

Assessing the impact of radiological measurement methods on forensic medical reports in traumatic vertebral compression fractures

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ABSTRACT

BACKGROUND: Vertebral compression fractures of varying severity and morphology may result from trauma and often require the preparation of a forensic medical report. Given the legal implications, accurate measurement of the compression ratio is critical. This study aims to evaluate whether four literature-defined methods for determining compression ratios are consistent with one another and with radiology reports, and to examine whether the choice of method alters the conclusions of forensic medical reports.

METHODS: A retrospective review was conducted of forensic reports issued by our Department of Forensic Medicine between June 1, 2014 and June 1, 2024. Forty-two cases met the predefined inclusion criteria. For each vertebral fracture, the compression ratio was calculated using four established methods. Consistency was assessed both among these methods and between each method and the compression ratio documented in the corresponding radiology report. Finally, it was evaluated whether measurement discrepancies would alter the forensic conclusions regarding (1) the effect of the fracture on life functions, (2) permanent weakness or loss of function of one of the senses or organs, and (3) degree of disability.

RESULTS: Agreement among the four measurement methods was weak to moderate, with inconsistency rates of 14.8% to 66.7% compared to radiology reports. Forensic report conclusions varied according to the measurement method.

CONCLUSION: Method selection significantly influences both calculated compression ratios and the resulting conclusions of forensic reports in vertebral compression fractures. A standardized, universally accepted measurement protocol is therefore required in forensic practice to support fair and consistent legal decisions.

Keywords: Vertebral compression fracture; compression ratio; disability; forensic report.

INTRODUCTION

Trauma-related vertebral fractures constitute a major cause of global mortality and morbidity. In the United States, treatment and rehabilitation costs for spinal and spinal cord injuries rank second only to those for neonatal respiratory distress syndrome.^[1,2]

The reported incidence of vertebral injuries among trauma patients ranges from 5.8% to 23.2%.^[3,4] Mechanistically, these

fractures are classified into four main categories: compression fractures, burst fractures, flexion-distraction (Chance) fractures, and fracture-dislocations.^[5,6] Compression fractures are the most prevalent in the thoracic, lumbar, and subaxial cervical regions, accounting for 50%-70% of thoracolumbar vertebral fractures.^[6,7]

Traffic accidents, falls, violence, and sports/recreational injuries represent the leading etiologies. The incidence of traumatic spinal fractures is estimated at 136.9 per million in un-

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derdeveloped countries versus 87.2 per million in developed countries, with the highest rates observed among males aged 20–40 years.^[2,8,9]

Forensic Medical Significance of Vertebral Fractures

These injuries frequently arise from criminal incidents and require forensic evaluation. Under the Turkish Penal Code (TPC), prosecutorial authorities or criminal courts request definitive forensic medical reports. In civil cases and insurance claims, courts and insurers request assessments of causality and injury-specific disability to support compensation decisions. Therefore, clear, standardized guidelines for defining and reporting these injuries are crucial for accurate determination of criminal penalties and civil compensation.

The TPC, in force since 2005, specifies that a bone fracture increases the applicable penalty according to the “effect of the fracture on life functions” (EFLF). To standardize implementation, a guideline was issued by forensic medicine experts, defining a range of fracture types and assigning severity grades from 1 to 6 [10]. Under this guideline, vertebral compression fractures with a compression ratio (CR) below one-third are graded as 3 (moderate), whereas those exceeding one-third are graded as 4 (severe) (Table 1).

The TPC also provides for increased penalties when an injury causes permanent weakness or loss of function of a sense or organ (PWFO). The accompanying guideline defines this as follows: “If the anatomical loss and/or functional impairment of the organ or extremity corresponds to 10-50% of the or-

gan’s or extremity’s own anatomical structure and/or function, it should be considered ‘permanent impairment of function’; if it exceeds 50%, it should be regarded as ‘loss of function’.”^[10] Completion of the prescribed healing period is required for assessment: six months for conservatively treated adult vertebral corpus fractures and nine months if stabilization procedures have been performed (Table 1).^[11]

Disability is defined as the residual impairments that persist after completion of all treatment and rehabilitation. The quantification of these impairments using standardized tables, based on specific clinical parameters, is referred to as the “degree of disability.”^[12] Assessment of degree of disability also requires completion of the prescribed fracture healing period.^[11] In Türkiye, multiple medicolegal/legal regulations have been enacted over time, and the degree of disability is calculated according to the regulation in force at the time of injury (Table 1).^[13]

Forensic medical guidelines and tables for vertebral compression fractures—used in both definitive and disability reports—emphasize the vertebral body CR as a key determinant of report outcomes.^[10,14-16] However, no universally accepted standard method exists for measuring this ratio.^[17,18]

Various methods have been described for calculating the vertebral CR.^[17-20] The four most commonly used are:

Method 1: Ratio of the anterior to posterior height of the fractured vertebral body.^[17-20]

Method 2: Ratio of the anterior height of the fractured ver-

Table 1. Medicolegal evaluation in vertebral compression fractures

	Vertebral body compression ratio				
	<1/3	>1/3	<25%	25-50%	>50%
Definitive report					
Criminal case					
EFLF	3	4			
PWFO	If fusion surgery has been performed, permanent weakness is considered. In other cases, calculation according to the disability tables is recommended.				
Disability report					
Civil case					
Disability Table	15	22 ^{and}			
Impairment Table					
Injury model			8	13/18*	28/23*
ROM model			4/2/5*	6/3/7*	10/5/12*
Disability Guide					
Injury model			8	13/18*	28/23*
ROM model			4/2/5*	6/3/7*	10/5/12*

EFLF: Effect of fracture on life functions; PWFO: Permanent weakness or loss of function of one of the senses or organs. ^{and}If the compression ratio is greater than 1/2. *According to the cervical/thoracic/lumbar vertebral segment.

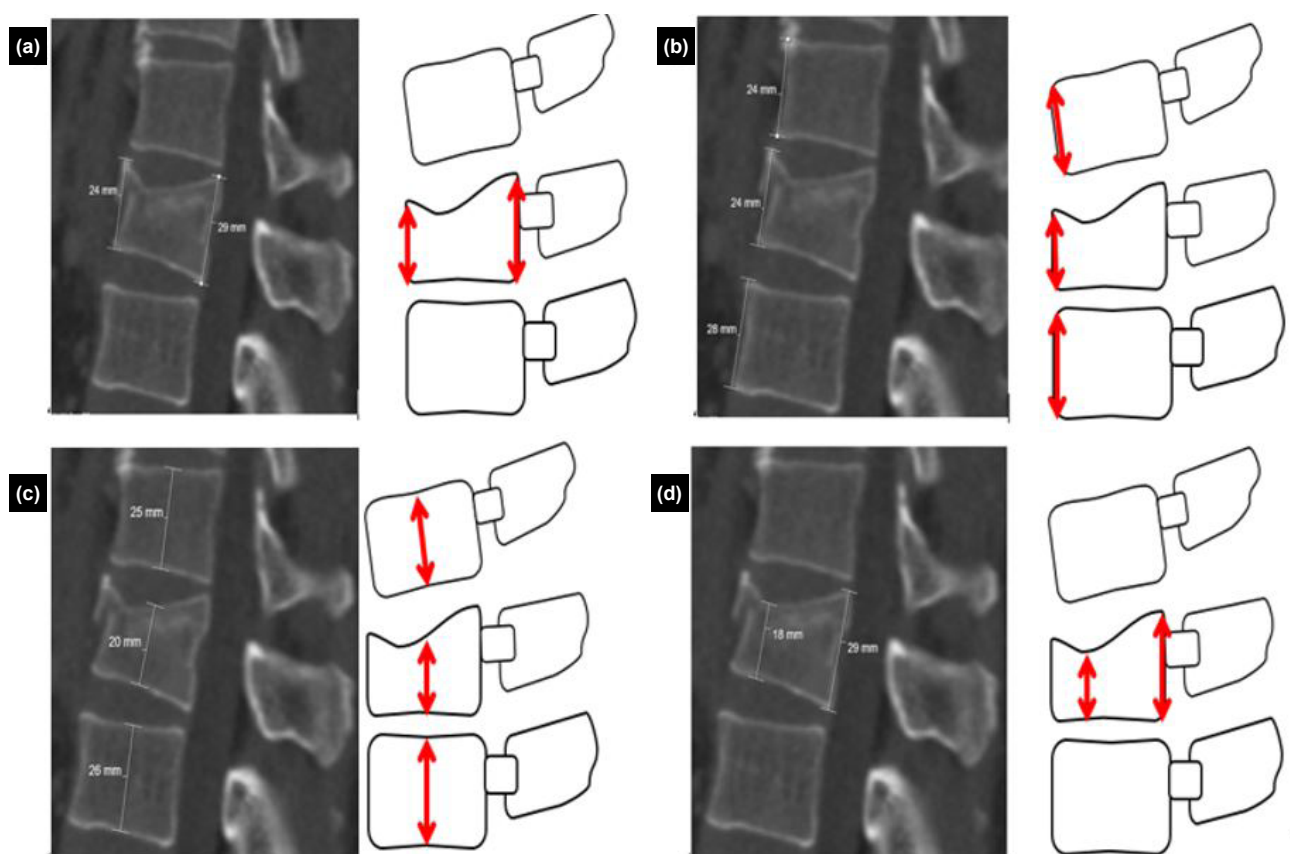


Figure 1. Methods for measuring the compression ratio (CR). (a) Method 1; (b) Method 2; (c) Method 3; (d) Method 4. For example, if the anterior height of the fractured vertebra is 24 mm and the posterior height is 29 mm, the compression rate calculated using Method 1 is: $(1-24/29)*100=17.2\%$.

tebral body to the mean anterior heights of the adjacent vertebrae.^[17-20]

Method 3: Ratio of the mid-vertebral (middle) height of the fractured body to the mean mid-vertebral heights of the adjacent vertebrae.^[19]

Method 4: Ratio of the minimal (deepest collapsed) height of the fractured vertebral body to its posterior height (Fig. 1).^[17]

A 2016 international survey of experts showed that 51.4%-54.6% of respondents used Method 1, while 34.6%-38.3% used Method 2.^[18] Data on the usage frequencies of the other methods are not available.

Although CR is a key determinant in both definitive and disability forensic reports, no standardized measurement method exists. This study aimed to evaluate whether variation in measurement methods for vertebral compression fractures—and therefore the absence of a standardized approach—significantly impacts forensic report outcomes, which play a critical role in both criminal and civil proceedings.

MATERIALS AND METHODS

Ethical Approval of the Study Protocol

This study was conducted with the approval of the Düzce

University Clinical Research Ethics Committee (date: 02.09.2024, approval number: 2024/169) and adhered to the principles of the Declaration of Helsinki.

Formation of the Data Group

Case files of definitive and permanent disability reports issued between June 1, 2014 and June 1, 2024, by the Düzce University Department of Forensic Medicine were reviewed retrospectively. Inclusion criteria were vertebral fractures with measurable height loss, accessible radiological images, and a confirmed causal relationship with trauma. Exclusion criteria comprised inadequate image quality, consecutive fractures in the same vertebral region, or unavailable imaging. Each image obtained at a different time and each fracture affecting a distinct vertebra were accepted as separate cases. A total of 42 cases met these criteria. Among them, 27 radiology reports included defined CRs, and 56 forensic reports were analyzed—27 on EFLF, 14 on PWFO, and 15 on degree of disability.

Data Collection and Processing Procedure

Radiological images (computed tomography [CT] or magnetic resonance imaging [MRI]) obtained on the day of injury were used to assess EFLF, whereas images acquired after completion of the defined healing period were used for PWFO and

Table 2. Comparison of cases by age and gender

Gender	Count (n)	Mean Age	Minimum	Maximum	Standard Deviation
Male	32	44.94	17	81	17.71
Female	10	43.00	21	78	20.53
Total	42	44.48	17	81	18.18

Table 3. Correlation between measurement methods [ICC (95% CI)]

	Method 1	Method 2	Method 3	Method 4
Method 2	ICC=0.8538 (0.7441 to 0.9187)			
Method 3	ICC=0.3938 (0.1055 to 0.6211)	ICC=0.5733 (0.3293 to 0.7455)		
Method 4	ICC=0.6357 (0.4141 to 0.7862)	ICC=0.6302 (0.4064 to 0.7826)	ICC=0.7628 (0.5995 to 0.8651)	

disability evaluations. CRs for each vertebral fracture were measured on PACS (Picture Archiving and Communication Systems) using the four methods described above. Radiology reports were reviewed for documented CR; when present, those values were recorded. Each method's CRs were compared pairwise and, where available, against the ratio documented in the radiology report. Furthermore, it was assessed whether variations in these CRs influenced the conclusions of the forensic reports. To assess reliability, all measurements were repeated by the same researcher after a three-week interval, and independently by a second researcher. Intra-class correlation coefficients were calculated for intra- and interobserver agreement.

Statistical Analysis

All analyses were carried out in the SPSS software (IBM Statistical Package for the Social Sciences, v22, Armonk, New York.). Categorical variables were summarized as frequency and percentage; continuous variables as mean±standard deviation, median, and minimum–maximum values. Inter-rater reliability was evaluated using kappa for categorical measures and the intraclass correlation coefficient (ICC) for continuous measures.^[21,22]

RESULTS

Descriptive Findings

Of the 42 cases, 76.2% (n=32) were male and 23.8% (n=10) were female. Ages ranged from 17 to 81 years (mean±SD: 44.48±18.18) (Table 2).

A total of 56 forensic reports were generated for these cases: 27 on EFLF, 14 on PWFO, and 15 on degree of disability. Of the 15 cases evaluated for disability, six were assessed using

the Disability Guide, four using the Impairment Table, and five using the Disability Table (Fig. 2).

In this study, in-vehicle traffic accidents were the leading cause of vertebral compression fractures (54.8%, n=23), followed by pedestrian injuries (26.2%, n=11). The least common etiology was impact from a falling heavy object (2.4%, n=1) (Fig. 3). Fractures were most frequent at L1 (21.4%, n=9), followed by L4 (14.3%, n=6), L2 (11.9%, n=5), and T12 (9.5%, n=4) (Fig. 4).

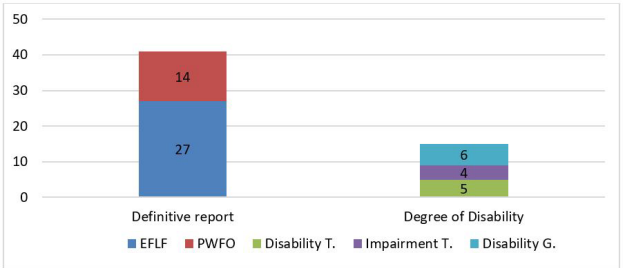


Figure 2. Distribution of cases according to the type of forensic report issued.

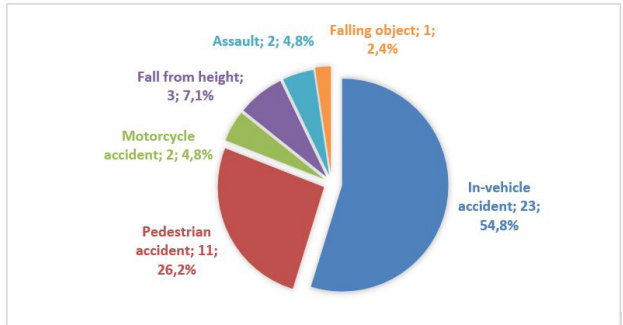


Figure 3. Percentage distribution of cases by type of incident.

Table 4. Comparison of radiology reports and measurement methods

	Radiology Reports (n)	%
Method 1		
Compatible	18	66.7
Incompatible	9	33.3
No data	15	-
Method 2		
Compatible	23	85.2
Incompatible	4	14.8
No data	15	-
Method 3		
Compatible	19	70.4
Incompatible	8	29.6
No data	15	-
Method 4		
Compatible	9	33.3
Incompatible	18	66.7
No data	15	-
Total	42	100%

Correlation Between Radiological Measurement Methods

Comparison of CRs across the four methods revealed the highest agreement between Method 1 and Method 2 (ICC=0.8538) and between Method 3 and Method 4 (ICC=0.7628). The lowest agreement was observed between Method 1 and Method 3 (ICC=0.3958) (Table 3).

Comparison of Radiological Measurement Methods with Radiology Report Results

Of the 42 imaging studies, each had an accompanying radiology report, but 15 of these did not specify a CR. Among the

27 reports with available ratios, the rates of discrepancy between the radiologist-reported value and each measurement method were: 14.8% (n=4) for Method 2, 29.6% (n=8) for Method 3, 33.3% (n=9) for Method 1, and 66.7% (n=18) for Method 4 (Table 4).

Comparison of Radiological Measurement Methods with Issued Forensic Report Results

For the assessment of EFLF, CRs derived from all four radiological measurement methods were inconsistent with the corresponding forensic report conclusions. Pairwise comparisons among the four radiological methods revealed good agreement between Method 1 and Method 2 ($\kappa=0.630$; 95% CI, 0.172–1.000), moderate agreement between Method 3 and Method 4 ($\kappa=0.497$; 95% CI, 0.190–0.804), and poor agreement between Method 2 and Method 4 ($\kappa=0.404$; 95% CI, 0.099–0.709). All other method pairs showed poor agreement (Table 5).

In comparison with the PWFO conclusions, Method 3 demonstrated good agreement ($\kappa=0.755$, 95% CI, 0.307–1.000) and Method 2 showed moderate agreement ($\kappa=0.567$, 95% CI, 0.032–1.000), whereas Method 1 ($\kappa=-0.418$, 95% CI, -0.124–0.960) and Method 4 ($\kappa=0.235$, 95% CI, -0.054–0.525) were inconsistent. Pairwise comparisons among the four methods showed that Method 1 and Method 2 agreed well ($\kappa=0.806$, 95% CI, 0.448–1.000), Method 2 and Method 3 also showed good agreement ($\kappa=0.755$, 95% CI, 0.307–1.000), and Method 1 and Method 3 exhibited moderate agreement ($\kappa=0.581$, 95% CI, 0.0953–1.000), while Method 4 remained inconsistent with all others (Table 6).

Comparing the conclusions of the 15 disability reports with the results from each radiological measurement method revealed discrepancies in 20% (n=3) of cases for Method 1, 33.3% (n=5) for Method 2, 13.3% (n=2) for Method 3, and 40% (n=6) for Method 4 (Table 7).

Assessment of Measurement Consistency

Intra- and interobserver reliability was assessed by having the primary researcher repeat all measurements three weeks af-

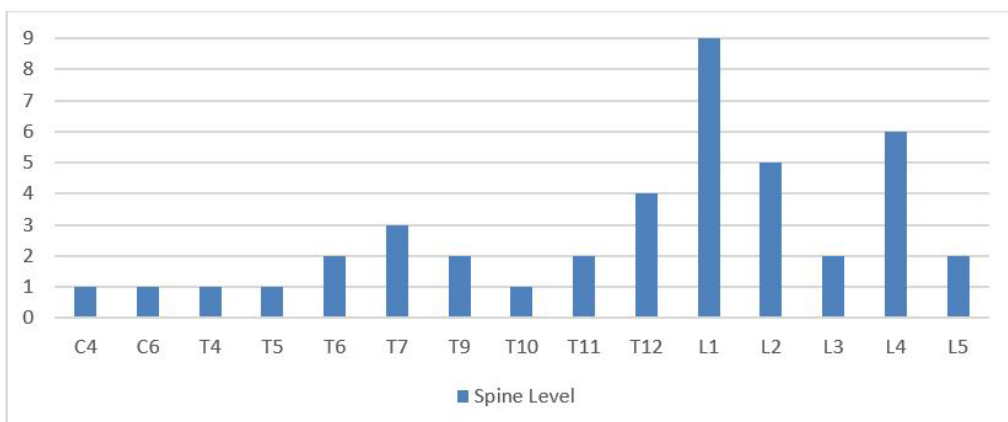
**Figure 4.** Distribution of vertebral fractures by spinal level.

Table 5. Comparison between forensic report values and measurement-based values for the severity grade of EFLF (effect of the fracture on life functions)

n=27	Forensic Report Value			Method 1			Method 2			Method 3							
	3	4	κ (95% CI)	3	4	κ (95% CI)	3	4	κ (95% CI)	3	4	κ (95% CI)					
M1																	
	3	18	7	κ = -0.130													
	4	2	0	(-0.281 to 0.0204)													
M2																	
	3	18	5	κ =0.216			23	0	κ =0.630								
	4	2	2				2	2	(-0.190 to 0.621)		(0.172 to 1.000)						
M3																	
	3	18	4	κ =0.362			20	2	κ =-0.118		20	2	κ =0.335				
	4	2	3	(-0.0438 to 0.768)			5	0	(-0.244 to 0.00724)		3	2	(-0.121 to 0.791)				
M4																	
3	13	3	κ =0.187			16	0	κ =0.208		16	0	κ =0.404		16	0	κ =0.497	
4	7	4	(-0.174 to 0.548)			9	2	(-0.0496 to 0.467)		7	4	(0.0986 to 0.709)		6	5	(0.190 to 0.804)	

M1: Method 1; M2: Method 2; M3: Method 3; M4: Method 4. EFLF: Effect of fracture on life functions.

Table 6. Comparison between forensic report decisions and measurement-based decisions for PWFO (permanent weakness or loss of function of one of the senses or organs)

n=13	Forensic Report Value				Method 1			Method 2			Method 3			
	N	W	κ (95% CI)		N	W	κ (95% CI)	N	W	κ (95% CI)	N	W	κ (95% CI)	
M1														
	N	8	1	κ = -0.418										
	W	2	2	(-0.124 to 0.960)										
M2														
	N	9	1	κ =0.567			9	1	κ =0.806					
	W	1	2				0	3	(0.448 to 1.000)					
M3														
	N	10	1	κ =0.755			9	2	κ =0.581		10	1	κ =0.755	
	W	0	2	(0.307 to 1.000)			0	2	(0.0953 to 1.000)		0	2	(0.307 to 1.000)	
M4														
	N	4	0	κ =0.235			4	0	κ =0.330		4	0	κ =0.150	
	W	6	3	(-0.0540 to 0.525)			5	4	(-0.0121 to 0.672)		6	3	(-0.0540 to 0.525)	
											7	2	(-0.0756 to 0.375)	

M1: Method 1; M2: Method 2; M3: Method 3; M4: Method 4. PWFO: Permanent weakness or loss of function of one of the senses or organs. N: Normal; W: Weakness.

ter the initial evaluation, and a second researcher independently measure each case using each method. Intraclass correlation analysis demonstrated excellent consistency for all methods (Table 8).

DISCUSSION

This study analyzed 42 cases of trauma-related vertebral compression fractures reported by our Department of Forensic Medicine. Of these, 76.2% (n=32) were male and 23.8% (n=10) female, with mean ages of 44.94±17.71 years for

males and 43.00±20.53 years for females. Incident etiology included in-vehicle traffic accidents in 54.8% (n=23), pedestrian injuries in 26.2% (n=11), and falls from height in 7.1% (n=3). Although epidemiological data vary according to country development level, incident type, and study year, most literature reports a predominance of males aged 31.7–50.9 years, with traffic accidents as the leading cause and falls from height as the second most common mechanism.^[2-4,7,8,23] Therefore, our cohort is consistent with the literature in terms of gender distribution, age, and etiology.

Table 7. Comparison between forensic report and measurement-based values for disability ratios

n=15	Forensic Report Value	Method 1	Method 2	Method 3	Method 4
Case 3	8	13	13	8	13
Case 7	29	21.2	21.2	29	29
Case 8	4	4	4	4	4
Case 9	4	4	4	4	5
Case 12	15	15	0	0	15
Case 13	17	17	17	17	17
Case 16	32	32	32	32	32
Case 20	8	8	8	8	13
Case 22	23.5	23.5	23.5	23.5	23.5
Case 23	37	37	37	37	37
Case 27	26.2	26.2	26.2	26.2	26.2
Case 29	18	18	8	18	23
Case 32	8	8	0	8	18
Case 35	8	13	13	8	13
Case 36	13	13	13	8	13
Rate of differing results (n,%)		3 (20%)	5 (33.3%)	2 (13.3%)	6 (40%)

Table 8. Interobserver correlation

	1st researcher (1st and 2nd measurements)		1st researcher and 2nd researcher	
	ICC	95% CI	ICC	95% CI
Method 1	0.9579	0.9232-0.9772	0.9274	0.8690-0.9603
Method 2	0.9901	0.9817-0.9947	0.9703	0.9454-0.9839
Method 3	0.9729	0.9502-0.9854	0.9695	0.9440-0.9835
Method 4	0.9516	0.9118-0.9737	0.9433	0.8970-0.9691

In our cohort, transportation-related incidents (in-vehicle, motorcycle, and pedestrian accidents) comprised 85.3% of cases—markedly higher than rates reported in previous studies.^[2-4] This likely reflects our exclusive inclusion of vertebral injuries undergoing forensic evaluation, as self-inflicted or non-forensically referred events (e.g., simple falls, heavy-object impacts, sports injuries) often bypass forensic assessment.

As emphasized in the literature, the thoracolumbar junction (T10–L2) accounts for over half of all spinal fractures, a vulnerability attributed to its transitional anatomy between kyphosis and lordosis, high mobility, exposure to diverse mechanical forces, and relatively weak muscular support. In our series, fractures most commonly involved L1 (n=8), L4 (n=6), L2 (n=5), and T12 (n=4), with 47.6% (n=20) of cases affecting the thoracolumbar junction, consistent with previous reports.^[5,24,25]

From a clinical standpoint, multiple classification systems have

been proposed to guide the choice between conservative and surgical management of vertebral compression fractures.^[26,27] Although contemporary schemes incorporate a range of radiological and clinical parameters, assessment of vertebral height loss remains a cornerstone of the most widely used practical classifications.^[28]

Despite its recognized importance, no single classification has achieved universal acceptance, nor has any standardized protocol for measuring vertebral height loss been established.^[17,18] This lack of consensus undermines the validity and consistency of treatment decisions. In their 2006 review, the Spine Trauma Study Group evaluated several measurement techniques—detailing each method's strengths and limitations—and ultimately recommended Method 2 for routine clinical practice.^[17]

In a 2016 global survey of neurosurgeons, orthopedic surgeons, and trauma surgeons, practitioners were asked which

method they employ to assess vertebral height loss. Depending on the vertebral segment and geographic region, 51.4% to 54.6% of respondents favored Method 1, whereas 34.6% to 38.3% preferred Method 2. This study not only highlights the absence of consensus in clinical practice but also challenges the earlier endorsement of Method 2, arguing that such recommendations should await further reliability investigations.^[18]

Method 1 quantifies vertebral compression by calculating the ratio of the anterior to posterior height of the fractured vertebral body. This straightforward and rapid approach evaluates the structural integrity of the anterior and middle columns. However, in burst fractures the posterior wall may also collapse, leading to underestimation of the true degree of compression.^[19,20] In our series, CRs derived using this method differed by more than one-third from those reported by the radiology specialist and were discordant with both the EFLF and PWFO determinations in the forensic reports. Moreover, application of Method 1 would have altered the disability rating in 20% of the disability reports.

Method 2 defines vertebral compression as the ratio of the anterior height of the injured vertebra to the mean anterior heights of the adjacent vertebrae. By anchoring measurements to intact vertebrae, this approach remains valid even when collapse affects the entire vertebral body. Comparative analyses have shown that Method 1 underestimates compression relative to Method 2, and Method 2 has been specifically recommended for burst fractures.^[19,20] In our cohort, CRs calculated using Method 2 diverged from the radiology specialist's values in 14.8% of cases. Poor correlation was observed with EFLF determinations, while moderate agreement was found with PWFO assessments. Moreover, applying Method 2 would have altered the disability rating in one-third of the forensic disability reports.

Method 3 quantifies vertebral compression by comparing the mid-vertebral height of the injured vertebra to the mean mid-vertebral heights of the adjacent cephalad and caudad segments. Limited radiographic evidence suggests that other techniques may underdiagnose fractures with prominent central column collapse, particularly in osteoporotic spines where mid-body weakness predisposes to instability.^[14] In our series, CRs calculated by Method 3 differed from the radiology specialist's measurements in 29.6% of cases. This method exhibited poor agreement with EFLF determinations but good agreement with PWFO assessments, and it would have altered the disability rating in 13.3% of the forensic disability reports.

Method 4 defines vertebral compression as the ratio of the point of maximal collapse to the posterior height of the fractured vertebra. Although this approach lacks robust validation, it is argued to better capture focal deformities than fixed-wall techniques.^[19] In our series, CRs derived by Method 4 diverged from the radiologist's measurements in 66.7% of cases and showed poor agreement with both EFLF and PWFO determinations. Moreover, applying this method would have al-

tered the disability rating in 40% of forensic reports. Despite its theoretical advantage—since trauma can produce collapse in varying vertebral regions—Method 4 proved the least consistent with expert assessments and yielded the highest rate of discrepancies in disability evaluations.

Pairwise comparisons among the four measurement methods revealed that none demonstrated perfect consistency. The strongest agreement occurred between Methods 1 and 2 (ICC=0.8538), which may reflect their shared reliance on anterior vertebral height. Yet, the robust correlation between Methods 3 and 4 (ICC=0.7628), despite no common measurement parameter, and the moderate agreement between Methods 1 and 4 (ICC=0.6357), both of which employ posterior vertebral height, call this assumption into question. All remaining intermethod comparisons yielded only weak to moderate consistency.

Articles 87 and 95 of the Turkish Penal Code define “aggravated injury resulting in consequences” and “aggravated torture resulting in consequences,” respectively, prescribing enhanced penalties when a bone fracture is demonstrated. Because vertebral fracture CRs are calculated using various non-standardized formulas, forensic reports may assign disparate EFLF ratings (and thus different sentences) for identical fracture patterns. In our study, none of the four measurement methods demonstrated consistency with the EFLF determinations recorded in forensic reports. This inconsistency underscores the urgent need for forensic experts and injury assessment authorities to adopt a single, validated protocol for quantifying vertebral compression fractures.^[10]

Articles 87, 89, and 95 of the Turkish Penal Code designate permanent weakening of function as an aggravating factor in sentencing. The accompanying guideline lists commonly encountered conditions and specifies only spinal injuries treated with fusion surgery as PWFO. Although vertebral fractures are both frequent and highly morbid, no additional fracture patterns are defined; for unlisted conditions, the guideline refers to general disability–impairment tables. In our study, we compared each radiological measurement method's results with the PWFO determinations recorded in the forensic reports. Methods 1 and 4 showed poor agreement with the issued PWFO decisions, whereas Methods 2 and 3 demonstrated moderate agreement.

When we compared measurement methods against 15 issued disability reports, we found inconsistencies in 20% of cases for Method 1, 33.3% for Method 2, 13.3% for Method 3, and 40% for Method 4. Such discrepancies between expert reports may raise doubts among decision-makers regarding their reliability. Our data indicate that these inconsistencies stem not only from differences in expert opinions but also from measurement techniques. This situation underscores the urgent need for standardization of vertebral compression assessment in forensic medicine practices.

Another critical concern involves the imaging reports issued

by radiology specialists. In our series, approximately one-third of these reports noted only the presence of a fracture and omitted any quantification of vertebral compression. Among the reports that did include a CR, none specified the measurement method employed.

From a clinical standpoint, treatment decisions integrate multiple parameters defined by fracture classification systems—fracture morphology, neurological status, and comorbidities—and spine surgeons typically review imaging studies directly. In forensic practice, however, the reported CR profoundly influences expert conclusions, even when no other abnormalities are present, and forensic physicians customarily base their evaluations on the radiologist's report.

In practice, forensic authorities sometimes must issue reports based solely on medical documentation—without direct patient examination—or may lack access to the underlying imaging studies. In our series of 27 cases in which radiology reports specified a CR, the proportions of measurements that diverged from the radiologist's value were 33.3% for Method 1, 14.8% for Method 2, 29.6% for Method 3, and 66.7% for Method 4.

Although our investigation was limited to a single center, the ten-year inclusion period and the outsourcing of emergency imaging to external radiology services resulted in fracture reports prepared by a wide array of radiologists. The pronounced discrepancies between radiologists' documented CRs and those derived from our standardized measurement methods imply an underlying lack of consistency in vertebral height assessment protocols.

A single-point variation in EFLF severity grading or a determination of PWFO can markedly increase criminal penalties, and even a 1% discrepancy in measured compression may alter civil compensation. Such variability—rooted in non-standardized measurement techniques—is therefore unacceptable. Expert witnesses must base their reports on rigorous scientific and technical methods before submitting them to judicial authorities.^[29] Yet forensic evaluations often depend on radiology reports that either omit the CR altogether or fail to specify the measurement method used. In our series, none of the four methods we assessed fully corresponded to the CRs documented by radiologists.

Limitations

The main limitation of this study was the modest sample size. Factors contributing to this include the relatively small population of our province, the fact that forensic medical reports are also prepared by the Forensic Medicine Branch Directorate and state hospital outside our department, the poor image quality in some cases, and our inability to obtain radiographs taken at external centers.

CONCLUSION

Multiple techniques are available for quantifying vertebral compression in fracture cases, yet no universally accepted

standard method exists. The vast majority of studies address measurement from a clinical standpoint and—to our knowledge—none have explored its medicolegal implications.

Omitting the measurement protocol in both radiological and forensic reports leads to inconsistent evaluations and threatens procedural fairness. To prevent such disparities and uphold judicial integrity, forensic assessments must adopt a single, validated measurement procedure that aligns with legal criteria. Expert opinions should meet the highest scientific and technical standards, integrating vertebral compression quantification into disability and impairment frameworks as well as forensic medical practice.

We recommend conducting multicenter studies with larger cohorts to identify the most reliable measurement method and establish consensus guidelines for vertebral compression assessment.

Ethics Committee Approval: This study was approved by the Düzce University Clinical Research Ethics Committee Ethics Committee (Date: 02.09.2024, Decision No: 2024/169).

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ORİJİNAL ÇALIŞMA - ÖZ

Travmatik vertebra kompresyon kırıklarında radyolojik ölçüm yöntemlerinin adli tıbbi raporlar üzerindeki etkisinin değerlendirilmesi

AMAÇ: Travma sonucunda farklı şiddet ve morfolojide vertebra kompresyon kırıkları oluşabilmekte ve çoğu zaman adli tıbbi rapor hazırlanması gerekmektedir. Hukuki sonuçları göz önüne alındığında, kompresyon oranının doğru ölçülmesi kritik öneme sahiptir. Bu çalışma, literatürde tanımlanmış dört farklı ölçüm yönteminin kompresyon oranını belirlemede birbirleriyle ve radyoloji raporlarıyla uyumlu olup olmadığını değerlendirmeyi ve yöntem seçiminin adli tıbbi rapor sonuçlarını değiştirip değiştirmediğini incelemeyi amaçlamaktadır.

GEREÇ VE YÖNTEM: 1 Haziran 2014 ile 1 Haziran 2024 tarihleri arasında Adli Tıp Anabilim Dalı tarafından düzenlenmiş adli raporlar retrospektif olarak incelenmiştir. Önceden belirlenmiş dahil etme kriterlerini karşılayan 42 olgu çalışmaya dahil edilmiştir. Her bir vertebra kırığı için kompresyon oranı, literatürde tanımlanmış dört farklı yöntemle hesaplanmıştır. Tutarlılık hem bu yöntemler arasında hem de her bir yöntem ile ilgili radyoloji raporunda belgelenen kompresyon oranı ile karşılaştırılarak değerlendirilmiştir. Son olarak, ölçüm farklılıklarının adli tıbbi raporlardaki şu üç konuda sonucu değiştirip değiştirmediği incelenmiştir: (1) Kırığın hayat fonksiyonlarına etkisi, (2) duyu veya organlardan birinin işlevinde sürekli zayıflama ya da kayıp, (3) engellilik oranı.

BULGULAR: Dört ölçüm yöntemi arasındaki uyum zayıf ile orta düzeyde bulunmuş olup, radyoloji raporlarıyla karşılaştırıldığında tutarsızlık oranları %14.8 ile %66.7 arasında değişmiştir. Adli tıbbi rapor sonuçları, kullanılan ölçüm yöntemine göre farklılık göstermiştir.

SONUÇ: Yöntem seçimi, hem hesaplanan kompresyon oranlarını hem de vertebra kompresyon kırıklarına ilişkin adli tıbbi raporların sonuçlarını önemli ölçüde etkilemektedir. Bu nedenle, adli uygulamalarda adil ve tutarlı hukuki kararları desteklemek amacıyla standart ve evrensel olarak kabul edilmiş bir ölçüm protokolüne ihtiyaç vardır.

Anahtar sözcükler: Adli tıbbi rapor; engellilik; kompresyon oranı; vertebra kompresyon kırığı.

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