ORIGINAL ARTICLE

CASTING OR BRACING? LONG-TERM CLINICAL AND RADIOLOGICAL OUTCOMES OF TWO CONSERVATIVE MODALITIES IN THORACOLUMBAR VERTEBRAL FRACTURES

Alçı veya Korse? Torakolomber Vertebra Kırıklarında İki Konservatif Yöntemin Uzun Dönem Klinik ve Radyolojik Sonuçları

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ABSTRACT

Objective: To evaluate and compare the long-term clinical and radiological outcomes of hyperextension casting and Jewett bracing for the conservative management of thoracolumbar vertebral compression fractures.

Material and Methods: Patients with stable compression fractures between T10 and L2, treated conservatively with either hyperextension casting (Group A) or Jewett bracing (Group B) from 2002 to 2012, were retrospectively reviewed. Pain levels were assessed using the Visual Analog Scale (VAS), functional status via the Oswestry Disability Index (ODI), kyphotic angle by the Cobb method, and patient satisfaction was also recorded.

Results: A total of 35 patients were included (Brace group: n = 18; Cast group: n = 17). There were no statistically significant differences between groups in terms of age, sex, bone mineral density (BMD) index, or follow-up duration ($p > 0.05$). However, hospital stay was significantly longer in the cast group (2.1 ± 0.68 days vs. 1.1 ± 0.52 days, $p < 0.001$). Kyphotic deformity progression was significantly less in the cast group ($p=0.042$). No major complications occurred, but earlier mobilization was achieved in the brace group.

Conclusion: Although Jewett bracing provided advantages regarding early mobilization and functional recovery, hyperextension casting was more effective in limiting long-term kyphotic progression.

Keywords: *Thoracolumbar Fracture; Hyperextension Cast; Jewett Brace; Conservative Treatment; Kyphotic Angle*

ÖZET

Amaç: Torakolomber vertebral kompresyon kırıklarının konservatif tedavisinde hiperekstansiyon alçısı ve Jewett ateli ile elde edilen uzun dönem klinik ve radyolojik sonuçları değerlendirmek ve karşılaştırmak.

Gereç ve Yöntemler: 2002-2012 yılları arasında T10 ve L2 arasında stabil kompresyon kırıkları olan ve hiperekstansiyon alçı (Grup A) veya Jewett ateli (Grup B) ile konservatif tedavi uygulanan hastalar retrospektif olarak değerlendirildi. Ağrı düzeyleri Görsel Analog Ölçeği (VAS) ile, fonksiyonel durum Oswestry Engellilik Endeksi (ODI) ile, kifotik açı Cobb yöntemi ile değerlendirilmiş ve hasta memnuniyeti de kaydedilmiştir.

Bulgular: Toplam 35 hasta çalışmaya dahil edilmiştir (Destek grubu: n = 18; Alçı grubu: n = 17). Gruplar arasında yaş, cinsiyet, kemik mineral yoğunluğu (KMY) indeksi veya takip süresi açısından istatistiksel olarak anlamlı bir fark yoktu ($p > 0,05$). Ancak, alçı grubunda hastanede kalış süresi anlamlı olarak daha uzundu (2,1 ± 0,68 gün vs. 1,1 ± 0,52 gün, $p < 0,001$). Kifotik deformitenin ilerlemesi alçı grubunda anlamlı olarak daha azdı ($p=0,042$). Önemli bir komplikasyon görülmedi, ancak brace grubunda daha erken mobilizasyon sağlandı.

Sonuç: Jewett brace, erken mobilizasyon ve fonksiyonel iyileşme açısından avantajlar sağlasa da, hiperekstansiyon alçısı uzun vadeli kifotik ilerlemeyi sınırlamada daha etkili olmuştur.

Anahtar Kelimeler: *Torakolomber Kırık; Hiperekstansiyon Alçısı; Jewett Korsesi; Konservatif Tedavi; Kifotik Açı*

INTRODUCTION

The thoracolumbar junction (T10–L2) represents a biomechanically vulnerable region due to its anatomical position between the rigid thoracic spine and the highly mobile lumbar segments, rendering it particularly susceptible to traumatic injury (1, 2). As a result, thoracolumbar vertebral fractures account for up to 90% of all spinal fractures, highlighting the clinical importance of this transitional zone in spinal trauma (3). In the absence of neurological deficits, stable thoracolumbar vertebral fractures are typically managed conservatively, with hyperextension casting and Jewett bracing being two principal modalities (4, 5). Conservative management is considered the first-line treatment for thoracolumbar injuries with a Thoracolumbar AO Spine Injury Score (TLAOSIS) below 4, as these cases are generally deemed stable and non-operative (6).

In the modified Thoracolumbar Injury Classification and Severity Score (mTLICS) system, the closest and most widely used classification scheme to TLAOSIS, the treatment scheme is similar (7). Previous studies have reported that only 1.4% of patients with a TLICS score below 4, who were initially managed non-operatively during their index hospitalization, subsequently required delayed surgical intervention (8).

The hyperextension cast (HEC) aims to immobilize the spine in hyperextension in compression fractures involving the anterior column, limiting flexion forces and preventing the progression of kyphotic deformity (9). When applied in the acute phase, HEC facilitates the realignment of spinal segments and contributes to load redistribution and stabilization. In contrast, the Jewett brace functions by selectively limiting flexion movements and reducing axial load on the anterior column, thereby promoting fracture stability (10).

Despite the widespread use of conservative approaches, few recent clinical studies have evaluated the long-term efficacy of traditional hyperextension casting. This study aimed to evaluate the long-term radiological and functional results of hyperextension cast and Jewett brace in the conservative treatment of stable thoracolumbar vertebral fractures and contextualise the findings in the light of the available literature.

MATERIALS AND METHODS

The research adhered to the ethical principles outlined in the Declaration of Helsinki and was approved by the ethics committee of the institute where the study was conducted (2025-945). This study retrospectively reviewed patients diagnosed with stable compression fractures at the thoracolumbar junction (T10–L2) between 2002 and 2012. These patients were managed conservatively using either hyperextension casting (Group A) or a Jewett brace (Group B).

Eligible patients were required to be 18 years or older, have a Thoracolumbar AO Spine Injury Score (TLAOSIS) below 4, be treated non-operatively with either a hyperextension cast or a Jewett brace, and have a minimum follow-up duration of 10 years.

Patients were excluded from the study if they had neurological deficits, multilevel fractures, a history of spinal surgery, documented spinal osteoporosis (T-score<-2.5), pathologic fractures, incomplete medical records, declined to participate, died during follow-up, or underwent surgical treatment. The patient selection process and flow diagram are presented in Figure 1.

Relevant clinical data and imaging records were retrospectively retrieved from institutional medical databases. Collected parameters included age, sex, fracture level, pain scores using the Visual Analog Scale (VAS), functional outcomes assessed by the Oswestry Disability Index (ODI), and kyphotic angles measured at baseline, post-treatment, and final follow-up.

Local kyphotic angle (LKA) was calculated using the Cobb method, by drawing lines parallel to the superior endplate of the vertebra above the fracture and the inferior endplate of the vertebra below, and then measuring the angle formed by the intersection of perpendiculars to these lines. For sagittal alignment analysis, physiological sagittal inclination was considered as 5° in the thoracic spine, 0° at the thoracolumbar junction, and –10° in the lumbar spine. The vertebral body compression ratio was calculated by dividing the anterior height of the fractured vertebral body by the average anterior height of the adjacent superior and inferior vertebral bodies, then multiplying by 100 (11).

The decision to pursue conservative management was made by an experienced spine surgeon (HG)

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and was preferred for cases with a Thoracolumbar AO Spine Injury Score (TLAOSIS) below 4 (12). The choice between hyperextension casting and Jewett bracing was made by the patient following informed consultation.

During the hyperextension cast procedure, patients were placed in a prone position between two parallel tables to ensure optimal lordotic alignment of the thoracic and lumbar spine. A body cast was then applied for external stabilisation, extending from the axillary level to the thoracolumbosacral region. The cast was meticulously moulded to ensure correct anatomical reduction and allowed to dry in the reduced position. An appropriately sized fenestration was created over the thoracoepigastric area to avoid compromising respiratory function. Following the procedure, patients were allowed to ambulate without restriction, typically on the same day, once their pain became tolerable (Figures 2 (a,b,c).

As an alternative to hyperextension casting, the Jewett hyperextension brace was used. After either the cast or the brace was applied, patients were assisted by a physiotherapist to achieve an upright position and were permitted to ambulate immediately. Hospital discharge was approved once patients had achieved adequate pain control with oral analgesics, could maintain a regular diet, and were able to independently perform basic activities of daily living.

The orthosis (whether cast or brace) was monitored during monthly follow-up visits and replaced when

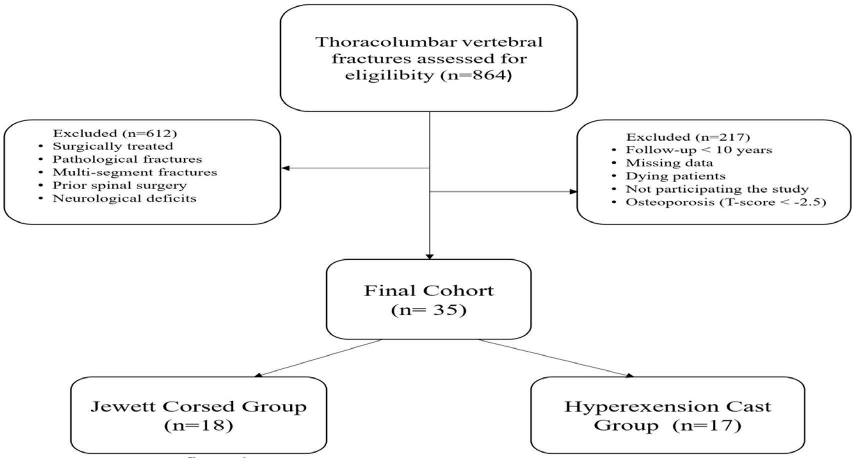

Figure 1. Patient flowchart

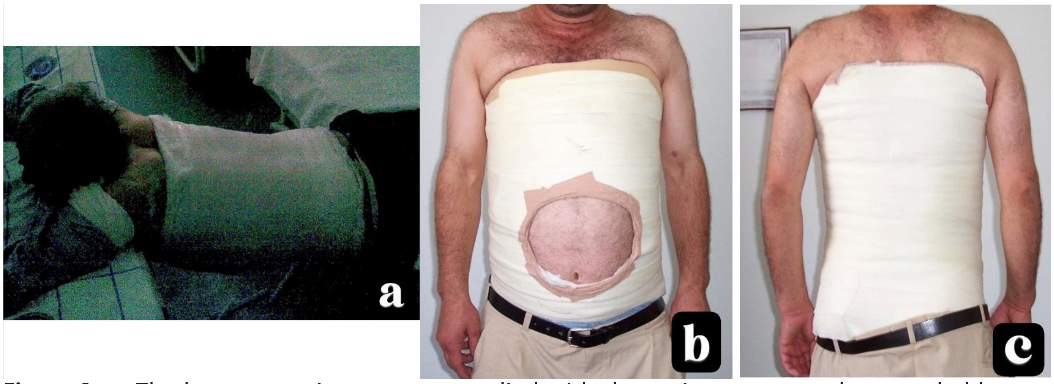

Figure 2. a. The hyperextension cast was applied with the patient prone and suspended between two parallel tables to induce lumbar hyperlordosis, thereby optimizing thoracolumbar alignment.
b-c. An anterior thoracoepigastric fenestration was created to provide ventilation without compromising respiratory function.
b. The anterior thoracoepigastric fenestration. Patients were allowed to ambulate on the same day as the procedure, once pain levels were tolerable.

necessary. It was removed at the end of the thirdmonth, and patients were allowed to return to work following device removal.

No thromboembolic events or pressure ulcers were observed during bed rest or hospitalization. Furthermore, no allergic reactions, skin lesions, or fungal infections attributable to either the cast or the brace were reported throughout the treatment period.

Statistical Analysis

Statistical analyses were performed using SPSS version 25.0 (IBM Corp., Armonk, NY, USA). Continuous variables were reported as mean ± standard deviation (SD), and categorical variables were presented as counts and percentages (n [%]). The normality of distribution was assessed using the Shapiro–Wilk test. For comparisons between groups, the Independent Samples t-test was applied for normally distributed variables, whereas the Mann–Whitney U test was used for non-normally distributed variables. The Chi-square test was employed for the analysis of categorical data. A p-value of <0.05 was considered statistically significant. For variables found to be statistically significant, effect sizes were calculated using Cohen's d. The follow-up duration was reported as 15.3 ± 2.8 years (range: 10–20 years) and is reflected accordingly in the figures and relevant sections.

Post hoc power analysis: For endpoints with between-group differences, effect sizes (Cohen's d) and achieved power (1−β) were calculated using the statsmodels package (Python 3.11) with $\alpha=0.05$ (two-sided). For the final follow-up Cobb angle (Cohen's d = 0.70; $n_1=18$, $n_2=17$), the achieved power was 0.54.

RESULTS

A total of 35 patients were included in the analysis (Brace group: n = 18; Cast group: n = 17). The groups were comparable in terms of age, sex, bone mineral density (BMD) index, and follow-up duration (p > 0.05). However, the length of hospital stay was significantly longer in the Cast group compared to the Brace group (2.1 ± 0.68 days vs. 1.1 ± 0.52 days; p < 0.001). Early mobilization was observed more frequently in the Brace group (Table 1).

There was no significant difference in the baseline Cobb angle between the groups (15.5 ± 5.7° in the brace group vs. 15.1 ± 6.0° in the cast group; p = 0.841). At the final follow-up, the Cobb angle was significantly higher in the brace group compared to the cast group (16.7 ± 5.5° vs. 13.0 ± 5.1°, respectively; p = 0.042).

The anterior body height (ABH) ratio was higher in the brace group immediately after treatment (24.7 ± 9.3% vs. 19.5 ± 7.8%; p = 0.072), although the difference did not reach statistical significance (Figure 3).

At final follow-up, the sagittal index (SI) was significantly greater in the brace group than in the cast group (19.1 ± 6.7° vs. 13.9 ± 5.8°; p = 0.015) (Table 2). Detailed regression analysis examining the relationship between BMD and Cobb angle is presented in table 3. These time-dependent radiological changes are illustrated in Figures 3 (Cobb angle), 5 (anterior body height, ABH), and 6 (sagittal index, SI).

At the final follow-up, the Oswestry Disability Index (ODI) score was significantly lower in the Cast group compared to the Brace group (30.2 ± 2.7 vs. 35.6 ± 6.3, respectively; p = 0.002; Cohen's d = 1.09). Similarly, Visual Analog Scale (VAS) scores were markedly lower in the Cast group (2.2 ± 0.6 vs. 3.1 ± 0.4; p < 0.001; Cohen's d = 1.72) (Table 3).

Post-hoc power analysis for these statistically significant findings is provided intable 3. The longitudinal trends for ODI and VAS are depicted in Figure 3.

Table 1. Baseline Demographic and Clinical Characteristics of the Study Groups

Characteristic	Brace Group (n = 18)	Cast Group (n = 17)	p-value
Age (years)	49.1 ± 14.5	48.7 ± 14.2	0.941
Male, n (%)	10 (55.6%)	9 (52.9%)	1.000
Female, n (%)	8 (44.4%)	8 (47.1%)	1.000
BMD Index	27.1 ± 3.0	26.8 ± 3.6	0.833
Follow-up duration (years)	15.2 ± 2.9	15.5 ± 2.9	0.795
Length of hospital stay (days)	1.1 ± 0.5	2.1 ± 0.7	<0.001*

* Statistically significant (p < 0.05); BMD: bone mineral density

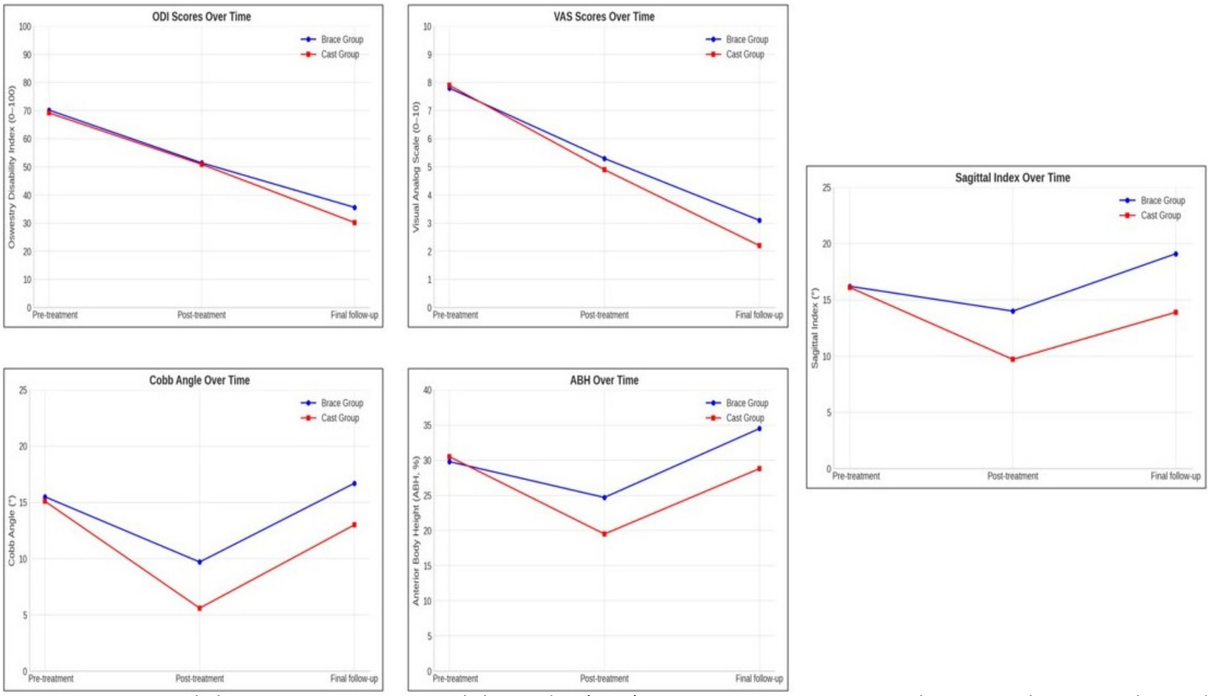

Figure 3. Temporal change in Oswestry Disability Index (ODI) scores across treatment phases. Both groups showed gradual improvement; however, the cast group demonstrated greater functional recovery at final follow-up.
Time-dependent changes in Visual Analog Scale (VAS) scores for pain assessment. Pain scores decreased in both groups, with significantly better outcomes observed in the cast group at long-term follow-up.
Temporal change in Cobb angle between brace and cast groups, measured by the Cobb method at baseline, post-treatment, and final follow-up. The cast group showed better kyphotic correction at final follow-up.
Temporal change in anterior vertebral body height (ABH) between groups at baseline, post-treatment, and final follow-up based on standardized lateral radiographs. The cast group exhibited better height restoration over time.
Longitudinal changes in sagittal index (SI) in patients treated with hyperextension casting versus Jewett bracing. Both groups showed an initial reduction in SI following treatment; however, the cast group exhibited significantly better preservation of sagittal alignment at final follow-up. The mean follow-up duration was 15.3 ± 2.8 years.

Table 2. Comparative Radiological Parameters Between the Brace and Cast Groups

Radiological Parameter	Brace Group (n = 18)	Cast Group (n = 17)	Cohen's d	p-value
Cobb angle – Pre-treatment (°)	15.5 ± 5.7	15.1 ± 6.0	0.07	0.841
Cobb angle – Post-treatment (°)	9.7 ± 7.7	5.6 ± 8.8	0.50	0.137
Cobb angle – Final follow-up (°)	16.7 ± 5.5	13.0 ± 5.1	0.70	0.042 *
Anterior body height – Pre-treatment (%)	29.8 ± 11.7	30.5 ± 12.4	-0.06	0.873
Anterior body height – Post-treatment (%)	24.7 ± 9.3	19.5 ± 7.8	0.61	0.072
Anterior body height – Follow-up (%)	34.5 ± 13.0	28.8 ± 11.3	0.47	0.166
Sagittal index – Pre-treatment (°)	16.2 ± 6.2	16.1 ± 5.9	0.02	0.940
Sagittal index – Post-treatment (°)	14.0 ± 5.9	9.7 ± 5.3	0.77	0.025 *
Sagittal index – Final follow-up (°)	19.1 ± 6.7	13.9 ± 5.8	0.83	0.015 *

* Statistically significant ($p < 0.05$)

Table 3. Functional Outcomes Based on ODI and VAS Scores

Functional Parameter	Brace Group (n = 18)	Cast Group (n = 17)	Cohen's d	p-value
ODI – Pre-treatment	70.2 ± 7.1	69.2 ± 5.0	0.16	0.627
ODI – Post-treatment	51.4 ± 7.8	50.9 ± 6.9	0.07	0.855
ODI – Final follow-up	35.6 ± 6.3	30.2 ± 2.7	1.11	0.002 *
VAS – Pre-treatment	7.8 ± 0.8	7.9 ± 0.9	-0.12	0.859
VAS – Post-treatment	5.3 ± 0.7	4.9 ± 0.8	0.53	0.114
VAS – Final follow-up	3.1 ± 0.4	2.2 ± 0.6	1.77	<0.001 *

Post-hoc power analysis results for statistically significant parameters		
Parameter	Effect Size (Cohen's d)	Calculated Power
Cobb angle (Final Follow-UP)	0.70	0.54
Sagittal Index (Final F-UP)	0.84	0.70
ODI (Final Follow-UP)	1.10	0.90
VAS (Final F-UP)	1.71	1.00

Regression analysis of Bone Mineral Density (BMD) and Cobb angle at final follow-up						
Variable	Coefficient	Std. Error	t-value	p-value	95% CI Lower Limit	95% CI Upper Limit
Constant	3.46	7.54	0.46	0.650	-11.85	18.76
BMD Index	0.42	0.28	1.52	0.137	-0.14	0.99

* Statistically significant (p < 0.05); ODI: Oswestry Disability Index; VAS: Visual Analog Scale; BMD: bone mineral density.
Post-hoc power analysis revealed adequate power (>0.80) for ODI and VAS parameters but limited power (<0.80) for Cobb angle and sagittal index measurements. Interpretation of radiological parameters should therefore be cautious due to potential type-II errors. Regression analysis showed no significant relationship between Bone Mineral Density (BMD) and Cobb angle at final follow-up (p=0.137), indicating BMD may not independently predict the progression of kyphotic deformity.

DISCUSSION

This study aimed to compare the long-term clinical and radiological outcomes of the Jewett brace, widely used in the conservative management of stable thoracolumbar vertebral fractures, with the hyperextension cast, which has become less common in current practice. Our findings showed that the hyperextension cast was significantly more effective than the Jewett brace in maintaining the kyphotic angle (p = 0.042), suggesting that its anterior column support mechanism plays a more prominent role in sagittal alignment. In contrast, the Jewett brace yielded superior outcomes in terms of functional recovery and pain control (p = 0.002 and p < 0.001). These findings are in line with previous reports in the literature (10, 13-15). Earlier mobilization with the brace may partly explain short-term advantages in activity and satisfaction. Nevertheless, long-term functional outcomes favored the cast group (lower ODI and VAS at final follow-up), likely reflecting the benefits of sustained kyphotic control (Table 3).

Previous studies have shown that hyperextension casting effectively prevents the progression of kyphotic deformities through anterior column stabilization (9, 10). In our study, the sustained maintenance of fracture reduction achieved by the hyperextension cast, particularly at the T12–L1 segment, highlights the biomechanical superiority of this method. Nonetheless, existing literature indicates a decline in the clinical preference for hyperextension casting, primarily due to issues related to patient compliance and prolonged immobilization periods. (16). Similarly, the 2024 systematic review by Karimi et al. reported no clear superiority of rigid orthoses over early mobilization in neurologically intact burst-fracture patients, prompting a re-evaluation of which cases truly warrant conservative bracing (17). Additionally, regression analysis investigating the relationship between Bone Mineral Density (BMD) and kyphotic progression (Table 3) did not reveal a statistically significant association. This finding suggests that BMD alone may not reliably predict the long-term radiological outcomes of kyphotic deformity following conservative treatment.

The findings reported by Wood et al. underscore the potential of non-operative management to yield favorable long-term outcomes (18). Nonetheless, our study demonstrated that the Jewett brace was less effective than the hyperextension cast in preserving the kyphotic angle. This finding is consistent with the biomechanical analyses reported by Chow et al. and Roy-Camille et al. (10,19). Another notable finding is the comparable complication rates observed between the two groups, suggesting that both conservative treatment modalities are safe and can yield favorable outcomes when applied with appropriate patient selection. Nonetheless, the Jewett brace appears to offer advantages in terms of patient satisfaction and ease of application. The Jewett brace facilitates early mobilization due to its lightweight anterior support design, which permits upright posture while limiting spinal flexion, allowing patients to resume basic activities sooner without compromising vertebral stability.

Our findings suggest that the hyperextension cast may yield radiological outcomes comparable to those of surgical treatment, particularly in terms of preserving the kyphotic angle. This highlights the need to re-evaluate current conservative treatment protocols. Although recent literature reflects a declining preference for hyperextension casting, our study provides robust evidence supporting its clinical efficacy.

The prolonged follow-up period in our study also allowed a more accurate evaluation of the durability of radiological alignment and functional recovery. Changes in kyphotic angle and patient-reported outcomes such as pain and disability may evolve over time, underscoring the value of long-term observation in conservative treatment assessment.

The results of the post-hoc power analysis (Table 3) indicated that this study had adequate statistical power (>0.80) for evaluating clinical parameters, specifically ODI and VAS. However, it demonstrated limited power (<0.80) for radiological parameters such as Cobb angle and Sagittal Index. Thus, our radiological findings may underestimate true differences between treatment groups due to potential type-II errors.

The principal limitations of this study are its retrospective design and relatively small sample size. Additionally, post-hoc power analysis revealed adequate statistical power (>0.80) for evaluating functional outcomes (ODI and VAS) but limited power (<0.80) for radiological measurements (Cobb angle and Sagittal Index). Therefore, the radiological findings should be interpreted cautiously due to potential type-II error risks (Table 3). Nevertheless, the extended follow-up period (mean 15.3 ± 2.8 years) enhances the robustness of the findings. Future prospective, randomized controlled trials are warranted to validate these results.

CONCLUSION

This study demonstrated that the hyperextension cast, a conservative treatment modality often overlooked in the management of stable thoracolumbar vertebral fractures, is significantly more effective than the Jewett brace in ensuring long-term control of kyphotic deformity. Although the Jewett brace offers short-term advantages in terms of functional improvement and pain reduction, the sustained preservation of the kyphotic angle achieved with the hyperextension cast plays a critical role in maintaining long-term spinal alignment. These findings suggest that the hyperextension cast—despite its declining use—should be reconsidered as a viable conservative alternative, and may offer outcomes that warrant consideration as an alternative to surgical intervention in carefully selected patient populations.

Acknowledgment

The authors declare that they have no conflict of interest to disclose

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