Original Article

Functional ability in individuals with spinal cord injury*

Capacidade funcional em indivíduos com lesão de medula espinhal

Capacidad funcional en individuos con lesión en la médula espinal

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ABSTRACT

Objectives: To investigate the characteristics of individuals with spinal cord injury being treated in public hospitals, in Ribeirao Preto, Sao Paulo, and to assess the functional independence according to the degree of injury, the time after injury and the rehabilitation. **Methods:** Is a cross-sectional observational study conducted from January 2003 to July 2006, comprising 22 patients being treated on these hospitals, with assessment of functional capacity through the Functional Independence Measure (FIM) scale. **Results:** Of 22 patients who survived after hospital discharge, 91 % were men, with age from 30 to 39 years (36.4 %). The main etiology of the above-mentioned injury was an accident of traffic (50%), 11 patients (50%) presented cervical injury, 10 (45.5%) had chest injury and lumbar injury. In individuals with cervical injury the total FIM score was low, implying less functional capacity. It was observed an increase of the FIM scores with the increase of time after injury, regardless of participation in rehabilitation programs. **Conclusions:** The results suggest the essential aspects found in this research must be proposed in rehabilitation programs to treat the population within the studied context.

Keywords: Spinal cord injuries/rehabilitation; Recovery of Function/physiology; Outcome assessment (health care)

RESUMO

Objetivos: Investigar características de indivíduos com lesão de medula espinhal atendidos em hospitais públicos de Ribeirão Preto – São Paulo, e avaliar a independência funcional segundo nível de lesão, tempo pós-lesão e reabilitação. **Métodos:** Estudo de observação transversal realizado de janeiro de 2003 a julho 2006 abrangendo 22 pacientes atendidos nesses hospitais, com avaliação da capacidade funcional pela escala Medida de Independência Funcional (MIF). **Resultados:** Dos 22 pacientes que sobreviveram após saída hospitalar, 91% eram homens, com idade de 30 a 39 anos (36,4%). A etiologia principal da referida lesão foi acidente de trânsito (50%) e 11 pacientes (50%), tiveram lesão cervical, 10 (45,5%) lesão torácica e um lesão lombar. Nos indivíduos com lesão cervical os escores na MIF total e motora foram menores implicando em menor capacidade funcional. Observou-se aumento dos escores da MIF com o aumento do tempo pós-lesão, independente da participação em programa de reabilitação. **Conclusões:** Os resultados apontam aspectos essenciais para a proposição de programa de reabilitação para esta população no contexto estudado.

Descritores: Traumatismos da medula espinhal/reabilitação; Recuperação da função fisiológica/fisiologia; Avaliação de resultados (cuidados de saúde)

RESUMEN

Objetivos: Investigar las características de individuos con lesión de médula espinal atendidos en hospitales públicos de la ciudad de Ribeirao Preto, estado de Sao Paulo, y evaluar la independencia funcional según: grado de lesión, tiempo pos-lesión y rehabilitación. **Métodos:** Es un estudio de observación transversal, realizado de enero de 2003 a julio 2006, abarcando 22 pacientes atendidos en esos hospitales, con evaluación de la capacidad funcional por medio de la escala Medida de Independencia Funcional (MIF). **Resultados:** De los 22 pacientes que sobrevivieron, después de la salida del hospital, 91% eran hombres, con edad de 30 a 39 años (36,4%). La etiología principal de la referida lesión fue accidente de tránsito (50%) y 11 pacientes (50%) tuvieron lesión cervical, 10 (45,5%) lesión torácica y uno lesión lumbar. En los individuos con lesión cervical los puntajes en la MIF total y motora fueron menores, lo que implicó en una menor capacidad funcional. Se observó un aumento de los puntajes de la MIF con el aumento del tiempo pos-lesión, independientemente de la participación en programas de rehabilitación. **Conclusiones:** Los resultados apuntan aspectos esenciales para proponer programa de rehabilitaciones dirigidas a esta población dentro del contexto estudiado.

Descriptores: Traumatismos de la médula espinal/;rehabilitación; Recuperación de la función/fisiología; Evaluación de resultado (atención de salud)

** Study performed in public hospitals integrated with SUS (the national public health system), in Ribeirão Preto (SP), Brazil.*

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INTRODUCTION

Spinal cord injury (SCI) is an aggression than may have several causes, with trauma being the most frequent, including gunshot wounds, motor vehicle accidents, falls and diving accidents, violence and sports injuries. SCI is accompanied by functional deficits of locomotion, sensitivity, sexuality, urinary and intestinal elimination, and the autonomic nervous system, which worsens these alterations even more, as it harms the neural system, affecting motor and sensorial coordination[1-2].

Considering that the main causes of spinal cord injuries involve traumas and that most of the affected population is younger than 40 years, it is a severe incapacity that is suddenly brought upon a healthy, young and active population, with all the consequent psychobiological and psychosocial repercussions. Data from the Brazilian Institute of Geography and Statistics (IBGE, acronym in Portuguese), published by the demographic census 2000, report a contingent of 200,000 paraplegics and 50,000 tetraplegics in Brazil in a population of 169,872,856 people[3-5].

Epidemiological studies show that traumatic spinal cord injuries are an alarming fact in Brazil and worldwide. SCI occurs in about 15% to 20% of spinal fractures, with different incidences in each country. Germany, for instance, has an estimated 17 new cases per million people per year, in the United States (USA) that rate ranges between 32 and 52 new cases, while in Brazil the estimate is for 40 new cases per million people per year[1,3].

Before World War II, 80% of all paraplegics died few years after the injury. Nowadays, with the advancements in health services and care to trauma victims, the death rate has decreased and 80% of the paraplegics survive for ten years after the injury, though complications may occur[5].

To describe the impact of spinal cord injury on an individual, in addition to monitoring and assessing rehabilitation outcomes, it is necessary to adopt standardized measures to evaluate if the needs regarding activities of daily living are being met.

Literature recommends implementing new concepts and clinical practices to better understand the extent of the problem. The International Classification of Functioning, Disability and Health (ICF) framework, introduced by the World Health Organization in 2001, and translated into Portuguese in 2003, is originally based on the 1976 International Classification of Impairments, Disabilities and Handicaps. The term *functioning* used in the ICF refers to functions, body structures, activity and societal participation; incapacity results from the interaction between the individual's dysfunction, as well as the limitation to his or her activities and restrictions to societal participation, and the environmental factors that may work as barriers or facilitators of their performing those activities and participation[6].

The ICF presents a new view, as it addresses the activities that individuals with body structure and/or function alterations may have, as well as their societal participation. It offers a broader contextualization view of the individuals, families, and the community, in a more social and less biological perspective[7].

To meet the referred need, in the 1980's, rehabilitation professionals from the USA developed a scale to measure functional capacity: the Functional Independence Measures – MIF[8], which has been translated and validated in Brazil[9-10]. Functional assessment permits to follow the patient's evolution in the rehabilitation process, while performing tasks, independent from their daily routine.

The clinical practice guidelines with recommendations for evaluating outcomes of the rehabilitation process of SCI patients, presented by the *Consortium for Spinal Cord Medicine,* recommend including the following four domains in the focus: motor reestablishment; functional independence; social integration and quality of life[11].

Functional independence after SCI is one of the treatment expectations. One of the recommendations by the *Consortium for Spinal Cord Medicine*[12] clinical practice guidelines is that patients' functional capacity should be evaluated and monitored throughout the rehabilitation process, and to modify the treatment strategy to minimize functional results.

OBJECTIVES

To investigate the characteristics of individuals with SCI seen at hospitals located in Ribeirão Preto and affiliated to the national public health system, the Unique Health System (SUS, abbreviation in Portuguese), and assess functional independence, according to the level of injury, time post-injury and rehabilitation.

METHODS

The project was approved by the Research Ethics Committee at Hospital das Clínicas da Faculdade de Medicina de Ribeirão Preto-USP, in compliance to resolution 196/96.

The inclusion criteria were the following: individuals who suffered SCI between January 2003 and July 2006, were seen at SUS-affiliated hospitals and living in Ribeirão Preto - Sao Paulo state, with 18 years of age or older, capable of answering pertinent questions, and who agreed to participate in the study, after being informed about the study objectives, and signing the Free and Informed Consent Form.

Data were first collected from patient records and

later by means of an interview performed at the patient's home, using an instrument designed by the researchers. After reviewing the patient records, subjects were contacted by telephone, and the visits were scheduled to the date and time of their choice.

Functional capacity was assessed using the Functional Independence Measures (FIM) scale, and the lead researcher participated in the Training Course promoted by the Medical Board for Rehabilitation with the Hospital das Clínicas da Faculdade de Medicina da Universidade de São Paulo, which was conducted by one of the authors who conducted the validation of the instrument in Brazil.

The FIM scale addresses six functioning dimensions: self-care, sphincter control, mobility, locomotion, communication and social cognition. In each area, two or more activities are assessed, totaling 18 functional categories (13 motor and 5 cognitive), which are evaluated in terms of function independence, using a 7-point scale, in which each item is scored from 1 to 7 depending on the level of dependence to perform that task. The Total FIM score ranges from 18 to 126 points and the lower the score, the higher the level of dependence10.

The scale should be applied at least at three points: first, before 72 hours after admission; second, within 72 hours before discharge, and, third, for patient follow-up, three months after discharge from the rehabilitation program.

RESULTS

During study period, 28 patients suffered SCI and were assisted at hospitals in Ribeirão Preto, however, four died after the first hospitalization and two died after being discharged.

Table 1 lists the demographic and clinical variables of the 22 individuals who participated in the study.

Of the 22 study subjects, 20 (91.9%) were male and the predominant age group was 30 to 39 years (mean 37.9, SD 11.6). As for the etiology of the trauma, the most frequent were motorcycle accidents and falls, followed by motor vehicle collisions and/or rollover.

Cervical level injuries were the most frequent, with 11 patients (50%), followed by thoracic level with 10 patients (45.5%). As for the preservation of motor and/or sensitive function, 9 (41%) individuals had complete injury (ASIA-A) and 12 (54.5%) did not have this specification stated on their medical record, revealing a register flaw.

Time post-trauma at the moment of assessment at home ranged between six months and 44 months (mean 25.18; SD 13 months).

Table 2 presents the results considering the spinal cord injury levels and total, motor and cognitive FIM scores.

The FIM results showed that patients who suffered SCI at the cervical level had lower scores, compared to patients with thoracic and lumbar level SCI. However, the cognitive FIM score achieved the highest variation level, i.e., the plateau of 35.0.

Table 1 – Demographic and clinical variables of the study population. Ribeirão Preto, 2007 (n=22)

Variables	F	%
Gender		
Female	2	9.0
Male	20	91.0
Age Group		
20 ----- 29	6	27.3
30 ----- 39	8	36.4
40 ----- 49	4	18.2
50 ----- 59	2	9.1
60 or more	2	9.1
Etiology of the trauma		
Vehicle collision or rollover	5	22.7
Gunshot wounds	2	9.1
Motorcycle	6	27.3
Fall	6	27.3
Diving	1	4.5
Beating	2	9.1
Level of injury		
Cervical	11	50.0
Thoracic	10	45.5
Lumbar	1	4.5
Spinal cord injury classification - ASIA		
A	9	41.0
B	1	4.5
Not specified on the medical record	12	54.5
Time since the trauma at the moment of the interview		
Less than 1 year	5	22.7
1 year	5	22.7
2 years	7	31.8
3 years and 8 months	5	22.7

Table 3 presents the total, motor and cognitive FIM scores according to SCI level and time post-injury. The time is divided in two points, up to 12 months (6m to 12m) and 13 months or more (13m to 44m).

It was observed that the total, motor and cognitive FIM scores of individuals with SCI evaluated up to 12 months after the injury are lower for all injury levels, compared to those with 13 months or more of time post-injury.

Table 4 presents total and motor FIM scores according to rehabilitation follow-up and time post-injury.

Of the 22 participants, 11 (50%) were being followed at rehabilitation services at the moment of data collection and they presented higher total and motor FIM scores than those who were not being followed; though no statistically significant differences were found between the groups. It was observed that there was an association between participating in a rehabilitation program and achieving higher FIM scores. Hence, it is expected that dependence level reduces as functional independence improves.

In this study, all participants with less than 12 months

Table 2 – Values and variations of total, motor and cognitive FIM, according to the level of spinal cord injury. Ribeirão Preto, 2007

Injury level	Values and Variations	Total FIM (score 18-126)	Motor FIM (score 13-91)	Cognitive FIM (score 5-35)
Cervical (n = 11)	Mean (s.d.)	70.2(24.9)	41.6(24.4)	28.6(7.3)
	Variation	25–101	13–77	12–35
	Median	62.00	28.00	32.00
Thoracic (n = 10)	Mean (s.d.)	90.3(23.6)	59.1(19.4)	31.2(5.9)
	Variation	48-12	24-78	15-35
	Median	98.00	65.50	32.50
Lumbar (n = 1)	Mean	109.00	74.00	35.00
Total (n = 22)	Mean (s.d.)	81.1(25.9)	51.0(23.4)	30.0(6.6)
	Variation	25-112	13-78	12-35
	Median	90.00	61.50	32.50

Table 3 – Total, motor and cognitive FIM according to the spinal cord injury level and time post-injury. Ribeirão Preto, 2007

Injury Level	Time post-injury	Values and Variation	Total FIM	Motor FIM	Cognitive FIM
Cervical	Up to 12 months (n=2)	Mean (s.d.)	55.5(43.1)	39.0(36.8)	16.5(6.4)
		Variation Obs	25-86	13-65	12-21
		Median	55.50	39.00	16.50
	13 months or more (n=9)	Mean (s.d.)	73.5(21.9)	42.2(24.0)	31.3(4.3)
		Variation Obs	46-101	17-77	22-35
		Median	62.00	28.00	34.00
	Total (n=11)	Mean (s.d.)	70.3(24.9)	41.6(24.4)	28.6(7.4)
		Variation Obs	25-101	13-77	12-35
		Median	62.00	28.00	32.00
Thoracic	Up to 12 months (n=3)	Mean (s.d.)	73.6(26.0)	47.3(17.6)	26.3(9.9)
		Variation Obs	48-100	33-67	15-33
		Median	73.00	42.00	31.00
	13 months or more (n=7)	Mean (s.d.)	97.4(20.4)	64.1(19.1)	33.3(1.9)
		Variation Obs	54-112	24-78	30-35
		Median	106.00	71.00	34.00
	Total (n=10)	Mean (s.d.)	90.3(23.6)	59.1(19.4)	31.2(5.9)
		Variation Obs	48-112	24-78	15-35
		Median	98.00	65.50	32.50
Lumbar (n=1)	13 months or more	Mean	109.0	74.00	35.00
	Up to 12 months (n=5)	Mean (s.d.)	66.4(30.0)	44.0(22.7)	22.4(9.4)
		Variation Obs	25-100	13-67	12-33
		Median	73.00	42.00	21.00
	13 months or more(n=17)	Mean (s.d.)	85.5(23.9)	53.1(23.9)	32.3(3.5)
		Variation Obs	46-112	17-78	22-35
		Median	96.00	64.00	34.00
	Total (n=22)	Mean (s.d.)	81.1(25.9)	51.0(23.4)	30.1(6.6)
		Variation Obs	25-112	13-78	12-35
		Mediana	90.00	61.50	32.50

post-injury time and participating in a rehabilitation program achieved better total and motor scores on the FIM scale compared to those who were not being followed in that period. However, the referred impact was not observed in FIM scores for subjects in rehabilitation in the period of 13 months or more. After 13 months, motor and total FIM scores were similar for both groups, with the mean total FIM of 85.6 (DP 24.6) for individuals in rehabilitation and 85.3 (DP 24.8) for those not in rehabilitation. The bivariate analysis between FIM and time post-injury and FIM and rehabilitation was not statistically significant.

Table 5 shows that the scores in every FIM domain among individuals with cervical level SCI were lower for those who were not in a rehabilitation program. Cervical level injuries imply severe complications due to the SCI, involving impaired basic physiological functions, such as breathing pattern and hemodynamic balance. Therefore, following those patients is essential to minimize potential risks of complications.

In relation to dependence level (total FIM sub-scores), level of injury and participation in rehabilitation of the individuals with cervical SCI, 5 (45.5%) were participating, one of which presented maximum and moderate dependence, whereas the other 4 (57.1%) individuals presented minimum dependence. The six (54.5%) other

Table 4 – Total and motor FIM according to patient participating in rehabilitation or not and time post-injury. Ribeirão Preto, SP, 2007

	Participation in Rehabilitation		Total
	YES	NO	
Up to 12 months post-injury total FIM (18-126)	**(n=3)**	**(n=2)**	**(n=5)**
Mean (sd)	86.3(13.5)	36.5(16.3)	66.4(30.0)
Observed Variation	73-100	25-48	25-100
Median	86.0	36.5	73.0
Motor FIM (13-91)			
Mean (sd)	58.0(43.9)	23.0(14.1)	44.0(22.7)
Observed Variation	42-67	13-33	13-67
Median	65.0	23.0	42.0
13 months post-injury total FIM(18-126)	**(n=8)**	**(n=9)**	**(n=17)**
Mean (sd)	85.6(24.6)	85.3(24.8)	85.5(23.9)
Observed Variation	54-111	46-112	46-112
Median	90.5	96.0	96.0
Motor FIM(13-91)			
Mean (sd)	53.1(24.4)	53.1(24.9)	53.1(23.9)
Observed Variation	24-77	17-78	17-78
Median	60.5	64.0	64.0

Table 5 – Level of functional dependence of patients with SCI by FIM sub-score, according to injury level and participation in rehabilitation. Ribeirão Preto, 2007.

Injury Level	Participation in Rehabilitation	Level of Functional Dependence			Total
		(2 - 3)	(4 - 5)	(6 - 7)	
Cervical	Yes	1(20.0)	4(80.0)	-	5(45.5)
	No	3(50.0)	3(50.0)	-	6(54.5)
	Total	4(36.4)	7(63.6)	-	11(100.0)
Thoracic	Yes	1(20.0)	2(40.0)	2(40.0)	5(50.0)
	No	1(20.0)	2(40.0)	2(40.0)	5(50.0)
	Total	2(20.0)	4(40.0)	4(40.0)	10(100.0)
Lumbar	Yes	-	-	1(100.0)	1(100.0)
	No	-	-	-	-
	Total			1(100.0)	1(100.0)

1 (18 points)
2 - 3 (19 – 60 points) Maximum and moderate dependence
4 - 5 (61-103 points) Minimum dependence and supervision, encouragement or preparation
6 - 7 (104 -126 points) Modified or complete independence
Results presented as numbers (%).

individuals who were not participating presented maximum and moderate dependence. For all FIM sub-scores, individuals with cervical SCI presented the lowest scores, indicating a higher level of dependence; therefore, showing, that participating in a rehabilitation program is an essential strategy to increase independence.

Only five of the ten individuals with thoracic SCI were in rehabilitation. However, patients from both groups, with and without rehabilitation, presented the same level of dependence.

The individual with lumbar SCI followed a rehabilitation program and his independence level was modified or complete in terms of functional dependence. The FIM value and variations for that individual showed that self-care is the FIM score with the strongest impact (41.0) on functional independence. However, the mobility and locomotion FIM scores were reduced.

None of the 22 study subjects presented a complete dependence level: 11 (50%) presented minimum dependence, 6 (27.3%) presented maximum dependence and 5 (22.7%) presented moderate or complete independence.

Considering the scores obtained in the using the FIM, 27.3% have maximum to moderate dependence, and as most individuals have cervical level SCI, they require up to 50% assistance. However, in the same group, 7 individuals (63.6%) presented minimum dependence, thus requiring up to 25% assistance.

DISCUSSION

The demographic characteristics of the study subjects, who were mostly men and whose mean age ranged between 30 and 40 years corroborate the findings of several other studies with SCI patients (13-16). The most common causes for trauma were traffic accidents and

falls, which are conditions that demand intervention for both individual and collective prevention. In Brazil, specific measures have been implemented to change behaviors such as driving after consuming alcoholic beverages and at high speeds, and for using seatbelts as well as to avoid diving in shallow waters. Nevertheless, local campaigns and the education of children and youths should be implemented to help reduce these rates.

The numerous patients with cervical and thoracic spinal cord injury found in the study demonstrate the impact that these accidents have on the spine and spinal cord, and the harm caused on individuals who suffer permanent injuries, considerably affecting their functional capacity. The level and type of spinal cord injury determine the patients' physical and/or sensorial capacity losses. Their functioning profile, however, will depend on the facilitating action performed by the environment where they live and interact, including the accessibility to and use of health services. Studies have shown that patients with incomplete injuries have higher motor FIM scores, compared with patients with complete injuries. This evaluation is important to plan expected rehabilitation outcomes[13-15]. Not every patient record contained these data, which shows register failure, with negative consequences for health care.

The evaluation using the FIM scale identified that in the motor level, patients who suffered cervical level SCI showed lower functional dependence, whereas the cognitive FIM apparently did not suffer any influences regarding the injury level. Similar results were found in national studies[17]. Literature alerts that the FIM evaluation for cognitive domains, which encompasses understanding, expressing, social interaction, problem solving and memory may result in a false negative and, on the other hand, the highest score found denotes that the referred functions are in the plateau of normality[10].

It was observed that individuals with SCI evaluated with up to 12 months post-injury time had lower total, motor, and cognitive FIM scores, for all injury levels, compared with individuals with post-injury time of 13 months or more. Results show that average motor FIM scores increased with post-injury time, i.e., the individuals' functional independence improved with time.

It was found that time is a relevant fact that affects the FIM, but this hypothesis was not confirmed by the *Mann Whitney* test for total and motor FIM, as the results did not give evidence of any statistically significant differences between the two groups. The association between the functional independence level and post-injury time showed statistically significant differences between the groups only for the cognitive FIM dimension (p=0.01).

A study performed in Singapore using the FIM to assess outcomes in patients with SCI found that patients of services specialized in rehabilitation, which had been followed for some time, had higher scores. However, poorer functional outcomes were associated with older age, cardiovascular disease, depression, pressure ulcer, and not participating in a rehabilitation program[17].

Studies to evaluate rehabilitation outcomes evidenced that the total FIM scores increased significantly with time, regardless of the type of injury. Nevertheless, tetraplegic patients stayed longer in the rehabilitation center[15,18].

Rehabilitation should be initiated since the first hospitalization after the SCI, and should meet each individuals particular needs, use an interdisciplinary approach, thus possibly preventing initial complications and reducing the total cost of care. Delays in initiating those actions may have a negative effect on the individuals' functional independence and extend rehabilitation time[10,19].

Literature recommends that individuals with cervical SCI should initiate rehabilitation as soon as possible, as any delay may imply in lower functional gains[10].

Some authors[10] state that, in Brazil, patients join rehabilitation programs between 16 and 24.2 months after the SCI, which makes comparisons with international data difficult, considering that most patients initiate rehabilitation before four months post-injury.

The above authors found that the group of patients that initiated rehabilitation sooner, considering the time of injury, had poorer functional performance, considering motor FIM scores. Therefore, patients with older SCI presented, in average, higher functional independence.

The findings of the present study and of the study by Riberto et al.[10] point at the hypothesis that functional independence was acquired by other means, rather than by formal rehabilitation in specialized services, i.e., patients have issues that must be solved so they can perform daily living activities and develop their abilities within the context of their own lives.

Although the functional independence expected at the end of the first year post-injury for patients with cervical trauma sometimes cannot be achieved due to the variations involving patients' age, gender and comorbidities, the care delivered during the first months post-injury is crucial for monitoring, treating and preventing complications that could cause morbidities, or even mortality[16]. Rehabilitation should include patient and family education, training to prepare patients towards self-care, as well as emotional and social support. Exposing patients to technologies that allow for them to obtain the maximum level of independence in an adequate environment makes a difference when deciding to return to family living or becoming institutionalized[18-19].

CONCLUSIONS

The present study permitted to characterize individuals with SCI assisted at hospitals in Ribeirão Preto from

January 2003 to July 2006 and the functional limitations in the period after discharge.

Regarding their functional independence, using the FIM Scale, it was found that individuals with SCI had higher dependence in the period until 12 months post-injury, compared with individuals with more than 13 months post-injury time. This shows the need to provide patients with greater disabilities early accessibility to rehabilitation services to prevent the occurrence of complications that increase morbidity and mortality, and improve functioning.

Based on the present study results, we believe that the intervention by professionals working with rehabilitation should surpass the limits of ritualistic and routine practice, so as to develop a health care model that addresses the individual's real need, as those professionals are participating agents of the individuals' care process. Adopting instrument that have been tested and validated for a specific population, in this case, using the FIM Scale for patients with SCI, helps nurses to collect data and later plan how to achieve care outcomes.

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