



# Comparative Analysis Between Isolated Posterior and Anteroposterior Approaches for Severe Scoliosis Treatment

## *Análise comparativa entre as abordagens cirúrgicas por via posterior isolada e por via anteroposterior para tratamento de escoliose severa*

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### Abstract

**Objective** To comparatively analyze isolated posterior and double surgical approaches for the treatment of severe scoliosis.

**Methods** We retrospectively analyzed medical records of 32 patients with scoliosis angular value  $> 70^\circ$  submitted to surgical treatment in a tertiary hospital between 2009 and 2019. These patients were divided into two groups: PV group with 17 patients submitted to arthrodesis by isolated posterior route (PV) and APV group with 15 patients approached anteriorly and posteriorly (APV). In the PV group, there were 16 female patients and 1 male, with a mean age of 16.86 years old. In the APV group, there were 10 female patients and 5 males, with a mean age of 17.71 years old. Cobb angles were measured by a single spinal surgeon manually on panoramic radiographs, orthostasis before and after surgery. Weight, pre- and postoperative height, and duration of the procedure were also evaluated.

**Results** In the PV group, preoperative and postoperative Cobb angles, verified in the main curve, were  $96.06 \pm 8.45^\circ$  and  $52.27 \pm 15.18^\circ$ , with an average correction rate of  $0.54 \pm 0.16$ , respectively. In the APV group, these values were  $83.12 \pm 11.60^\circ$  for preoperative Cobb angle, and  $48.53 \pm 10.76^\circ$  postoperatively, with correction rate of the main curve of  $0.58 \pm 0.11$ .

### Keywords

- ▶ escoliosis
- ▶ thoracotomy
- ▶ vertebral arthrodesis

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**Conclusion** The two forms of surgical approach for the treatment of severe scoliosis were astowed as to the rate of correction of the deformity. Therefore, isolated posterior access has an advantage over the double approach, based on shorter surgical time, shorter hospital stay, and less risk of complications

## Resumo

**Objetivo** Analisar comparativamente as abordagens cirúrgicas por via posterior isolada e dupla abordagem para tratamento da escoliose severa.

**Métodos** Analisou-se retrospectivamente prontuários de 32 pacientes com escoliose de valor angular  $> 70^\circ$  submetidos a tratamento cirúrgico em hospital terciário entre 2009 e 2019. Dividiu-se estes pacientes em dois grupos: Grupo VP com 17 pacientes submetidos a artrodese por via posterior isolada (VP) e Grupo VAP com 15 pacientes abordados por via anterior e posterior (VAP). O Grupo VP apresentou 16 pacientes do sexo feminino e 1 do masculino, com idade média de 16,86 anos. No grupo VAP, 10 pacientes do sexo feminino e 5 do masculino, com idade média de 17,71 anos. Os ângulos de Cobb foram mensurados por único cirurgião de coluna, manualmente, em radiografias panorâmicas, em ortostase no pré- e pós-operatório. Foram avaliados também peso, altura pré- e pós-operatória e duração do procedimento.

**Resultados** No Grupo VP, o ângulo de Cobb pré-operatório e pós-operatório, verificados na curva principal, foram respectivamente  $96,06^\circ \pm 8,45^\circ$  e  $52,27^\circ \pm 15,18^\circ$ , apresentando taxa média de correção de  $0,54 \pm 0,16$ . No grupo VAP, esses valores foram de  $83,12^\circ \pm 11,60^\circ$  para o ângulo de Cobb pré-operatório,  $48,53^\circ \pm 10,76^\circ$  pós-operatório, com a taxa de correção da curva principal de  $0,58 \pm 0,11$ .

**Conclusão** As duas formas de abordagem cirúrgica para tratamento de escoliose severa se equiparam quanto à taxa de correção da deformidade. Portanto, o acesso posterior isolado apresenta vantagem em relação a dupla via, baseado no menor tempo cirúrgico, menor tempo de internação e menos risco de complicações

## Palavras-chave

- ▶ escoliose
- ▶ toracotomia
- ▶ artrodese vertebral

## Introduction

Scoliosis is defined as a three-dimensional deformity of the spine with an angulation  $> 10^\circ$  in the coronal plane, with idiopathic scoliosis of the adolescent as its most common type.<sup>1</sup>

The surgical access historically indicated to treat severe scoliotic deformities in patients with skeletal maturity is the double approach route, in which both anterior and posterior access (APV) is made.<sup>1,2</sup>

In some countries, APV is the recommended access for surgical approach to scoliosis of neuromuscular etiology, with rigid curvatures and that do not correct to  $< 60^\circ$  on radiographs with inclination.<sup>1,2</sup>

The previous approach was proposed with the objective of providing better rates of deformity correction.<sup>2-4</sup> However, due to the need for chest and abdomen invasion in some cases, anterior access has been pointed out as a cause of significant complications and morbidities in adult patients.<sup>5</sup>

The posterior access route (PV) for thoracic and lumbar spine arthrodesis with instrumentation through pedicular screws is the gold standard for the treatment of progressive idiopathic scoliosis.<sup>3</sup>

The surgical technique of posterior vertebral fusion is in constant actualization. The use of segmental instrumenta-

tion has been improved, at first with Luque wires, and later, with multiple hooks and hybrid instrumentation.<sup>6</sup>

Recently, sublaminar bands were created, with action similar to that of sublaminar wires, and, in selected cases, they add to the correction of scoliosis, associated with pedicular screws.<sup>3</sup>

The current constructions use pedicular screws in the lumbar and thoracic spine, becoming great allies in the correction of deformities. In the treatment of severe progressive idiopathic scoliosis, they present good corrective rates for severe defects angulation, with a small number of complications. In this context, the relevance of the anterior pathway has been questioned, even in severe scoliosis.<sup>3</sup>

Performing comparative analysis between surgical approaches by isolated posterior route and anterior-posterior approach for treatment of severe scoliosis

## Materials and Methods

The present study was approved by the ethics and research committee of our institution under CAAE number: 46852321.7.0000.5040 and Opinion 4,732,781

We retrospectively analyzed the clinical and radiographic records of 32 patients with scoliosis with curvature  $\geq 70^\circ$  followed in an orthopedics service in a tertiary hospital.

The selection of patients submitted to anterior and posterior or only posterior approach was performed randomly and alternately, being approached by the same surgeon, with his team, from 2009 to 2019, in said service. All patients had preoperative planning, surgical procedure, and postoperative follow-up of at least 2 years in the orthopedic outpatient clinic.

Patients were divided into 2 groups. The group of patients operated by PV comprised 17 individuals (PV group) and there were 15 patients in the group approached by APV (APV Group). All patients operated by double approach underwent the procedure in two surgical times, with an average interval of 15 days between the procedures.

Anterior surgery was performed by thoracotomy or thoracofrenolombotomy performed in the hemithorax corresponding to the convexity of the curve, associated with discectomy of 3 to 5 levels at the apex of the deformity and anterior arthrodesis with the use of rib bone graft removed in the surgical route.

The posterior pathway was performed through median longitudinal incision and instrumentation with bilateral pedicled screws in all possible segments, associated with reduction and fixation maneuver with two longitudinal rods and autologous bone graft of the blades and spinous processes.

The patients were submitted to anthropometric evaluation and radiographic examinations of the total spine with posteroanterior incidences and orthostasis profile, and lateral inclinations in supine position.

Radiographs were performed to evaluate the deformities: calculation of Cobb angles, determination of structured curves, and for surgical planning. Anthropometric parameters were weight, and height before and after surgery.

Surgical time, weight, height, duration of surgery and Cobb angle value were evaluated.

Intraoperative neurophysiological monitoring was used in all patients. The use of Cell-saver to prevent blood loss was randomly performed due to another ongoing study. All patients were supported by postoperative ICU and were able to walk before the 3<sup>rd</sup> postoperative day.

### Inclusion and Exclusion Criteria

Patients with congenital or neuromuscular scoliosis and those with major curves < 70° were excluded from the study. The inclusion criteria used were structured and rigid curves scoliosis with Cobb angle ≥ 70°.

### Data Analysis

The data were expressed as mean and standard deviation, submitted to the Kolmogorov-Smirnov normality test, and analyzed using the Student t test (intergroup analysis) and paired t test (intragroup analysis) (parametric data). All analyses were performed adopting a 95% confidence in the software IBM SPSS Statistics for Windows, version 20.0 (IBM Corp., Armonk, NY, USA).

### Results

In the PV approach group, the mean preoperative Cobb angle (main curve) was 96.00°. After surgery, the mean Cobb angle was 43.08°, with a mean variation of 52.27°. The mean correction rate was 54% (► Table 1).

In the APV approach group, the mean preoperative Cobb angle (main curve) was 83.2°. After surgery, the mean Cobb

**Table 1** Comparative analysis between the posterior and double approaches

Access routes			
	PV Group	APV Group	p-value
Age (years old)	16.86 ± 7.82	17.71 ± 4.59	0.710 <sup>a</sup>
Weight	43.17 ± 8.76	50.34 ± 7.73	0.036 <sup>a</sup>
Gender (M/F)	5/10	1/16	0.76 <sup>b</sup>
Height			
Preoperative	1.50 ± 0.12	1.54 ± 0.09	0.226 <sup>a</sup>
Postoperative	1.58 ± 0.08	1.61 ± 0.08	0.324 <sup>a</sup>
p-value	< 0.001 <sup>c</sup>	< 0.001 <sup>c</sup>	
Duration	228.64 ± 95.50	367.94 ± 83.76	< 0.001 <sup>to</sup>
PV Segments	12.82 ± 1.99	12.12 ± 1.83	0.348 <sup>a</sup>
Coronal Cobb angle			
Preoperative	96.06 ± 8.45	83.12 ± 11.60	0.001 <sup>a</sup>
Postoperative	43.80 ± 17.36	34.59 ± 9.37	0.067 <sup>to</sup>
p-value	< 0.001 <sup>c</sup>	< 0.001 <sup>c</sup>	
Cobb angle variation	52.27 ± 15.18	48.53 ± 10.76	0.424 <sup>a</sup>
Correction rate	54 ± 16%	58 ± 11%	0.443 <sup>B</sup>

Abbreviations: APV, anteroposterior approach; F, female; M, male; PV, posterior approach.

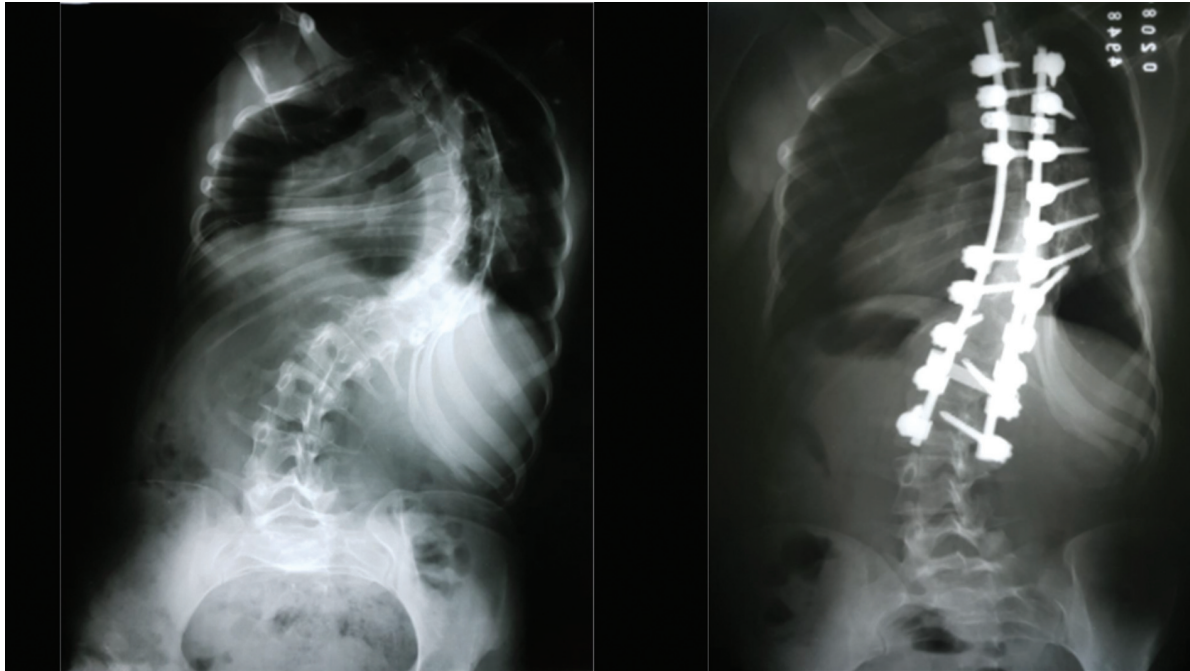
<sup>a</sup> - Student's t-test (mean ± standard deviation); <sup>b</sup> - Fisher exact test (n, %); <sup>c</sup> - Paired t-test.

angle was  $34.59^\circ$ , with an average variation of  $48.53^\circ$ . The mean correction rate was 58% (► **Table 1**).

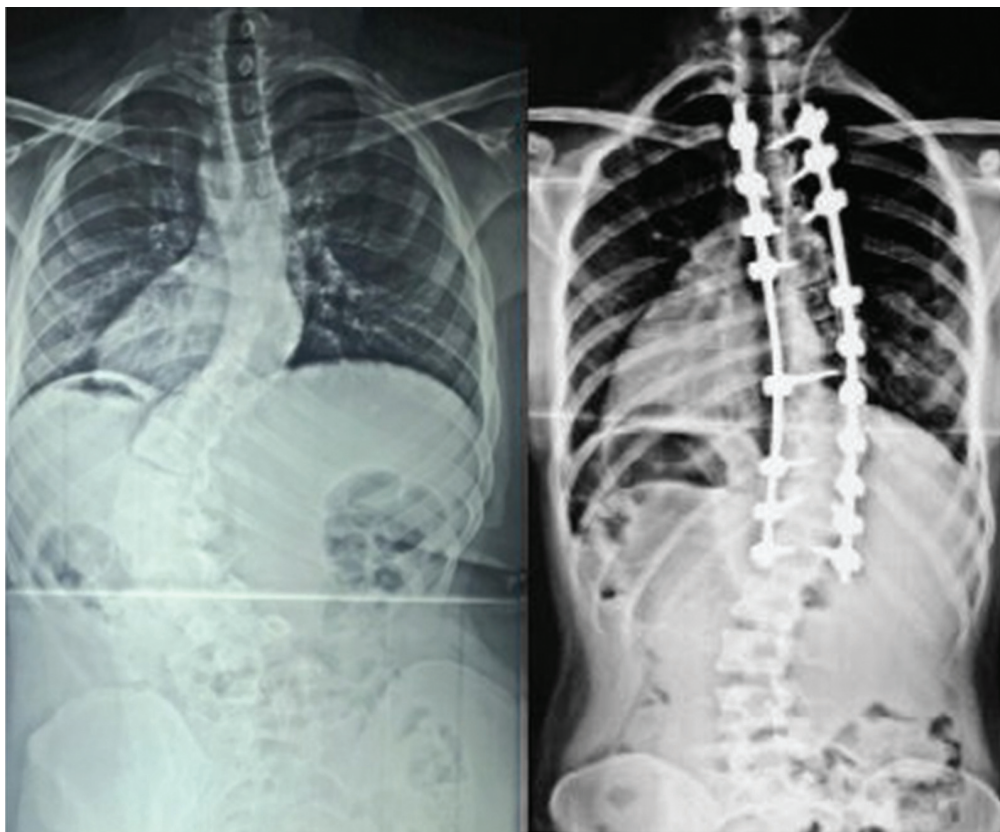
There was no statistical significance in the variation of the correction rate between the double-approach group (anterior and posterior) compared with the single (posterior) approach group (► **Table 1**).

## Discussion

Spinal fusion with instrumentation is indicated in adolescents with scoliosis, with immature skeleton, when the Cobb angle of the primary curve exceeds  $45^\circ$ .<sup>11</sup> However, choosing single versus double approach for rigid and severe scoliosis is still



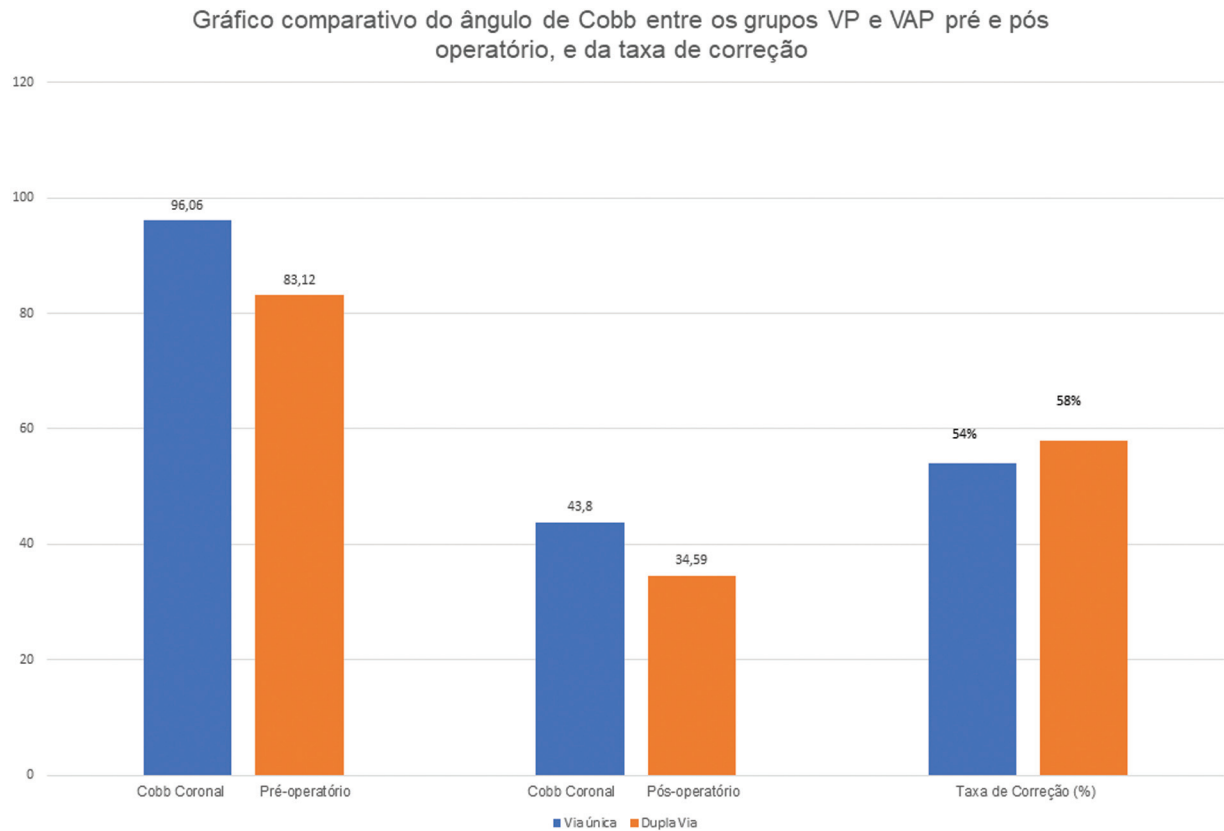
**Fig. 1** Pre- and postoperative moments of severe scoliosis  $> 70^\circ$  with double approach.



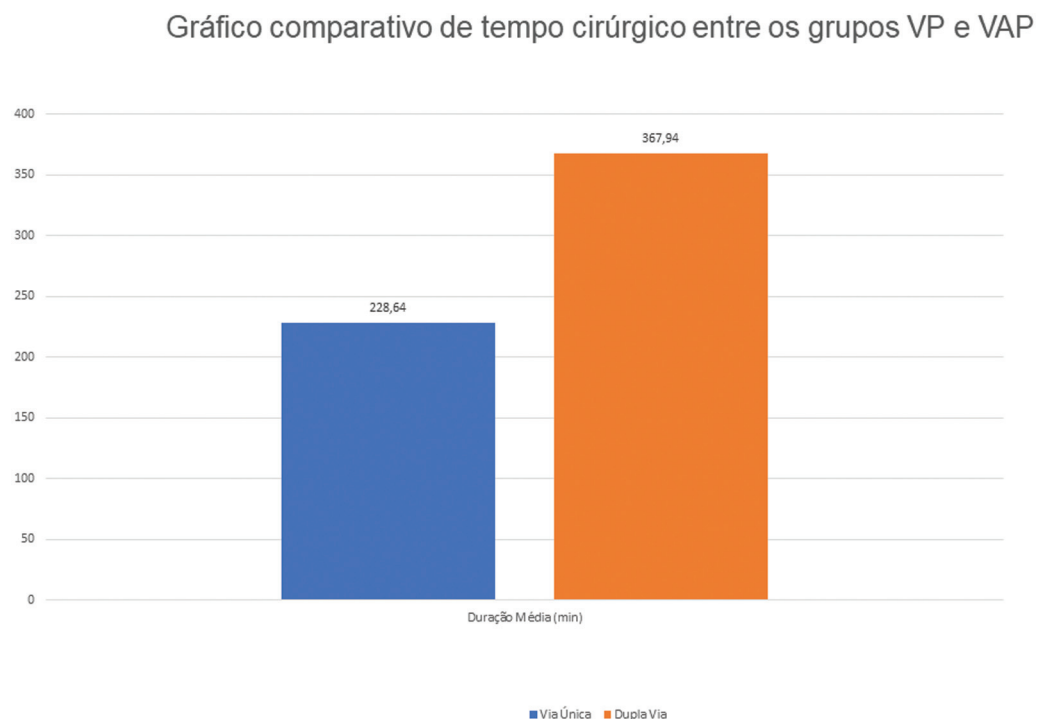
**Fig. 2** Pre- and postoperative moments of severe scoliosis  $> 70^\circ$  with single approach.

controversial. Bullman et al.<sup>12</sup> and Shao et al.<sup>9</sup> consider that the combined approach is safe, effective, and leads to a good three-dimensional correction of severe curves with fewer neuromuscular complications, infection and pseudoarthrosis.

Yamin et al.<sup>13</sup> concluded that anterior release and halo-pelvic traction followed by posterior instrumentation and arthrodesis was a safe and effective way to treat rigid scoliosis. Sucato et al.<sup>14</sup> revealed that the correction of the



**Fig. 3** Comparative graph of the Cobb angle between the PV and APV groups before and after surgery, and the correction rate.



**Fig. 4** Comparative graph of surgical time between the PV and APV groups.

coronal plane was lower in the single approach group compared with the double-route group. The anterior release procedure via thoracoscopy did not affect pulmonary function and was recommended in the treatment of idiopathic scoliosis. Meanwhile, Good et al.<sup>15</sup> and Lin et al.<sup>8</sup> suggested that single-way access is effective for correcting moderate and severe curves, avoiding the side effects of the double approach. In the present study, double route and isolated posterior route were performed with good corrections in both, as shown in ►Figs. 1 and 2.

In the present study, it was evidenced that the single posterior access can achieve similar results of angular correction compared with the double-approach treatment (►Fig. 3).

Many studies have concluded that the technique of correction only by posterior route can reduce blood loss, surgery time, hospitalization time, and hospital expenses.<sup>7,16–20</sup> These findings corroborate the results of the present study, in which the surgery time is significantly longer in the double-approach technique, increasing the risks related to major surgeries (►Fig. 4).

According to Chen et al.,<sup>21</sup> the Cobb angle is a very important parameter for judging the effectiveness of surgery in high-grade scoliosis; in its meta-analysis, there was no statistical relevance in the difference between the double and single approach groups, regardless of how severe the curves were evaluated.

## Conclusion

In our study, there was no statistically significant difference between the mean correction rates of the main curves between the two studied groups. In fact, the posterior single pathway presented a better mean Cobb angle variation.

It is noteworthy that the posterior single approach technique has a lower rate of surgical complications, blood loss, surgical time, hospital stay, and hospital expenses, according to several literary studies.<sup>12,18–21</sup>

In conclusion, posterior single access, performed by experienced surgeons, seems to be effective and safe in the treatment of severe scoliosis, and there is no statistically proven benefit of the combined pathway in relation to the postoperative correction rate.

### Contributions of the Authors

Each author contributed individually and significantly to the development of this article: Verde S. R. L., Verde E. C. L., JAAO, and Dias Júnior C. P. P. elaborated the study; Dias Júnior C. P. P., GFDT, Prado Filho C. S., and Andrade C. L. A wrote the article; Verde S. R. L. had the primary responsibility for the final content. All authors read and approved the final content of the article.

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### Conflict of Interests

The authors have no conflict of interests to declare.

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