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PLACE OF PELVIC INCIDENCE IN TRAUMATIC PATHOLOGY IN THORACOLUMBAR FRACTURES

Hamza El Ouagari*, Tarik El Mountassir, Moncef Boufettal, Reda Allah Bassir, Jalal Mekkaoui, Mohamed Kharmaz, Moulay Omar Lamrani and Mohamed Saleh Berrada

Department of Orthopedic Surgery, Ibn Sina Hospital, University Mohamed V, Faculty of Medicine of Rabat, Avenue Mohamed Belarbi El Alaoui B.P.6203 10000, Rabat. Morocco.

***Corresponding Author:** **Hamza El Ouagari**

Department of Orthopedic Surgery, Ibn Sina Hospital, University Mohamed V, Faculty of Medicine of Rabat, Avenue Mohamed Belarbi El Alaoui B.P.6203 10000, Rabat. Morocco.

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ABSTRACT

Thoracolumbar fractures are frequent and severe lesions that can compromise the functional prognosis. Understanding the anatomical and biomechanical peculiarities of the spine is a guarantee of success. These are the pelvic parameters of Duval-Beaupère as well as their correlations with the spinal curvatures which gave the notion of type of back impacting the therapeutic approaches in degenerative and malformative pathologies. Through our study, we will compare the clinical and radiological characteristics of these two types of back in traumatic pathology.

KEYWORDS: Thoracolumbar fractures – Trauma.

1- INTRODUCTION

Fractures of the thoracolumbar spine are frequent,[1] and severe lesions which could affect the functional prognosis and lead to a profound deterioration in the patient's quality of life.[2]

Understanding the anatomical and biomechanical specificities of the spine is a guarantee of success.

These are the pelvic parameters of Duval-Beaupère,[3] as well as their correlations with the spinal curvatures which gave the notion of type of back impacting the therapeutic approaches in degenerative and malformative pathologies. The notion of sagittal balance evaluated on an X-ray of the entire spine in a standing position as well as the position of the sacrum with respect to the femoral heads makes it possible to calculate the pelvic parameters and their correlations with the lordosis lumbar, thus determining the type of back according to the Roussouly classification.[4,5]

In trauma, in a bedridden patient only, we dispose a lateral radiography of the lumbosacral hinge taking the femoral heads. Thus, the calculated pelvic incidence tells us about the harmony and the type of back

- Low pelvic incidence backs are Roussouly types I and II backs: stiff backs.
- The backs with high pelvic incidence are the backs types III and IV: flexible backs.

Through our study, we will compare the characteristics of the backs with low and high pelvic incidence that we could notice on standard radiographs of the lumbosacral hinge taking the two femoral heads in profile and performed with the initial lesion assessment.

2- MATERIAL ET METHODS

2-1- Type of Work

We conducted a retrospective, descriptive and comparative study over a period of 14 years on 120 patients operated on for a thoraco-lumbar spine fracture in the department of orthopedic surgery and trauma of the Habib Bourguiba University Hospital Center in Sfax between February 2005 and July 2019.

This study concerns a group of patients operated on by the same surgeon and using the same technique. All of our patients underwent spinal osteosynthesis via the posterior approach with screw-rod or screw-rod-hook instrumentation using the in situ rod adjusting technique.[6,7] A posterior and posterolateral bone graft was systematic.

In our study, we included, patients with

- An age ≥ 15
- A complete preoperative radiological assessment necessarily including standard radiographs of the lumbosacral hinge taking the two femoral heads in profile.

- And a minimum retrospect of 1 year.

Excluded from our study were patients with
- An incomplete and unusable file;
- Fracture on a pathological bone;
- Patients who have been lost track of after the intervention.

We have established a file determining the clinical and radiological data of each patient
- General information about the patient and the circumstances of the accident.
- The characteristics of the fracture and its consequences on the spinal statics.
- The neurological status according to Fränkel-Asia.
- The clinical and anatomical results postoperatively and in retrospect according to the Denis Pain Scale, the Oswestry score (ODI: Oswestry Disability Index), the Schöber index and resuming work.
- Radiological study: of the level of the lesion, of the type and classification of the fracture, study of the deformity (Regional traumatic angulation (ART), Sagittal Farcy Index (SIF),[8] Gardner Segment Kyphotic Deformity (GSKD),[9] through a standard radiological assessment and a CT scan of the thoraco-lumbar spine, assessment of the type of back based on the estimation of the pelvic incidence measured on standard radiographs of the lumbosacral hinge taking the two femoral heads in profile performed in lying down position (Figure 1).
- Checking the type of back is done on the radiography of the entire spine in profile performed in a standing position during the first post-operative check.
- Anatomo-radiological results: estimation of the correction by determining the relative gain and losses in the last retrospect, study of the sagittal balance through the sagittal heel in T9 and the Sagittal vertical axis (SVA) measured on an x-ray of the whole spine from a frontal and standing position and in profile carried out in the last retrospect.

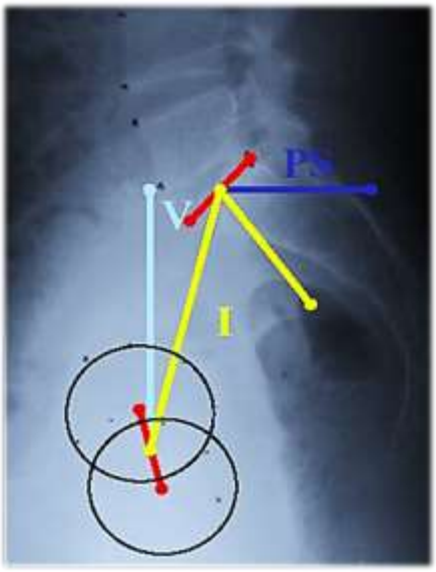


Figure 1: Pelvic parameters.

3- RESULTS

Our group contains 94 men (78.3%) and 26 women (21.7%), i.e. a sex ratio which is equal to 3.6. The average age of our patients was 34.8 years with a standard deviation of 12.2 years.

The majority of fractures were the result of a fall from a high place, i.e. 66.6% of the cases (fall off scaffolding, fall off a palm tree, etc.), 26.7% of the cases were caused by a road accident, while 6.7% of the cases resulted from other mechanisms (suicide attempt, etc.).

Table 1: Showing the distribution of the circumstances of the trauma according to the type of back.

	Road accident	Others	P (Khi2Test)
Stiff backs	33,9%	66,1%	0.078
Flexible backs	19,7%	80,3%	

Trauma to the thoracolumbar spine was associated with other lesions in 49 of our patients, or 40.8% of the cases. The life prognosis was threatened in 22.5% of the cases, divided into 10% head injuries, 10% chest injuries and 2.5% abdominal injuries. Trauma to the limbs was found in 23.3% of our patients.

Table 2: Showing the rate of associated lesions in each type of back.

	Isolated	Associated	P (Khi2Test)
Stiff backs	50,8%	49,2%	0.068
Flexible backs	67,2%	32,8%	

In our entire group, 84 of our patients (70%) were without neurological signs at the time of admission.

14 patients, or 11.7% of all of our patients, had complete paraplegia.

The other 22 patients, or 18.3%, had incomplete neurological damage.

For backs with a low pelvic incidence, there were 18 patients (30.5%) with deficits, five of whom had a complete neurological deficit and thirteen had an incomplete deficit.

For backs with a high pelvic incidence, 18 patients (29.5%) were found with neurological signs, nine of whom had complete paraplegia and nine had incomplete paraplegia.

Table 5: Showing the distribution of neurological signs according to the type of back.

Neuroloical deficit	Complete	Incomplete	P (Khi2 Test)
Stiff backs	8,5%	22%	0.171
Flexible backs	14,8%	14,8%	

We have counted 68.3% of the fractures located at the level of the thoracolumbar hinge (L1 is the most affected vertebra: 31.7% of the cases) and 31.7% of the fractures are localized at the level of the lumbar spine.

For flexible backs Roussouly's type III and IV; it was found that the fractures are located at the level of the thoracolumbar hinge in 80.3% of the cases.

As for the stiff backs type I and II, it was noted that the fractures are localized at the lumbar level in 44.1% of the cases.

Table 3: Determining the distribution of the localization of the fractures according to the type of back.

	Charnière	Lombaire	P (Khi2Test)
Stiff backs	55,9%	44,1%	**0.004**
Flexible backs	80,3%	19,7%	

In our group, compression fractures (type A) were 63.3%, flexion-distraction fractures (type B) were found in 25.8% of the cases and rotational fractures (type C) were found only in 10.9% of cases.

For stiff backs, type A was observed in 72.9% of the fractures, while for flexible backs, types B and C were found in 45.9% of fractures.

Table 4: Showing the distribution of Magerl type A according to the type of back.

	Type A	Others	P (Khi2Test)
Stiff backs	72,9%	27,1%	**0.033**
Flexible backs	54,1%	45,9%	

120 patients were selected for this study with an average retrospect of 50.7 months, with a standard deviation at 21 months.

The Denis Pain Scale score was less than 3 in 90% for cases of low pelvic incidence backs and 65.6% for those of high incidence backs.

Table 6: Detailing the functional results according to the Denis Pain Scale.

Denis Pain Scale	< 3	≥ 3	P (Khi2 Test)
Stiff backs	90%	10%	**0.010**
Flexible backs	65,6%	34,4%	

As for the overall radiological results of stiff backs type I and II, the post-operative relative gain was 67.3% for ART, 87.3% for GSKD and 85.1% for SIF.

And for flexible backs type III and IV, the post-operative relative gain was 128.8% for ART, 131.2% for GSKD and 161.7% for SIF.

As for the loss of correction at the last retrospect, for stiff backs, it was 2.1° for ART, 1.2° for GSKD and 1.5° for SIF, while it was 3.2° for ART, 3° for GSKD and 2.8° for SIF for flexible backs.

Table 7: Showing the relative gain and loss of correction by type of back.

		Pre op	Post op	Relative gain	Losses
Stiff backs	**ART**	26,6°	10°	67,3%	2,1°
	SIF	19,8°	5°	85,1%	1,5°
	GSKD	19,9°	3,8°	87,3%	1,2°
Flexible backs	**ART**	21,9°	-3,9°	128,8%	3,2°
	SIF	19,6°	-2,8°	161,7%	2,8°
	GSKD	19,9°	-2,2°	131,2%	3°
p	**ART**	0.031	**0.000**	**0.000**	0.137
	SIF	0.887	**0.000**	**0.039**	**0.012**
	GSKD	0.985	**0.000**	0.069	**0.000**

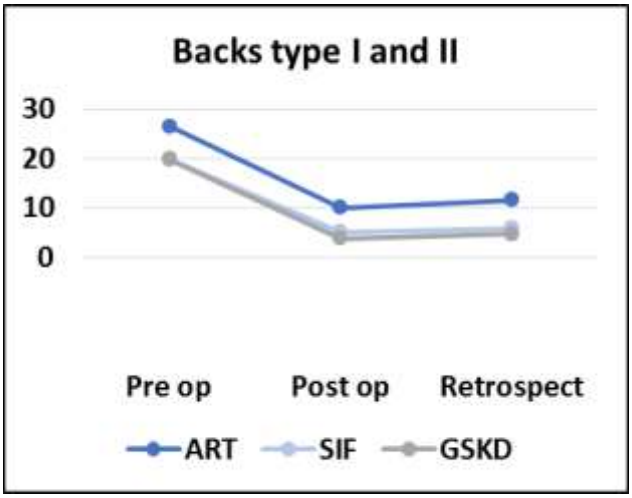


Figure 2: Evolution of radiological values for stiff backs.

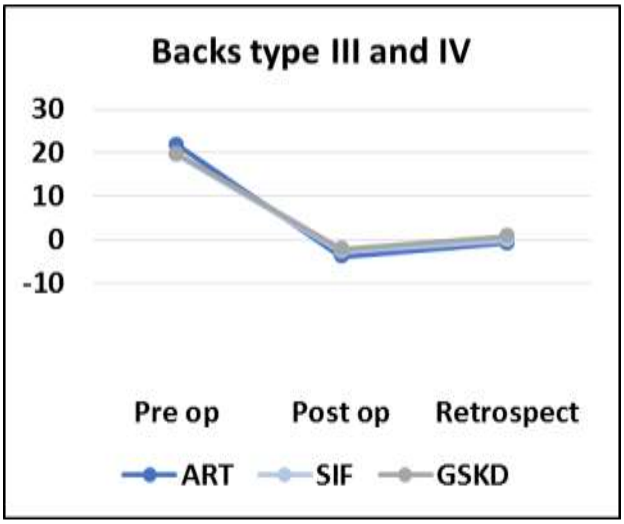
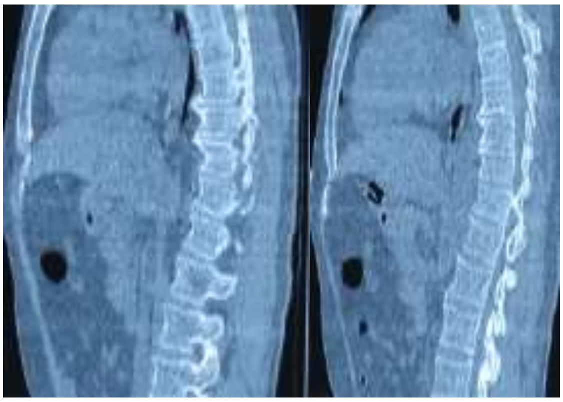


Figure 3: Evolution of radiological values for flexible backs.

As for the study of sagittal balance, for the group of backs types I and II which are considered stiff, 33.3% of the patients are balanced at the last retrospect.

And for the group of backs types III and IV which are considered flexible, more than 90.9% are balanced at the last retrospect.

It has been found on CT images that these low pelvic incidence backs, which are considered as stiff, are pathological backs with radiological indications in favor of the after-effects of Schuermann's disease.



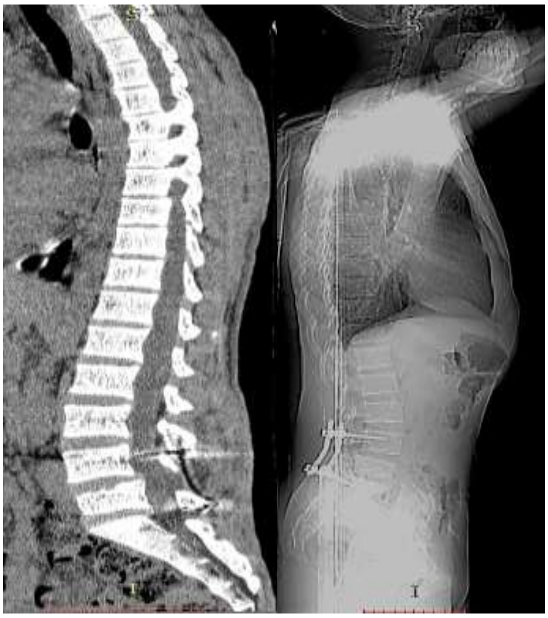


Figure 4: CT images in favor of the pathological nature of stiff backs.

DISCUSSION

The majority of fractures were the consequence of a fall from a high place, i.e. 66.6% of the cases (fall from scaffolding, fall from a palm tree, etc.). This is also the most frequent etiology for the Blamoutier series,[10] 70% and Gajjar,[11] 66%.

In our group, road accidents are found in 26.6% of traumatic circumstances and it was noted that this etiology concerns more types I and II backs which are considered to be stiff (33.9%) than types III and IV backs which are considered flexible (19.7%), without being statistically significant (p = 0.078).

The frequent association of the thoracolumbar spine fracture with other lesions indicates the importance of causal energy.

This association was found in 40.8% of cases which are similar to those in other groups in the literature,[12,14] The vital prognosis was threatened in 22.5% of the cases affected by a cranial, thoracic and abdominal trauma; this rate is close to that of Alvine,[15] who indicates the occurrence of polytrauma in 20% of the cases. Limb damage was found in 23.3% of our patients, which has also been found in other groups in the literature,[14,16,17]

It was found that the association of the dorsolumbar spine fracture with other lesions concerns more the types I and II backs which are considered as stiff (49.2%) than the types III and IV backs which are considered as flexible (32.8%), without being statistically significant (p = 0.068).

We have noticed in our group of patients that those with types I and II backs (stiff) have less complete neurological deficit than those with types III and IV backs (flexible), without being statistically significant (p = 0.171); this could be explained by the rigid nature of these backs which seems to be the determining factor of the neurological status. Indeed, the flexion-extension movements would be neutralized or transformed into axial compression.

The extended thoracolumbar hinge from T12 to L1, with extension from T11 to L2,[18-21] is a transition zone between a rigid dorsal spine and a mobile lumbar spine.

It is the anatomical hinge, unlike the functional hinge which allows the transition between two spinal curvatures, low located in Roussouly's,[4,5] backs types I and II (located in L4 and L5), and identical to the anatomical hinge in backs types III and IV.

In our group, the anatomical hinge is the most affected one; it represents the site of 68.3% of fractures; this was found in most of the published series.[22,24]

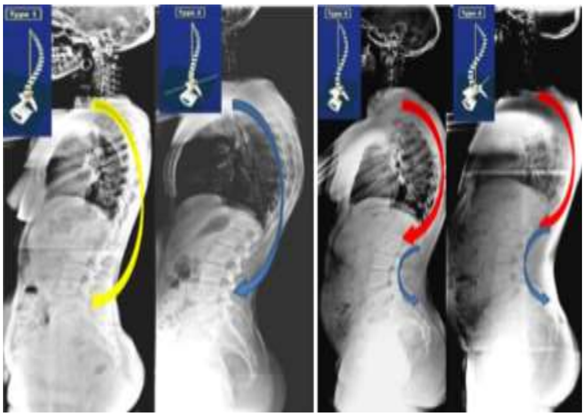
Table 8: Level of injury according to the literature.

	Steib[22]	Alvine[15]	Chatellier[25]	Our series
TL hinge	90%	71%	79%	**68,3%**
Lumbar	10%	29%	21%	**31,7%**

In our series, the fractures affected the hinge in 80.3% of the Roussouly types III and IV backs, which is in conformity with the literature,[22-44] while for types I and II, only 55.9% were located at the anatomical hinge; the rest (44.1%) of the fractures involved the lumbar level. This is explained by

- On the one hand by the dynamic effect of backs types III and IV and the static effect of the backs of types I and II;

- And on the other hand, by the mechanism of fractures often in axial compression in stiff backs types I and II and in flexion posterior distraction in flexible backs types III and IV.



A B

Figure 5: localisation of the hinge according to the type of back.

A- Backs types I and II: bottom functional hinge located
B- Backs types III and IV: functional hinge = anatomical hinge
Many classifications concerning thoracolumbar fractures have been used in the literature. Some are based on the mechanism and type of fracture, such as the classification of Magerl,[26] and that of Denis,[27] Others are based on scores calculated from the neurological state, the anatomopathological type of the fracture and the state of the posterior ligament complex, such as the classification of TLICS advanced by Vaccaro.[28] Load Sharing Scoring is made up of a score calculated from the degree of compaction of the vertebral body.[29]

Table 9: Radiological results in the literature.

Series	ART		GSKD		SIF	
	GR%	loss	GR%	loss	GR%	loss
Steib[22]	-	-	92%	2,9°	95%	2,1°
Pavlos[34]	-	-	72%	2,8°	77%	2,2°
Our series Backs type I and II	**67%**	**2,1°**	**87%**	**1,2°**	**85%**	**1,5°**
Backs type III and IV	**129%**	**3,2°**	**131%**	**3°**	**161%**	**2,8°**

According to Magerl, type A was found in 63.3% of the cases. This predominance has been observed in most series. In our study, we also noticed that type A of Magerl was observed in 73% for backs types I and II and 54% for backs types III and IV and the noted difference is statistically significant (p = 0.033)

According to the classification of Fränkel-Asia,[30] the absence of neurological deficit, classified Fränkel E, was noted in 70% of our patients.

This rate was lower than that of the Steib,[22] and El-Sharkawi,[24] series and higher than that of the Shin,[31] Waqar,[32] and James.[33] series. The evaluation of the pain symptomatology according to the Denis Pain Scale concluded that patients with types I and II backs have better functional results than patients with types III and IV backs, with a ≥3 grade: only in 3 patients with stiff backs (10%) and in 34.4% of the cases of patients with flexible backs (p = 0.01).

As to the radiological results (table 9), the reduction in vertebral and loco-regional deformities obtained after a posterior surgical.

Treatment differs from one series to another.

We noticed that the types I and II backs of our series are hypo or normo-corrected and make less loss of correction than the back types III and IV which are hyper-corrected.

The difference in terms of relative gain (GR) and loss of correction between these 2 groups is statistically significant with (p <0.05).

We agree with Roussouly's ideas that backs of types I and type II are considered pathological and that we should not try to hyper correct these varieties of backs. Unlike the type III and IV backs, the harmony of the curvatures requires hypercorrection to avoid the losses observed at the last retrospect. In fact, it has been observed on the CT images that these low pelvic incidence backs considered as stiff ones are pathological backs on radiological signs in favor of the aftereffects of Schuermann's disease, which confirms our per-operative findings which have shown degenerative phenomena affecting the posterior ligament complex (yellow ligament, inter-spinous ligament, joint capsules). This confirms the static character of these spinal columns.

CONCLUSION

In sagittal deformations of degenerative and malformation origins, the indication and the surgical correction depend essentially on the pelvic parameters and the sagittal balance of the spine which are often easy to analyze on a frontal and profile telecolonne made in a standing position.

For post-traumatic deformities, no study in the literature has taken into account the pelvic parameters and the type of back of each patient. The only pelvic parameter calculated in these patients while they are in a lying position on standard radiographs are those of the lumbosacral hinge taking the two femoral heads in profile, which gives an idea of the harmony of the back, and this could influence therapeutic management.

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