutory nor a common law duty to use available restraints, the mere failure to do so does not constitute contributory negligence nor influence mitigation of damages.93

In a sweeping opinion, the court in Britton v. Doehring94 held that the "plaintiff's non-use of available seat belts is inadmissible to mitigate the damages."95 The court clearly explained why it refused to admit any

95. Id. at 504, 242 So.2d at 671; accord, MacDonnell v. Kaiser, 68 D.L.R.2d 104 (N.S. 1968). It should be noted that Alabama does not require, by statute, installation of seat belts.
evidence of non-use in mitigation of damages: (1) there is no statutory requirement to use available seat belts; (2) there presently exists controversy concerning seat belt effectiveness; (3) if such evidence were admissible, a plaintiff injured in a vehicle equipped with seat belts would be penalized as compared with a plaintiff in an unequipped vehicle; (4) a requirement of use by one lawfully using the highway would require him to anticipate another driver's negligence; and (5) permitting the jury to determine what injuries were caused by non-use would allow the jury to enter the realm of speculation and conjecture. Thus, in order for such information to be admissible, the legislature must first require use of available restraints.

Further, there is no duty to use available seat belts. Since the reasonable prudent man is not required to use restraints except under unusual circumstances, the failure to fasten one's seat belt is not admissible against him in mitigation of damages.

E. Assumption of Risk Does Not Apply

The doctrine of assumption of the risk is not applicable to the seat belt controversy, either. When a person fails to wear an available seat belt, he does not assume the risk of possible injury, because before one can assume a risk, he must know that it exists. Various factors support this conclusion: there is no statutory duty to use available seat belts, nor is there a common law duty; there is controversy surrounding the effectiveness of seat belts in preventing injury; and the utility of seat belts has not been established in the public mind as evidenced by the fact that seat belts are not being used by the general public. Finally, in Miller v. Haynes, the court explained that failure to use a seat belt did not constitute an assumption of the risk of injury.

While travel in an automobile has reached the point where it can perhaps be said to be more dangerous than ever before, it has not reached the point where . . . an accident is so likely to occur that each and every time one gets into an automobile he must be held to have assumed the risk of injury.

96. See notes 6, 17-22, 26 and 37 supra and accompanying text.
100. See notes 6, 17-22 supra and accompanying text.
101. See notes 26 and 37 supra and accompanying text.
103. See note 36 supra and accompanying text.
104. See notes 24-25 supra and accompanying text.
105. 454 S.W.2d 293 (Mo. App. 1970).
106. Id. at 300.
IV. COURTS HOLDING SEAT BELT EVIDENCE ADMISSIBLE

A. Duty

The court in *Bentzler v. Braun*\textsuperscript{107} stated that, as a matter of common knowledge, an occupant of an automobile either knows or should know of the additional safety factor produced by the use of seat belts. Therefore, there is a duty to use available seat belts based on the common law standard of ordinary care, independent of any statutory mandate.

A recent California case\textsuperscript{108} determined that it is a question of fact for the jury whether, in the exercise of ordinary care, the plaintiff should have been using available restraints at the time of the accident. The question is to be answered in light of all the evidence and expert testimony as to the efficacy of seat belts. The jury is to consider whether the plaintiff knew or should have known of the safety features provided by seat belts.

A federal court\textsuperscript{109} has held that the wearing of a seat belt is sufficiently involved in the exercise of reasonable care to create an issue of common law negligence under "proper circumstances." The court explained that when the "proper circumstances" necessary to create a jury question are present, then the judge should instruct the jury to decide (1) whether a reasonable man under the same or substantially similar circumstances would have properly fastened his seat belt, and (2) whether the failure to do so was a causative factor in the production of injury. It is apparent from this case that the question should not go to the jury in the absence of "proper circumstances,"\textsuperscript{110} and even then, there must be proof of a causal connection between non-use and injury.

B. Proof of Causal Connection Required

1. SUBSTANTIAL EVIDENCE THAT NON-USE CAUSED INJURY

Even in those states that hold there is a duty to use available restraints, proof of the causal connection between non-use and injuries sustained is required to create a jury question. It is clear that a complete lack of evidence tending to prove a causal connection between plaintiff's

\textsuperscript{107} 34 Wis. 2d 362, 149 N.W.2d 626 (1967).
\textsuperscript{109} Mays v. Dealers Transit, Inc., 441 F. 2d 1344 (7th Cir. 1971).
\textsuperscript{110} The court failed to specifically define "proper circumstances" but found them to be present in the case before it. In that case, the right side of the truck cab in which the decedent was riding was ripped off on impact. However, the cab itself was not crumpled inward. The decedent was found on the roadway with a crushed skull, and human residue was found on the exterior of the cab. Under these circumstances, the court considered the evidence sufficient to go to the jury. It is submitted that in this particular case it was obvious that the decedent would have been injured less severely, if at all, if he had been wearing his seat belt. Thus, it was a unique case of severe impact without material damage to the interior of the vehicle under which the court concluded that there were "proper circumstances" to submit the case to the jury.
failure to use a seat belt and the extent of his injuries would preclude any consideration of the seat belt defense. In order for the defendant to be entitled to submit the issue to the jury, he must show by probative evidence that there is a causal relationship between the plaintiff’s failure to use seat belts and the injuries sustained by him.

A mere scintilla of evidence is insufficient to create a jury question. The burden of proof is on the defendant to show by substantial evidence that non-use aggravated the injuries the plaintiff would have suffered if he had been wearing seat belts. Evidence that leads to conjecture and surmise as to the causal relation is insufficient.

According to the Restatement of Torts, strict proof of a causal connection between the failure to utilize restraints and resulting injuries is required.

The plaintiff’s negligence is a legal contributing cause of his harm if, but only if, it is a substantial factor in bringing about his harm and there is no rule restricting his responsibility for it.

Apportionment of damages to different causes may be made where the plaintiff’s antecedent negligence does not contribute in any way to the original accident or injury, but is proved to be a substantial factor in increasing the harm which ensues. Therefore, in order to permit apportionment in seat belt cases, there must be satisfactory evidence that the failure to wear seat belts was a substantial factor in increasing the harm. The court should refuse to permit apportionment on the basis of mere speculation.

Seat belts are designed to protect against injury from the “second collision.” This results when the body of the occupant comes into contact with the interior of the vehicle in which he is riding after being suddenly jolted by the impact of the first collision.

Obviously, difficult problems of proof are involved in determining, first, what injuries resulted from this second collision, and, secondly, whether, in view of the force of the initial impact, a seat belt would have sufficiently restrained the user’s body to effectively prevent or reduce injury.

In fact, a symposium for defense lawyers on the seat belt defense concluded that evidence of the general effectiveness of restraints will not

---

114. Restatement (Second) of Torts § 465 (1965).
115. Id.
116. Id., comment c.
118. Id. at 1431.
establish the effect which seat belts would have had on the injury patterns involved in a particular case. In recognizing the difficulty of such proof, the writer stated that in many cases the use of the defense will not be possible because the evidence necessary to establish it will be lacking.\textsuperscript{120}

In view of the difficulty in proving a causal relation, the symposium suggested the elements necessary to establish a case for the jury. According to the symposium, proof of the following would be required: (1) the particular crash behavior of the subject vehicle; (2) the trajectory of the claimant’s body in the accident; (3) the relationship of vehicle crash events to occupant kinematics; (4) the particular injuries suffered; (5) the trajectory which a restrained occupant would have taken; (6) the extent of lesser injuries which the belted occupant would have sustained as a result of the impacts he would have made with the vehicle; and (7) that the claimant knew or should have known that seat belts are an effective safety device.\textsuperscript{121}

It is obvious from the above analysis that even in those states that have created a common law duty to use restraints, it is difficult to introduce substantial evidence that non-use was the cause of injury. Wisconsin has created such a common law duty. The court in \textit{Bentsler v. Braun}\textsuperscript{122} held that since there is no statutory requirement for use in Wisconsin, the question of the effect of failure to use available restraints is not a matter of law, but a question of fact for the jury. In order for non-use to constitute contributory negligence, it must have been a substantial factor in producing the injuries.

The various jurisdictions are in conflict concerning the admissibility of proof of a causal connection. The landmark case in Florida, \textit{Brown v. Kendrick},\textsuperscript{123} stands for the proposition that the plaintiff’s failure to fasten a seat belt is not the proximate contributing cause of the injury unless the accident could have been avoided in the absence of such a negligent act. However, in \textit{Sams v. Sams},\textsuperscript{124} a South Carolina case, it was held that the question of the effect of non-use should be decided in light of all the facts and circumstances adduced at trial.

In \textit{Miller v. Miller},\textsuperscript{125} it was explained that even if a duty to use a seat belt is imposed, the issue of proximate cause would still be present. According to that court:

\begin{quote}
[I]t would probably remain a matter of conjecture to what extent a motorist’s injuries are attributable to his failure to use a seat belt and whether, had it been used, other and different injuries would have resulted.\textsuperscript{126}
\end{quote}

\begin{flushleft}
\textsuperscript{120} \textit{Id.} at 202.
\textsuperscript{121} \textit{Id.} at 198.
\textsuperscript{122} 34 Wis. 2d 362, 149 N.W.2d 626 (1967).
\textsuperscript{123} 192 So.2d 49 (Fla. 1st Dist. 1966); \textit{see} notes 53-58 \textit{supra} and accompanying text.
\textsuperscript{125} 273 N.C. 228, 160 S.E.2d 65 (1968).
\textsuperscript{126} \textit{Id.} at 238, 160 S.E.2d at 73.
\end{flushleft}
The complicated task of damage apportionment would invite verdicts on prejudice, create unnecessary conflict in results and "degrade the law by reducing it to a game of chance."\textsuperscript{127} In fact, cases will be infrequent in which the extent of aggravation from non-use can be determined with any reasonable degree of certainty.\textsuperscript{128}

A recent Ohio case\textsuperscript{129} represents a liberal view concerning the admissibility of evidence of a causal connection between non-use and injury. In that case there was no evidence which tended to prove a causal connection. However, the court concluded that if the evidence in a future case indicated that the failure to use seat belts was a contributing factor in the occurrence of the accident,\textsuperscript{180} or in producing or aggravating injuries, then the issue should be submitted to the jury.

In \textit{Petersen v. Klos},\textsuperscript{131} the decedent was thrown from his vehicle on impact. The court decided that there was an insufficient basis for the implied conclusion that the decedent's injuries would not have been fatal had he been using seat belts. There was no reason to assume either that the decedent would have survived had he remained in the car, or that he was not killed prior to being thrown from the car. Therefore, a finding of a causal connection between the failure to use seat belts and the severity of injuries would have been clearly erroneous.

Statistics indicate that use of seat belts could reduce serious automobile injuries by one-third and deaths by 5000 per year.\textsuperscript{132} However,

it is apparent that these statistics [dealing with reduction and prevention of injuries] cannot be used to predict the extent or gravity of injuries resulting from particular automobile accidents involving persons using seat belts as compared to those who are not using them. . . .\textsuperscript{133}

It is possible to determine from these statistics only that, on the average, persons using seat belts are less likely to sustain injury, and that if one is injured while wearing a belt, the injuries are likely to be less serious.\textsuperscript{134}

Two recent cases have indirectly considered the causal connection problem. In \textit{Schomer v. Madigan}\textsuperscript{135} the court explained that apportionment of damages on the basis of non-use is improper unless the evidence produces both a reasonable means and a standard by which apportionment can be made. The court failed to specify what quantum of evidence

\begin{footnotesize}
\textsuperscript{130} It is not clear to this author how the failure to fasten one's seat belt could contribute to the occurrence of the accident itself. \textit{See} notes 78-86 \textit{supra} and accompanying text.
\textsuperscript{131} 426 F.2d 199 (5th Cir. 1970).
\textsuperscript{132} Bentzler v. Braun, 34 Wis. 2d 362, 149 N.W.2d 626 (1967).
\textsuperscript{133} \textit{Id.} at 386, 149 N.W.2d at 640. It should be noted that Wisconsin is one of the states which has created a common law duty to use available restraints.
\textsuperscript{134} \textit{Id.}
\textsuperscript{135} 120 Ill. App. 2d 107, 255 N.E.2d 620 (1970).
\end{footnotesize}
would be required, and what would constitute a reasonable means for apportionment. It stated only that there must be probative evidence that the plaintiff was not wearing his seat belt. In Lentz v. Schafer, the court refused to instruct the jury about the Illinois installation statute since the defendant failed to produce any evidence or request an instruction concerning plaintiff's non-use.

2. SPECULATION AND CONJECTURE INSUFFICIENT

The problem of conjectural damages cannot be dismissed lightly when the question involved is what the extent of injuries would have been had seat belts been used, and what happened because the seat belt was not used. In fact, there is evidence that the standard lap belts can cause more, rather than less, injuries in certain crash conditions. Some researchers believe that the seat belt is limited in value and, therefore, in one writer's opinion, the question of the effect of using the waist-type seat belt remains a matter of speculation and conjecture at best.

In any given collision, no doctor can say exactly what injuries would have been suffered had the victim been wearing a seat belt as compared to those he suffered without it. There are too many unknown variables such as exact number, degree, direction, duration and kinds of forces that might have been acting in any given accident to answer the question with any accuracy.

In those jurisdictions that have created a common law duty to utilize available restraints, evidence of non-use as the proximate cause of injuries is admissible because there is room for reasonable disagreement concerning the effect of non-use thus presenting a question of fact for the jury. Although the question of reduction of injuries if a seat belt had been worn is a question for the jury, it is highly speculative, and the defendant has a heavy burden of proof.

In Wisconsin, the fact that available seat belts were not being used does not, of itself, prove causation even though there is a duty to use seat belts. In Bentzler v. Braun, the plaintiff-passenger, who was not wearing his restraint, suffered severe injuries; the driver of the car sustained minimal injuries although he had also failed to use available

136. 404 F.2d 516 (7th Cir. 1968).
139. Id. at 614, quoted in Miller v. Miller, 273 N.C. 228, 233, 160 S.E.2d 65, 70 (1968).
143. Id.
seat belts. The court stated that the effect of plaintiff's non-use was a matter of conjecture, and that the jury could only speculate as to whether seat belts would have rendered the plaintiff's injuries less severe.

Obviously then, conjecture and surmise as to the effect on non-use are insufficient to create a jury question. The defendant has a heavy burden of proving that non-use was the proximate or contributing cause of injury. Finally, courts that hold there is no duty to use seat belts, conclude that to permit a jury to determine what injuries were caused by non-use, would be to allow them to enter the realm of speculation and conjecture.

3. EXPERT TESTIMONY REQUIRED

a. Quantum of Proof Necessary

The "net opinion" rule dictates that an expert's opinion is no stronger than: (1) the facts which support it, and (2) the medical explanation of its basis. The expert must clearly explain how he has arrived at the conclusion of a causal connection in order for his opinion to be admissible.

[T]he mere assertion of [a] reasonably probable contributory . . . connection by a medical witness cannot justify an award. The facts of the situation under examination in their totality must demonstrate causality by the greater weight of the credible evidence.

If the fact sought to be proved is one within the general knowledge of laymen, expert testimony is not required; otherwise, proof can be made only by experts. Since the specific effect of seat belts on injuries is not within the general knowledge of laymen, expert testimony is required to establish a causal connection.

The failure to use a seat belt, in and of itself, does not constitute contributory negligence. In order to raise the question of whether to submit such failure to the jury, the expert's testimony must indicate that non-use was a "substantial factor" in producing or aggravating the plaintiff's injuries. Furthermore, in order to permit apportionment of damages, thereby preventing the plaintiff from recovering for damages caused by his failure to use seat belts, there must be expert testimony proving a causal connection between non-use and injury. If the expert

147. Id.
148. Id. at 483, 189 A.2d at 447.
does not establish by satisfactory evidence that non-use was a substantial factor in increasing the harm, apportionment will not be considered.\footnote{151}

In \textit{Barry v. Coca-Cola Company},\footnote{152} the court recognized the obvious difficulty in producing effective expert testimony to establish that if seat belts had been used, the plaintiff would not have sustained the same injuries.

It [the expert testimony] would have to be based upon a hypothetical question of detailed specificity, strictly tailored to the facts proved with respect to the kind of seat belt used, its adjustment, the distance of the passenger from . . . [the object he collided with within the vehicle] and many other imponderables which I would not attempt to fully envision here.\footnote{153}

The court in \textit{Barry} stated that the jury may engage in speculation, to a degree, on the question of damages. However, unless the expert testimony is \textit{conclusive}, there is a risk of conjecture by the jury. In the seat belt area, the risk of conjecture is particularly high; therefore, conclusive expert testimony is a necessary prerequisite for submission of the issue to the jury.

In one court's opinion, expert testimony should not be required to prove that one who is firmly restrained by his seat belts will not be thrown from a vehicle on impact. However, the damage to the vehicle may be such that expert testimony would be required to prove whether a passenger in a vehicle who was thrown out and killed would have been seriously injured if he had been held in his seat by a seat belt.\footnote{154}

In \textit{Kavanagh v. Butorac},\footnote{155} a safety expert, who conducted tests on a vehicle similar to the plaintiff's, concluded that the plaintiff would not have hit his head on the rear view mirror if his seat belt had been "properly" fastened. The appellate court decided that the trial judge was at liberty to either consider or disregard the expert's opinion, and that there was insufficient proof that the results would have been different if the seat belts had been fastened. The court justified its decision on the basis that opinion evidence is not the same as conclusive proof that the injury sustained would have been materially altered by use of a restraint. Rather, it is mere speculation to say that the injuries would not have occurred had the plaintiff's seat belt been fastened.\footnote{156}

\section*{b. The Necessary Qualifications for Experts}

The determination of whether an expert witness is qualified to render an opinion on the effect of non-use is peculiarly within the discretion of the trial judge.\footnote{157}

\begin{footnotes}
\item[152] Id.
\item[153] Id. at 275, 239 A.2d at 276.
\item[155] 140 Ind. App. 139, 221 N.E.2d 824 (1966).
\item[156] The court noted that one reason for its conclusion was the varying interpretation of the phrase, "properly"-fastened seat belts.
\end{footnotes}
In the absence of credible evidence by one qualified to express the opinion of how the use or non-use of seat belts would have affected the particular injuries, it is improper for the court to permit the jury to speculate on the effect that seat belts would have had.\(^{158}\)

In *Bentzler v. Braun*,\(^{159}\) the only witness who testified regarding plaintiff's injuries was an orthopedic surgeon. He was qualified in his own profession, but the court concluded that he was not qualified to testify what effect the use of seat belts might have had. Therefore, the court decided that there was insufficient proof of causation for the issue to go to the jury.

The court, in *Truman v. Vargas*,\(^{160}\) decided that the defendant's expert witness was qualified to express an opinion with respect to the consequences of plaintiff's failure to use seat belts. The expert's qualifications in that case were as follows: (1) he was a recognized authority in automobile accident reconstruction and analysis; (2) he examined and photographed the damaged cars, and visited the scene of the accident; and (3) on the basis of his investigation, he formed an opinion of the speed of the vehicles at the time of the accident, the distances traveled post-impact and the exact manner in which the vehicles came together.

In a recent Seventh Circuit case,\(^{161}\) the plaintiff was injured when he was thrown through the windshield of the vehicle in which he was riding. The only evidence the defendant introduced at trial concerning the effect of plaintiff's failure to use seat belts was offered by an ear, nose and throat specialist. The court held that the witness was not qualified to testify as to the possible effect seat belts would have had on reducing the injuries suffered. Therefore, the defendant failed to establish by a preponderance of the evidence that plaintiff's injuries were due in any part to his failure to fasten his seat belt.

In *Tiemeyer v. McIntosh*,\(^{162}\) the plaintiff-taxi cab passenger contended that the defendant-taxi company's failure to provide seat belts was the proximate cause of her injuries. The plaintiff produced uncontroverted expert testimony to that effect. The expert witness was a highly qualified traffic safety consultant and was an assistant professor with a degree in science, a masters degree in chemistry and a doctorate in physiology. In his profession, he concentrated on problems of motor vehicle transportation as related to accidents and safety; he taught courses on the subject; he was a writer on accident prevention and safety; and he was a consultant to the traffic safety control board. The court held that expert opinion testimony, even when uncontroverted, is not binding on the trier

---

158. *Bentzler v. Braun*, 34 Wis. 2d 362, 388, 149 N.W.2d 626, 641 (1967). The court failed to explain what would constitute "credible evidence" and who would be "qualified to express the opinion."
159. *Id.*
162. 176 N.W.2d 819 (Iowa 1970).
of fact. In addition, the expert must be qualified to answer the particular question propounded; it was not sufficient that he was generally qualified in the area.168

V. SEAT BELT TECHNOLOGY

A. Quality and Effectiveness of Seat Belts

Seat belts are designed to prevent the serious injuries caused by ejection from the automobile and from being buffeted about in it.164 Restraints tend to alter the “path of body travel” during a collision, which is the manner in which the occupants move about in the car. For example, if a car strikes a brick wall head-on, the car will stop in approximately one quarter of a second. The restrained occupant will decelerate along with his vehicle. However, the unrestrained occupant continues to move in the same direction and at the same speed that the car was traveling just before impact.165

Federal standards require that seat belts be not less than 1.8 inches in width, that the webbing have a “breaking strength” of not less than 6000 pounds and that elongation of the webbing cannot be greater than twenty-five percent under a tension of 2500 pounds.166

In order to assure that these standards are met, there are two types of testing methods employed. The static testing method involves a gradual application of tension in order to determine webbing quality. The dynamic testing method, regarded as the superior of the two tests, involves a sudden application of tension to the belt equivalent to collision shock. During the tests, tensiometers are used to measure the deceleration forces acting on the belt.167

The belts must be designed to withstand at least the minimum number of “Gs”—unit of force applied to body at rest equal to the force exerted on it by gravity—that will be exerted on the belt during a collision. The average collision shock exerts a force of between 46.6 to 90 “Gs”, so that the potential force on the belt is somewhere between 5000 and 10,000 pounds.168 Seat belts must be designed and tested with a sufficient strength to withstand this impact pressure.

However, in Kapp v. Bob Sullivan Chevrolet Co.,169 a case which involved an allegedly defective seat belt manufactured by Davis Aircraft...
Products for General Motors, the chief engineer for Davis testified that manufacturers only test about one seat belt out of each lot of 150 to 200 belts. He justified the infrequent testing on the basis that the testing of an individual belt destroys its usefulness.

According to one author, restraints systems have been shown to be particularly effective in reducing the effect of certain accident collisions. Lap belts prevent full body ejection, and when a shoulder belt is worn in addition to the lap belt, upper-torso ejection is prevented. Seat belts reduce the impact force levels by decelerating the occupant along with his vehicle. Belts also permit the trajectory of occupants to be controlled so that the force and number of injury-producing impacts are reduced.

B. Defective Seat Belts

If a defective seat belt causes a person who is using it to sustain injuries, the injured party has a products liability cause of action against the manufacturer of the seat belt or the seller of the car. The action might rest on grounds of negligence, breach of warranty or strict liability.

Through the dynamic testing method, a wide range of effectiveness among various types of seat belts has been found. Most seat belt failures are due to poor design and construction stemming from the manufacturer's inexperience.

A number of substandard seat belts have been manufactured and marketed. Belts made with reject lengths of webbing and substandard buckles have been sold. Deliberately misleading advertising has been widespread.

However, many American seat belt manufacturers belong to the American Seat Belt Council, which is a voluntary association pledged to assure the public that belts offered for sale by member manufacturers are of satisfactory quality. Members certify that any belt to which they have affixed the ASBC seal meets standards of safety recommended by the New York Society of Automotive Engineers.

172. Id. In this connection, it is interesting to note the recent recall by Ford Motor Company of 4.04 million 1970 and 1971 vehicles in order to replace two faulty shoulder belt grommets that cost only pennies apiece. The grommet is a plastic locking device holding the shoulder belt connection to the lap belts. There have been about 80 cases of breakage, possibly due to failure of the harness to click into position. An interesting aside to this recall was that the general manager of Ford's Customer Service Division stated that shoulder belts are used so seldom that it is unlikely many grommets would break. See Ford Recalls Most 1970-1971 Cars for Repairs to Shoulder Belts, Miami Herald, July 1, 1972, § A, at 13, cols. 1-4.
174. Id.
There is practically a dearth of civil cases involving defective seat belts. The only reported case at present is *Kapp v. Bob Sullivan Chevrolet Co.*,\(^{175}\) which allegedly involved a defective seat belt. The injured plaintiff charged that not only was the seat belt improperly installed, but also that he was never warned of its limitations. The court stated that it was an undisputed fact that "no seat belt is manufactured which will remain unbreakable under all conditions."\(^{176}\) It held that although the seat belt webbing broke under the impact pressure, there was insufficient evidence for the case to go to the jury. The court also concluded that there was no liability for the failure to explain the limitations of seat belts. Rather, people are not entitled to rely on seat belts for protection from all conceivable consequences of an accident.

The plaintiff in *Kapp* was not allowed to avail himself of the doctrine of res ipsa loquitur, because the seat belts were not in the exclusive control of the manufacturer or installer. In addition, plaintiff's contention that the defective seat belt caused the head injuries he sustained when his head hit the dashboard was erroneous. Experts agree that a person wearing a lap belt will still hit his head on the instrument panel on impact.\(^{177}\)

Finally, a recent Department of Transportation disclosure of vehicle tests revealed that 11.5 percent of 1968 and 1969 automobiles tested, failed to meet at least one safety requirement.\(^{178}\) These general figures offer at least some indication of the possibility of defective seat belts.

**VI. No-Fault Insurance**

Although a complete analysis of no-fault insurance\(^{179}\) in Florida is clearly beyond the scope of this article, it should be noted that it will certainly have some effect on the development of case law in the seat belt area. It is obvious that where first party benefits are payable under no-fault insurance, it will not be material whether the failure to use available seat belts constitutes contributory negligence.

---

175. 234 Ark. 395, 353 S.W.2d 5 (1962); see also Garrett and Braunstein, *The Seat Belt Syndrome*, 2 J. TRAUMA 220, 232 (1962) (hereinafter cited as Garrett & Braunstein), wherein 35 cases of seat belt failures are discussed. Two cases involved damage to belt webbing or fittings caused by invasion of the compartment areas by either another vehicle or an object. Two other cases involved failure of the car structure itself, in that the floor pan to which the belt was attached buckled during the collision. In two other cases, the belt was improperly laced in the bracket on the floor. The remaining 29 belt failures were comprised of the following types of failure: 14 cases where the webbing slipped at the buckle or at the anchorage; 8 cases in which the webbing broke; 5 cases where the anchorages broke; and 2 cases involving other miscellaneous belt failures.

176. 234 Ark. 395, 406, 353 S.W.2d 5, 12 (1962) (emphasis in original). At that time, federal standards required a 4500 pound loop load. The court noted that when seat belts do break, it is ordinarily at an assembly point rather than in the webbing.


179. See, e.g., FLA. STAT. §§ 627.730-41 (1971). Further references to "No-Fault" insurance in this section will be to Florida legislation.
However, the seat belt controversy will still have a highly significant effect on tort law because there are several areas not covered by no-fault insurance. In fact, the cases in which the seat belt defense will be raised will involve serious injuries that are expressly excluded from coverage in the No-Fault Statute. For instance, an injured party is permitted to bring an action against the defendant for damages, pain and suffering where: (1) he has sustained medical costs in excess of $1000; or (2) the injury consists of any of the following: (a) permanent disfigurement, (b) a fracture of a weight-bearing bone, (c) loss of body member, (d) a compound fracture, (e) permanent injury within a reasonable medical probability, (f) permanent loss of a body function, and (g) death. In addition, there are several types of vehicles that are not covered by the statute: (1) all vehicles which are not four-wheel motor vehicles; (2) all public delivery conveyances for passengers; (3) vehicles used primarily in the occupation, profession or business of the insured; (4) and vehicles not required to carry no-fault insurance. Finally, it should be noted that the preceding are only some of the areas excluded from coverage under the Florida statute, which indicates that the seat belt controversy will remain viable in Florida.

VII. “THE SEAT BELT SYNDROME”—THE SEAT BELT AS A CAUSE OF INJURY

A. Value and Effect as a Preventative Mechanism

It is now commonly agreed among medical men involved in the seat belt area that death and injury are decreased by thirty-five percent with the use of a single lap belt when all types of accidents are considered. In addition, the risk of major or fatal injury is reduced considerably by wearing seat belts. The average risk reduction of major injury quoted in the literature is almost sixty percent.

While it is true that restraint systems may protect the occupant from the very serious trauma caused by ejection or “secondary collision,” the restraints themselves may act as sources of generally less lethal but significant injury. Restraint systems have created a third type of collision phenomena—the tertiary collision—which involves trauma resulting from the interaction of the occupant and his restraint system.

It is interesting that most, if not all, of the medical authorities that

184. Snyder, Pathology of Trauma Attributed to Restraint Systems in Crash Impacts, 39 AEROSP. MED. 812 (1968) [hereinafter cited as Snyder].
185. Id.
report seat belt induced injuries, stress the value of restraints and that their reports are not to be considered as indictments of the seat belt. Restraints do not alter the amount of force sustained in an accident; they merely alter the distribution of the force, attempting to place it across the less vulnerable pelvic area.\textsuperscript{186} Therefore, the principal effect of the seat belt appears to be the reduction of severe injury rather than the elimination or complete prevention of injury.\textsuperscript{187} While the belt does secure the pelvic region on impact, the belt stretches and the legs start upward due to inertia. The total body is bent forward into a U-shaped position, with the feet going up and the head coming down. However, without the lap belt, the occupant would be thrown upward at a thirty to forty degree angle into the windshield.\textsuperscript{188}

The inherent weaknesses of the lap belt are a matter of common knowledge. The three point system (lap belt in conjunction with single diagonal shoulder belt) eliminates some of the adverse effects of the lap belt used alone. However, by far the most effective restraint in reducing injuries is the upper torso inverted Y harness, anchored to a roof mounted inertia reel and used in combination with the floor-mounted lap belt.\textsuperscript{189}

To properly understand the sequence of events which is avoided by a properly-positioned seat belt, the typical series of motions and injuries to an unbelted passenger should be noted. When a car decelerates from sixty miles per hour to zero miles per hour in two feet, the unbelted occupant will normally go through the following motions and sustain certain injuries as a result: (1) There is a forward sliding movement with the knees striking the dashboard. This may lead to a compression load on the femoral shafts and hip joints with resulting injuries. (2) The femurs now act as levers aiding in the upward projection of the body, resulting in head and neck injuries. (3) There is a momentary recoil, after which the head is again thrown forward, but this time at a lower level, striking the dashboard, windshield and/or other projections. (4) Until the automobile comes to a complete stop, the occupant continues striking objects within the vehicle and may be ejected from the vehicle.\textsuperscript{190}

Of course, it is clear that there are accident conditions where the use of a seat belt has absolutely no preventative effect on injury. For example, where the damage to the interior of the vehicle is so severe that the occupant is crushed by the damage, the restraining effect of the seat belt will not reduce the injuries sustained.\textsuperscript{191}

Seat belt injuries, although potentially difficult to recognize, are anatomically predictable. Abrasions and contusion in the area of the

\textsuperscript{186} Fish & Wright, The Seat Belt Syndrome—Does It Exist?, 5 J. Trauma 746 (1965).
\textsuperscript{187} See Garrett & Braunstein, supra note 175.
\textsuperscript{188} Kapp v. Bob Sullivan Chevrolet Co., 234 Ark. 295, 353 S.W.2d 5 (1962).
\textsuperscript{190} See Doersch, supra note 182.
\textsuperscript{191} See Garrett & Braunstein, supra note 175.
iliac crest should arouse a suspicion of intra-abdominal injuries. Negative physical findings should not 11ull the physician into a false sense of security so that he dismisses a patient with possible seat belt trauma.108

B. Seat Belt Trauma to the Abdomen

1. Lap Belt Injuries

Lap type seat belts are designed to exert their restraining and decelerative action by keeping the pelvis and hips fixed to the frame of the car through the car seat. Unfortunately, no consideration is given to the fact that no restraint is provided for the head, neck, thorax or abdomen. In addition, improper use of the belt permits it to be placed across the abdomen to a point as high as the hypochondrium. As a result, injuries to the spine and ribs can occur.108

Abdominal injuries due to lap type seat belts can be divided into three broad categories. First, superficial abdominal wall injuries may result when there is minimal evidence of trauma. The skin may become abraded or exhibit ecchymosis. Recovery in this type of injury is usually progressive. Second, intra-abdominal vascular problems manifest themselves with immediate or slightly delayed signs of significant blood loss not accounted for externally, such as when there is a tear in the mesenteric vessels. Shock is inevitably present. The third category, rupture of a hollow viscus, such as an intestinal perforation, is probably the most hazardous abdominal injury due to the difficulty and delay in diagnosis.109

These injuries result because of, and not despite, the use of seat belts. They are associated with and secondary to the restraint provided by the belt as the accident victim is rapidly decelerated while his inertia flings him against the strap holding him to the frame of the car. Although many types of injuries may be anticipated from these safety devices, most of them are relatively insignificant when compared with the severe trauma and death the belts serve to prevent.105

Probably the best overt indication of intra-abdominal injuries caused by a seat belt is the presence of a seat belt contusion—an ecchymosis of the abdominal wall. It characteristically extends transversely across the lower abdomen at a level just cephalad to the anterior superior iliac spine. Such overt manifestations should alert the physician to the possibility of interior damage.108


193. Sube, Seat Belt Trauma to the Abdomen, 113 AM. J. SURGERY 346 (1967) [hereinafter cited as Sube].

194. Id. See also Shamblin, Seat Belt Injuries, 97 ARCH. SURGERY 474 (1968).

195. See Sube, supra note 193.

In 1951, one of the first indictments of the seat belt as an injury-producing factor was reported. A Comet aircraft crashed over England while carrying passengers wearing lap belts. Numerous ruptures of the thoracic and abdominal aorta were sustained. Subsequent to the autopsy reports, it was concluded that the snubbing action of the seat belt combined with forced flexion of the torso was the direct cause of these aortic ruptures.

A subsequent report of an automobile accident implicated safety belts as the cause of an unusual intra-abdominal injury. The victim suffered a contusion of the distal ileum adherent to the pelvic brim. Fibrous adhesions resulted in an intestinal obstruction at a later date.

In one of the most comprehensive early studies on seat belt injuries, Garrett and Braunstein reported the findings of the Automotive Crash Injury Research Study in 1962. In analyzing reports of 944 injured occupants who were wearing seat belts at the time of the accident, 150 of them were found to have received injuries to the lower torso. The percentage of lower torso injuries in seat belt users (15.9%) was similar to that of non-belt users (15.4%). Of the 150 lower torso injuries, 26 were attributed to the seat belts. Seven of the seat belt injuries involved intra-abdominal injuries, including a ruptured pancreas and duodenum, and a contused bladder and kidney. There was also evidence of severe pelvic fractures, combined with abdominal wall contusions from the seat belt. A total of 77 occupants had abdominal wall contusions due to the seat belt’s snubbing action. The abdominal bruises indicated the severe restraining action of the belt.

While seat belts have reduced major injuries from automobile crashes, they may cause severe injury if they are improperly fastened. Seat belts should be worn over the bony structure of the hip and pelvis and not across the abdomen. A loose, improperly-placed seat belt may restrain a passenger but can cause unnecessary visceral injury. The first reported case of splenic rupture caused by a lap-type belt involved a belt that was improperly worn. The belt was positioned so that the impact of the collision, plus the restraining action of the belt, caused sudden, severe compression of the upper abdominal viscera, with subsequent rib fractures and splenic rupture.

A belted front seat passenger suffered an unusual abdominal injury when the car he was riding in struck a telephone pole. The three unbelted passengers in the back were thrown into the front seat, pushing it forward. The belted passenger developed a large area of ecchymosis over the right iliac crest. An exploratory operation was performed. There was a gen-

---

199. See note 182 supra.
eralized peritonitis present with fibrinous adhesions scattered throughout and a blow-out-type perforation on the mesenteric border of the small bowel in the upper jejunal region. Although this type of injury is rare, it should be recognized as a seat belt injury resulting from a non-penetrating blunt abdominal trauma. 201

Four cases of intra-abdominal injury to belted passengers during an aircraft accident have been reported. 202 The possibility of injury resulting from the body decelerating against a restraining belt exists in any vehicular accident. The abdominal injuries sustained in the aircraft case were presumed to have resulted from the restraining action of the seat belt. The pattern of injury included lower abdominal wall and flank contusions, rupture of the distal small intestine and tears of the mesentery. The lacerated mesentery resulted in acute shock to the victims. Ruptures of the ileum also were present. The reporting physician stated that although seat belts do reduce the severity of injury, one could only postulate as to what might have resulted if the passengers had not been wearing seat belts.

One patient reportedly received contusions below the umbilicus, inflicted by a lap belt. He suffered peritonitis, a single jejunal perforation and a pelvic abscess. 203 A female passenger who was in the sixth month of pregnancy was involved in an accident while wearing a lap-type seat belt. The victim received a strapline bruise over the lower part of the abdomen and iliac spines, and suffered a rupture and avulsion of the pregnant uterus; the dead fetus was found in the upper part of the abdomen. 204 An obese female passenger who was wearing a three-point lap-diagonal seat belt at the time of the accident received multiple fractures of her left ribs, resulting in severe splenic laceration. The victim always wore the lap belt high on her abdomen due to her obesity. It was concluded that improper use of the restraint and not the restraint itself was the direct cause of the victim's injury. 205

A ventral hernia following an automobile crash has been attributed to the improper use of a lap belt by the victim. The victim's seat belt was too loose. As a result, the blunt trauma inflicted by the seat belt on the abdomen was increased, and the patient sustained a hernia of the colon, small bowel and intestine. 206

Except for isolated cases in which injury is actually produced by the use of a seat belt, restraints generally do not increase the severity of

201. Tolins, An Unusual Injury Due to the Seat Belt, 4 J. Trauma 397 (1964).
injuries. However, intra-abdominal injuries due to seat belts are dangerous because they are difficult to diagnose. In one instance,\textsuperscript{207} the only indicia of intra-abdominal injuries to the belted victim was an abrasion over the left upper abdominal quadrant. Two hours after admission to the hospital, his blood pressure dropped suddenly, and at the start of surgery, no blood pressure was obtainable. Surgery revealed a quantity (1500 cc.) of free interperitoneal blood and a contused segment of distal ileum with a five inch tear in the mesentery. There was brisk arterial bleeding from the torn mesentery, with bilateral retroperitoneal hematomas present in the vicinity of both the cecum and sigmoid. The patient recovered from these injuries, all of which had been inflicted by the blunt trauma of the seat belt.

In still another instance,\textsuperscript{208} the only overt indications of injury were bruise marks over both iliac crests, with tenderness in the lower abdominal quadrants and the lumbrosacral area. A test performed with a catheter was negative for blood or free fluid. Six days later, the patient became markedly disoriented and began to have intermittent temperature elevations. A laparatomy was performed, and the patient was found to have two complete transections of the jejunum. In addition, a small localized collection of blood was present in the lesser peritoneal sac, and the transverse mesocolon was torn from its posterior attachments. Again, the lap belt was implicated as the cause of injury, although it was noted that the belt does reduce major injuries.

A recent study has again emphasized the necessity of early diagnosis of seat belt injuries in order to prevent the possibility of prolonged morbidity and even mortality.\textsuperscript{209} The type of seat belt injuries sustained by three victims in a series of instances was considered classic. The victims all displayed external contusions from seat belt pressure, with ecchymosis in the area of the iliac crest. One patient had an avulsion of the terminal ileum, perforation of the upper ileum and mid jejunum, necrosis of the sigmoid colon and a rotation fracture of the right iliac crest. The patient's post-operative course was stormy, as he remained febrile and semiconscious for two days. The attending physician noted that the fractured wing of the ileum illustrated the magnitude of the force involved.

The second patient maintained a stable condition for two days following the accident. On the second post-injury day, he became semicomatose. On abdominal exploration, his rectus muscles were found to have been transected bilaterally with considerable hematoma in the rectus sheaths. A large quantity of brown fluid was present in the peritoneal cavity. The patient's jejunum was completely transected with an

\footnotesize{\textsuperscript{207} See Sube, \textit{supra} note 193.}
\footnotesize{\textsuperscript{208} Id.}
\footnotesize{\textsuperscript{209} Porter & Green, \textit{Seat Belt Injuries}, 96 ARCH. SURGERY 242 (1968).}
adjacent tear in the mesentery. Several small serosal tears were present in the jejunum and ileum.

Abdominal exploration of the third patient revealed a blowout perforation in the mid-small bowel, a ruptured spleen and an avulsion of the jejunal mesentery with early changes of gangrene in the jejunum supplied by vessels in this area. After surgery, the patient developed numerous complications, including pulmonary emboli, a pleural peritoneal fistula, enterocutaneous fistulae and sepsis. She died of severe bilateral bronchopneumonia approximately three weeks after the injury.

The reporting physician in the above cases stressed two main points in reference to abdominal injuries inflicted by seat belts. First, potential injury is inherent in the use of seat belts, and physicians should be aware of this. However, he concluded that it is not a common injury and is an acceptable substitute for what might have occurred if the victim had not been wearing his seat belt. Second, early diagnosis is necessary in order to prevent serious complications due to the insidious course of perforations in the small bowel. Therefore, it is imperative to maintain close observation of a patient who is injured while wearing a seat belt and who displays abdominal injury (ecchymosis) with persistent, even though slight, abdominal pain accompanied by any degree of distension.

Another recent study involved several persons injured by the blunt trauma inflicted on the abdomen by a lap belt. The lap belt was implicated in perforation and avulsion injuries of the bowel and mesentery after automobile collision. In addition, death of one patient was attributed to the seat belt.

In that study, the victims who survived sustained various abdominal injuries, including abrasion over the iliac crest and lower abdomen, due to compression by the seat belt and buckle. Truncal impact against the seat belt caused an ileum to be avulsed from its mesenteric root in one instance, which resulted in furious bleeding in numerous ileal arterial branches. In addition, the serosa had been torn away from its muscular layer, and there were multiple lacerations of the sigmoid colon mesentery accompanied by profuse bleeding. In another victim, laparatomy three hours after injury revealed two large tears in the mesentery of the ileum and complete avulsion of the greater omentum which was lying free in the pelvis.

The victim whose death was attributed to lap belt injuries was not operated on until eight days after the accident. At the time of the accident, the victim was wearing a lap-type seat belt and was able to leave the scene of the accident under his own power. Twelve hours later, he complained of abdominal pain and was admitted to a hospital. Trauma

210. Id.
211. Witte, Mesentery and Bowel Injuries from Automotive Seat Belts, 167 Annals Surgery 486 (1968).
of the lower abdominal wall from the seat belt was recognized, but intra-abdominal injury was overlooked. During the next seven days his condition deteriorated, and when he was transferred to the eventual operating hospital, he was moribund with signs of generalized peritonitis. Compression by the lap belt had produced a prominent band of ecchymosis over the lower abdominal wall. Surgery revealed a perforation of the terminal ileum with widespread purulent peritonitis. Although the perforated bowel was resected and double-barreled ileostomy constructed, the patient died three hours later.

The reporting physician in that study\(^{212}\) again emphasized the necessity for early diagnosis of seat belt-induced intra-abdominal injury. In addition, he stated that it was an inescapable conclusion that the visceral injuries he reported were caused by the sudden acceleration of the crash victim into the restraining device. Therefore, while the seat belt undoubtedly reduces injury by confining the accident victim to the vehicle, its prophylactic value must be weighed against possible injury attributed to its use. He concluded that: (1) serious injury may result from lap type belts; (2) the digestive tract and its attachments are particularly susceptible to restraints which on impact may suddenly disrupt normal bowel propulsion; and (3) based on physical laws governing colliding bodies, improved engineering of seat belts is needed to diffuse or soften the transmitted impact to the abdomen.\(^{213}\)

One instance of death attributed to seat belts resulted in an interesting civil suit for damages against the defendant who caused the accident.\(^{214}\) The medical testimony on trial was held sufficient to establish the possibility that the collision had thrown the decedent's body violently against his lap belt, placing sudden and severe pressure on all of his abdominal and pelvic organs; and that this had proximately caused acceleration of a pre-existing embryonal carcinoma of the left testicle, resulting in fatal spread of the disease throughout his body. The evidence introduced included nonexpert testimony of apparent good health prior to the accident and a change of the decedent's urine to a dark, rusty color a day after the accident, which indicated trauma to the area. In addition, there was testimony regarding soreness above the crotch in the area of the seat belt, and the onset of cancer symptoms.

In a report of three cases of intestinal injury from seat belts,\(^{215}\) it was again expressed that as more victims are saved from ejection and/or death by the use of seat belts, physicians must become increasingly aware of the potentially lethal, even though infrequent, "seat belt syndrome." In that report, one of the three victims died from the intraperitoneal in-

\(^{212}\) Id.

\(^{213}\) Possible improvements suggested included moving the strap buckle to one side, designing a wider band, or providing more elasticity in the belt.


\(^{215}\) Doersch, supra note 182.
juries sustained. She exhibited multiple generalized contusions and abrasions, including a severe "seat belt sign." Both of her rectus muscles were completely transected, the peritoneum was torn, and there was one continuous abscess cavity from the peritoneal space into the muscles and subcutaneous tissues on each side of the lower part of the abdomen. In addition, there were two large mesenteric lacerations and a traumatic thrombosis of the left iliac artery with streptococcus; the patient died one week after surgery from overwhelming sepsis.

In discussing the "seat belt syndrome" as it affected the other two cases, it was explained that the injuries are usually sustained in high-speed front-end collisions, and that "seat belt signs" are usually present. The two more fortunate cases reported represented typical seat belt injuries, including perforations of the cecum, mesenteric tears, hemo-peritoneum and an ascending colon that had to be replaced.210

Some experts believe that abdominal injuries associated with seat belts are the result of improper utilization of the belts.217 However, in a recent study of three cases, it was shown that in an automobile accident, serious intra-abdominal injuries may occur despite the proper use of seat belts.218 In this study, all of the victims had properly applied their seat belts, as indicated both by their statements and by the distribution of the seat belt abrasions, all of which were below the iliac crests. Despite this, the victims sustained serious intra-abdominal injuries. However, the attending physicians noted that, in all probability, the three victims would have suffered serious, possibly fatal, injury had they not been wearing seat belts.

The study concluded that the most frequent injury to the abdomen following lap belt trauma is perforation of the bowel and/or mesenteric rent, and that the greater the delay in diagnosis, the greater the morbidity. All the patients in the study suffered contusions below the iliac crest. In addition, the injuries sustained included obvious peritonitis, multiple seromuscular tears involving the sigmoid colon and small bowel, perforation of the antimesenteric surface of the mid-jejunum, a rent in the mesentery of the proximal and distal ileum accompanied by a hematoma and a completely transected bowel. The lap-type seat belt was implicated as the cause of these injuries.210

One of the most comprehensive studies to date on the effect of the restraints in crash impacts was an experiment conducted with the use of baboons.220 The study concluded that the lap belt itself was responsible for a distinctive pattern of injuries to the jejunum, spleen, pancreas,
duodenum and ileum. The device itself caused abdominal hernia and abdominal and thoracic aortic ruptures due to its "jackknifing" effect on the baboons. There was evidence of transverse linear contusions of the anterior abdominal wall corresponding to the position of the belt at impact. In pregnant subjects, the lap belt was found to have caused traumatic ruptures of the uterus, ventral hernias and placental separation resulting in fetal demise.

The experiments produced an additional interesting phenomena. It was established that human voluntary lateral subjective tolerance levels to side impacts are much lower than tolerance to forward or rear impacts. Side impact on lap-belted subjects produced ruptured bladders and contusions, tears, lacerations and complete severance of the uterus. Pancreatic hemorrhage occurred in all lateral impact cases at every crash level tested, due to the sudden, violent compression and/or displacement of the viscera. Finally, lateral impact was found to cause transected spinal cords in lap-belted subjects.

Two recent studies discussed the "seat belt syndrome" and indicated the various injuries that have become peculiarly attributable to lap belt trauma. One of the studies stated that there is a significant predilection for injury to the mesentery and intestine in belted victims. It summarized the distribution of reported abdominal injuries resulting from lap belt trauma as including: contusions of the abdominal wall and rectus muscles; ventral hernia; mesenteric laceration; contusions of the jejunum, ileum and colon; complete avulsion of the greater omentum; blow-out injuries of the duodenum, jejunum, ileum and colon; transection of the jejunum and ileum; fractures of the spleen, liver and pancreas; contusions of the bladder and kidney; ruptured abdominal aorta; and an adhesion of the terminal ileum to the pelvic brim.

The other study dealt with combined visceral and vertebral injuries resulting from the lap belt in a high speed collision. An accident was described in which there were four persons in the subject vehicle, and all had their belts properly fastened. All exhibited abdominal ecchymosis and signs of peritoneal irritation. The study distinguished the type of intra-abdominal injuries that occur when the lap belt is properly fastened from those when it is not. The injuries it listed when the belt is properly fastened are typical as in the first study. When the belt is improperly worn, solid organ injuries are more likely to occur, such as ruptures of the liver, pancreas or spleen. The report concluded that lap-type belts prevent many more injuries than they cause, principally because they

221. Id.
223. See Seitter & Sharp, supra note 192.
224. See Ritchie, supra note 222.
225. See note 223 supra and accompanying text.
prevent the victim from being thrown out of the automobile or being buffeted about within it.\(^{226}\)

2. SHOULDER BELT INJURIES

There is presently little information available regarding injuries which are attributable to the wearing of the lap belt plus an upper torso restraint during crash conditions. The primary reason is that this system has been used in vehicles of American manufacture only since 1968, and therefore injury experience in this country is limited.

Most studies of this type of seat belt system have come from Europe, where such systems have been in use for some years. However, use of this system has been shown to be more effective than the lap belt alone, since it prevents the "jackknifing effect" prevalent with lap belts. Therefore, the injuries attributable to this restraint should not be considered an indictment of its safety features.\(^{227}\)

The first fatal injury in this country attributed to the lap belt plus diagonal upper torso belt restraint, involved a traumatic rupture of the innominate artery of the victim.\(^{228}\) This unfortunate side effect was directly caused by the safety device designed to protect the occupant, who was involved in a head-on crash. The victim's shoulder harness over his left shoulder caused unequal deceleration of the chest and resulted in a fracture of the left clavicle and a widened mediastinum. This allowed the right side of the chest to rotate forward, creating a tearing force at the origin of the innominate artery. The victim died as a result of the tear in the innominate artery, which was accompanied by false aneurysm formation.

An early report dealt with injuries that are caused by improperly-worn shoulder belt.\(^{229}\) There were four victims involved in the study, and they suffered various severe injuries. Two of the victims died as a result of the crash impact against the improperly-applied belts. One had a cardiac arrest as a result of a ruptured left kidney and the left renal vein being torn from the aorta. The other victim, who was dead on arrival at the hospital, sustained a ruptured liver and spleen. The two more fortunate victims experienced seat belt-inflicted injuries including a ruptured right kidney, fractured ribs and a torn liver.

Splenic rupture caused by use of the diagonal shoulder belt in conjunction with the lap belt was first reported in 1965.\(^{230}\) A second instance of splenic rupture due to this system was reported in 1967.\(^{231}\)

\(^{226}\) See States, supra note 189.
\(^{227}\) Id.
\(^{230}\) See Fisher, supra note 210.
\(^{231}\) Fletcher & Brogdon, Seat-Belt Fractures of the Spine and Sternum, 200 J.A.M.A. 177 (1967) [hereinafter cited as Fletcher & Brogdon].
The shoulder belt has been incriminated as the cause of death of a victim who died in shock during an operation. In that case, the victim's hepatic veins were torn from the vena cava as a result of the trauma inflicted by the shoulder belt.

A comprehensive experimental study on the effect of seat belts included an analysis of the three point system (diagonal shoulder belt in conjunction with lap belt). The study concluded that the abrupt deceleration against this restraining device has potentially grave internal effects which are not necessarily correlated to the extent of overt tissue disruption. For example, there is a possibility of myofibrillar degeneration, which will not become obvious until it begins to affect myocardial functions some time after impact. In addition, there is evidence of interstitial hemorrhage of the kidney resulting in some instances.

Finally, it is apparent that a wide variety of injuries do occur in deceleration-type accidents, when safety belts are worn. The type of seat belt used has some influence on the type of injuries produced. It has been shown that the three-point system is more effective than the lap belt alone in preventing certain injuries, such as head and neck injuries. However, particular injuries have been attributed to the tortion or shearing action of this system. The diagonal over-the-shoulder-belt is more apt to produce injury to the upper part of the body, consisting mainly of a bruised chest, fractured ribs or sternum, lacerated liver, or injury to the kidneys or their vascular attachments.

3. MECHANISM OF INJURY

In a recent study, a belted victim was reported to have suffered various abdominal injuries, including adhesions between the mesentery of the ileum and pelvic brim causing partial small bowel obstruction, and also ruptures of the stomach, bowel, omentum and spleen. The report concluded that these injuries were indeed caused by the seat belts, although other injuries were thereby reduced, since the incidence of abdominal trauma was consistently higher with belted individuals than with unbelted ones. Therefore, it is necessary to determine the mechanism of seat belt injuries, so that perhaps improved engineering of these restraints can eliminate at least some of the injuries attributed to them.

It is apparent that many seat belt injuries are caused by improper use of the restraint, such as wearing the lap belt too low or too high. With a loose fitting lap or shoulder belt, the shearing action of the restraint is increased, fostering injury to the upper abdomen which may

233. See Snyder, supra note 184.
234. See States, supra note 189.
236. See Hodson-Walker, supra note 183.
involve solid organs. \(^{237}\) "Proper use" of a lap belt requires it to fit snugly across the lap, flush against the anterior superior iliac spines. A properly worn seat belt, however, still rides above the symphysis pubis and is therefore in direct contact with the lower abdominal wall. \(^{238}\) The mechanism of intra-abdominal injury caused by a properly applied seat belt will differ depending on the specific portion of the abdomen inflicted with seat belt trauma.

There are two distinct mechanisms of intra-abdominal injury, direct compression and entrapment. \(^{239}\) Direct compression of the intestine and mesentery between the seat belt and the unyielding structure of the posterior abdominal wall (including the immobile spinal column) results from decelerating forces being applied directly to the intestine or mesentery. Depending on the force of impact, the mesentery may either be torn perpendicular to the intestinal wall, or the small vessels of the mesenteric border may be torn, with subsequent hematoma formation and eventual gangrene of the intestinal segment. If the intestine is compressed, serosal tears of circumferential lacerations may result. Compression is the usual form of injury in blunt non-penetrating trauma to the abdomen.

Entrapment occurs when the afferent and efferent limbs of a short segment of intestine are entrapped by the advancing edge of the lap belt, producing an acute closed loop obstruction. This "closed loop" continues its forward acceleration due to inertia even after the victim's body comes to a halt. If the force is great enough, a circumferential transection of the loop may occur, or the increased intra-abdominal pressure may be transmitted to the closed loop. If this loop is dilated, and the increased intraluminal pressure in the loop exceeds the tension of the intestinal wall, the loop may perforate. In addition, the omentum and/or mesentery may also become entrapped resulting in avulsion. \(^{240}\)

The mechanism of injury in these intra-abdominal injury cases is usually a combination of bowel compression by the lap belt, acute flexion of the trunk, an increase in intra-abdominal pressure, and as a result, entrapment of a segment of bowel. Compression of the bowel between the lap belt and spine probably produces the seromuscular and mesenteric tears so frequently found in seat belt trauma cases. Circular perforation on the antimesenteric side of the small bowel represents a blow-out that probably resulted from entrapment and high intraluminal pressure. When the seat belt is properly applied, this type of injury to the lower abdomen is more frequent; when it is improperly applied, injury to the upper abdomen and solid organs is more prominent. \(^{241}\)

There is also a significant predilection of avulsion injuries to the

\(^{237}\) Id. See also MacLeod & Nicholson, supra note 218.
\(^{238}\) See MacLeod & Nicholson, supra note 218.
\(^{239}\) See Ritchie, supra note 222.
\(^{240}\) Id.
\(^{241}\) Id.
terminal ileum and cecum, probably accounted for by their relative immobility and constant anatomical location over the lumbar vertebrae. The cecum occupies a consistent and relatively fixed position in the lower right quadrant. The area of ileocecal junction is particularly vulnerable because of the relationship of the mobile ileum with the fixed cecum and ileocecal mesentery. Trauma which interrupts the thrombosis or ligation of mesenteric vessels in the region of ileocecal junction may also predispose the bowel to ischemic infarction due to inadequate circulation.242

Most authorities accept the hypothesis that intestinal injuries are due to compression of the viscus between the seat belt and the vertebral column. However, one study attributed a complete transection of the jejunum to a different mechanism.243 It was postulated that the fluid or food-filled segment of the bowel, due to its inertia, continued its forward acceleration even after the restraint caused the victim's body to come to a stop. This effect, coupled with the proximal and distal fixation of the involved segment of the bowel, produces the transection. The presence of a "forward-pulling" force is evidenced by instances where the transverse mesocolon is torn from its posterior attachments. Furthermore, it is unlikely that injuries to the mesentery result from forces of compression alone; a shearing or stretching force is probably the main agent involved in producing injury.

Finally, a recent study concluded that bursting injuries depend not only on intraluminal pressure, but also on the size and shape of the viscus involved.244 The intestinal tract itself is flexible and compressible. After sudden impact from an automobile collision, however, intraluminal flow and pressure cannot be easily distributed or dissipated. For example, a sudden and powerful force (the restraint) conveyed to the abdomen rapidly displaces bowel contents without time for relaxation of adjacent bowel loops. Intraluminal pressure consequently rises promptly even though the lumen is not occluded. Rupture (blow-out) results when the internal pressure is sufficient to overcome the limit of bowel elasticity, which is called "bursting wall tension."

This conclusion is supported by the fact that the impact force caused by acute frontal deceleration has been estimated to approach 2000 pounds. Tests have shown that eight pounds of force suddenly applied to the abdomen of a dog raises internal jejunal pressure to a level beyond which the human small intestine ruptures; the estimates of impact force from the lap belt during acute frontal deceleration are almost 250 times this force.245 On the other hand, gastric and colonic perforations are relatively

242. See Seitter & Sharp, supra note 192.
243. See Sube, supra note 193.
244. See Witte, supra note 211. This study derided those theories of bursting due to closure of the bowel loop or acute flexion of the intestine on the vertebral column as contrived.
245. Id.
uncommon. The stomach has a wide lumen, a thick wall and three muscular layers, so that considerably more force is required to exceed its "bursting wall tension."

The forward acceleration of the upper torso, combined with a constrained pelvis, may also cause the lap seat belt to act as a fulcrum for acute flexion of the trunk. Facial or scalp injury occurs when the head hits the dashboard. The addition of a shoulder harness may not only prevent this from happening, but by containing the crash victim in the upright position, it may also reduce the deceleration blow to the abdomen.240

C. Lumbar Injuries Caused by Seat Belts

1. LAP BELT INJURIES

There is no doubt that the automobile lap-type seat belt is an effective means of reducing the severity of injury and the incidence of fatality to automobile accident victims. If a passenger is unrestrained, the collision forces are dissipated on the skull, thorax and/or extremities. On the other hand, the lap belt focuses the collision forces on the pelvis and lower part of the torso. Due to its rugged construction, the lumbar spine is usually able to absorb the applied forces without structural failure. However, when the applied force exceeds the stress resistance of the spine's musculoskeletal parts, it produces lumbar fractures and/or fracture-dislocations.247

The most comprehensive study to date on lumbar-spine injuries sustained by persons wearing lap belts involved twenty-four such injuries.248 In twenty of these cases, there was a specific pattern of lumbar spine injury, involving a transverse type of lumbar fracture, which is extremely rare in unbelted individuals. The injury is characterized by the following: (1) a disruption of the posterior elements of the lumbar-spine—the disruption may be osseous, ligamentous, or both; (2) a longitudinal separation of the disrupted posterior elements; (3) a minimal, or no decrease in the anterior vertical height of the involved vertebral body; (4) a minimal, or no forward displacement of the superior vertebral fragment or vertebra; (5) a minimal, or no lateral displacement of this fragment or the superior vertebra; (6) location of the disruption between the first and third lumbar vertebrae in the majority of cases; and (7) seat belt contusions in the form of a typical band of ecchymosis across the abdomen in all but one case.249

One of the early studies on seat belt injuries noted with interest twelve cases of lumbar spine injuries, including four minor subluxations

246. Id.
247. Smith & Kaufer, supra note 196.
248. Id.
249. Id. at 239.
or severe contusions and eight serious injuries. The severe injuries consisted of compression fractures of the bodies of the second to fourth lumbar vertebrae (L2 to L4). One of these compression fractures was associated with permanent cord injury and possible partial disability.

A unique case of a transverse fracture of a lumbar vertebral body, which occurred when the victim ran into a steel pole head-on at an estimated speed of 80 miles per hour, has been reported. This fracture, which was not discovered until one month after the accident, was attributed to improper placement of the lap belt. The belt acted as a fulcrum, literally splitting apart the vertebral body by acute flexion of the torso over the lap belt.

In a subsequent case involving a similar "fulcrum fracture," the victim was wearing a loosened lap belt when the sports car in which she was riding struck the rear of a semi-trailer truck at a high rate of speed. The victim sustained a transverse fracture of the third lumbar vertebra, which involved the vertebral body, the pedicles, the transverse processes and the lamina. In addition, there was a small compression fracture of the anterosuperior margin of the vertebral body.

An injury of the cervical spine caused when the driver of a vehicle impacts his chin on the steering wheel rim, causing acute flexion of the neck, has been described as the "hangman's fracture." This type of injury has been attributed to the driver jackknifing over the lap belt. Eight cases in which the drivers sustained such a fracture-dislocation of the second and third cervical vertebrae have been reported.

Lap belt injuries to the spine usually occur in high speed front end collisions, due to the hyperflexion experienced by belt passengers in such accidents. In two reported cases, the victims sustained compression fractures of the fourth and fifth lumbar vertebrae.

It is clear that spinal fractures may be anticipated in lap belt injuries, including fractures of the transverse processes, pedicles, lamina and the vertebral body. In one reported case, the victim was involved in a head-on collision at 45 miles per hour and sustained a combination of these injuries from a lap belt loosely applied over the abdomen. The victim exhibited edema and ecchymosis in the paraspinal areas from the lower border of the rib cage to the top of the iliac crest posteriorly. X-rays revealed fractures of the transverse process of L1, L2 and L3 on the left with inferior displacement of the distal fracture fragments. In addition, there was a fracture through both pedicles and laminae of L3.

250. See Garrett & Braunstein, supra note 182.
252. Fletcher & Brogdon, supra note 231.
254. See Doersch, supra, note 182.
fractures of the bodies of L2 and L3, narrowing of the L2-L3 interspace, with a minor degree of subluxation of L2 or L3, resulting in a kyphotic deformity at the L2-L3 level.

With the lap belt alone, the forces involved are applied to a small surface area and the potential for injury to the lumbar spine is significant. Lumbar fractures of a peculiar type result from the hyperflexion of the entire vertebral column about the belt. The result is a disruption of the posterior bony and ligamentous elements of the lumbar spine with extension to the adjacent bony parts, but without displacement or compression of the vertebral body. In fact, a Chance fracture, which is a horizontal fracture of the vertebral body (in this case L2), spine and transverse processes, has been attributed to a lap belt.

A further instance has been reported in which a lumbar compression fracture was attributed to the lap belt. The hyper-flexion of the victim’s body over the lap belt literally splits the vertebral body apart, fracturing the pedicles, transverse process and lamina of the third lumbar vertebra.

As previously mentioned, the most comprehensive study to date described the characteristic lumbar vertebral injuries associated with the lap-type seat belt. In all but six of the twenty-four patients in that series, the injury was between the first and second lumbar vertebrae. The high incidence at this level is in sharp contrast to the usual site of traumatic fractures of the lumbar spine which is the twelfth thoracic or first lumbar vertebra. It is interesting to note that only one of the patients studied was occupying the driver’s seat at the time of the accident; this would indicate that the steering wheel serves to restrain the hyperflexion experienced by most of the victims.

In the same study, there was a consistent pattern of separation of the posterior elements while anterior compression was either absent or minimum. Since all the components of the inter-vertebral joint at the level of the belt lie posterior to the axis, they are subject to equal tension stress so that little or no compression or displacement occurs. The operative findings included ruptures of the interspinous ligaments, the capsules of the joints between the articular processes, the ligamentum flavum, and the posterior longitudinal ligaments. One patient sustained a posterior protrusion of the nucleus pulposis.

A mild variation of this pattern was found in seven of the patients, who suffered avulsions of one or both superior articular processes, in addition to the characteristic injuries. Avulsion of the inferior articular processes did not occur. Two other victims had a well-defined avulsion fracture of the posterior inferior portion of the dislocated vertebra. Five of the patients also sustained a horizontal fracture line (Chance fracture)

256. See Ritchie, supra note 222.
257. See Hodson-Walker, supra note 183.
258. See Snyder, supra note 184.
259. See notes 247-249 supra and accompanying text.
extending across the vertebral body and continuing posteriorly through the pedicles, transverse processes, laminae and spinous process.

Finally, paraplegia occurred in four of the twenty-four patients. These four victims tended to have higher spinal injuries (T1 to L2), and unlike the typical seat belt fracture, they exhibited significant displacement of the vertebra. Therefore, it would appear that the typical seat belt vertebral injury is a neurologically-benign lesion, unless it is accompanied by anterior or lateral displacement of the injured segments.  

Although the lap belt was instrumental in producing the lesions described in that study, the physicians stressed that their report should not be considered an indictment of the lap belt. All of the lesions studied resulted from severe collisions. The physicians concluded that if the victims had not been wearing seat belts, they would not have survived. Further, if the patients had been wearing shoulder belts, it was concluded that the injuries might not have occurred.

2. SHOULDER BELT INJURIES

The three point system is considered to be a far superior safety device than the use of the lap belt alone. It reduces the hyperflexion of the body over the lap belt, so that the upper body is prevented from flexing forward and striking injury-producing structures.

Therefore, it is interesting that a hyper-flexion, hyper-extension ("whiplash") injury has been attributed to this combination belt system. This system has also been implicated with other minor cervical injuries. It should be stressed that the shoulder belt should only be worn in conjunction with the lap belt, and never alone; otherwise, decapitation and other severe injuries to the internal organs of the neck are likely.

Four individuals who were wearing the combination lap-diagonal shoulder belts were involved in a head-on collision. Three of them received severe abdominal ruptures and two of these had flexion-compression injuries to the vertebra. However, improper use of the belt (too loose) was believed to have been an important injury-producing factor.

Finally, although the shoulder belt is an effective safety device, it cannot guarantee safety. It will prevent acute flexion of the spine but may be responsible for fractures of the sternum and rib cage. Furthermore, it has been implicated as the cause of a rupture of the left atrium,

260. See Smith & Kaufer, supra note 196.
261. Id.
262. See Snyder, supra note 184.
263. See States, supra note 189.
264. See Seitter & Sharp, supra note 192.
265. See Fletcher & Brogdon, supra note 231.
266. Lindgren & Warg, Seat Belts & Accident Prevention, 188 Practitioner 467 (1962).
in addition to fractures of the rib cage and sternum to a passenger who was wearing this type of restraint.\textsuperscript{267}

3. MECHANISM OF INJURY

The lap belt focuses collision forces on the pelvis and lower torso. Due to its rugged construction, the lumbar spine is usually able to absorb this force without structural failure. However, in some cases the force applied exceeds the stress resistance in this area and fractures result.

In one of the early studies on seat belt injuries,\textsuperscript{268} it was observed that most accidents which resulted in lumbar spine injuries were remarkably similar in several respects: (1) in a majority of the cases, impact speed exceeded 50 miles per hour; (2) in most cases, the vehicle was subjected to violent spinning or bouncing gyrations often accompanied by multiple impacts; and (3) in a few of the cases, a vertical component of force was introduced when the car jumped a ditch or ran off an embankment and landed on its wheels. Change of direction in all of the cases occurred so violently and rapidly that it was concluded that the restraining action of the lap belt probably contributed to the injuries. Because of the severity of the accident, however, it was believed that these cases would probably have produced the same, or worse, injuries if belts had not been worn.

In the most recent comprehensive study of lumbar injuries,\textsuperscript{269} it was concluded that fractures and fracture-dislocations of the lumbar spine are generally the result of compression, shear or torsion stresses, acting singly or in combination. The most common lumbar fracture is the simple compression fracture produced by a combination of vertical load and hyperflexion. When the lumbar spine is subjected to a vertical load, it is forced into flexion. Normally, flexion and extension of the intact lumbar spine occur around an axis that passes through the center of the nucleus pulposus. As flexion occurs around this axis, the portions of the vertebral bodies anterior to the axis are subjected to compression, while the portions posterior to the axis are subjected to tension. The distance from this axis to the anterior margin of the body is one-fourth the distance from the axis to the spinous process. Therefore, the anterior parts of the vertebral bodies are subjected to compression four times as great as the tension force on the posterior ligaments.

For this reason, when the lumbar spine is subjected to pure flexion forces, a vertebral body is crushed long before the posterior ligaments will rupture. Hyperflexion alone is not capable of producing either dislocation or fracture dislocation; but if hyperflexion and a vertical load are combined with a torsional force, then the tension on the posterior liga-

\textsuperscript{267} See Garrett & Braunstein, supra note 175.
\textsuperscript{268} See Smith & Kaufer, supra note 196.
\textsuperscript{269} Id.
ments is increased, so that they may fail at the same time anterior compression occurs. This combination of forces is the probable mechanism of lumbar fracture-fracture-dislocation.270

If the wearer of a lap belt is subjected to sudden deceleration, the resulting hyperflexion subjects the entire spine to tension stress, and a pure tension injury may result. The victims in a study of that phenomenon271 literally had their spines pulled apart. There was evidence of disruption of the posterior ligamentous structures, indicating that the spine failed under tension. It was concluded that the simplest mechanism which could account for the pattern of disruption and displacement observed was failure of the spine during distraction. The reporting physicians noted that consideration of tension stress as the primary mechanism producing these lumbar injuries represented a significant departure from the conventional flexion-rotation mechanism. However, there was a sound medical basis for this conclusion, and tension stress has been shown to be a mechanism of injury in the cervical spine.

Finally, the physicians concluded that the specific pattern of unusual and consistent marked separation between the posterior spinal elements, without the expected decrease in anterior vertical height, was caused by the primary tension stress of the lap belt. However, they stated that their report should not be considered an indictment of the lap belt, which is instrumental in preventing more severe injuries and death.272

270. Id.
271. Id.
272. Id.