

# The Traction Angle and Cervical Intervertebral Separation

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Seventeen normal young adults were evaluated for cervical intervertebral separation under different traction angles through motorized intermittent traction in the supine position. In all cases, the anterior and posterior intervertebral spaces were increased by traction at neutral position and in 30° flexion, but not in 15° extension. The effects of separation were 1) neutral position: anterior intervertebral separation C4-5 (12%) > C3-4 (8%), posterior intervertebral separation C6-7 (37%) > C3-4 (22%) > C4-5 (19%); and 2) 30° flexion: anterior intervertebral separation C2-3 (21%) > C4-5 (16%) > C5-6 (15%) > C3-4 (10%), posterior intervertebral separation C6-7 (20%) > C5-6 (19%) > C4-5 (17%). There was a significant decrease in intervertebral separation posteriorly in extension traction, especially at C6-7 (-50%), C5-6 (-37%), C4-5 (-26%), and C3-4 (-14%). The separation of facet joint surfaces was found after traction at 15° extension, but not in the neutral or flexion positions. [Key words: cervical traction, intervertebral space]

FOR MANY YEARS, cervical traction has been applied widely for pain relief of neck muscle spasm or nerve root compression in rehabilitation medicine.<sup>2,4-10,15,17</sup> Colachis and Strohm found that a traction force of 30 lb for a duration of only 7 seconds can separate the cervical intervertebral space (IVS) in the posterior direction. The amount of separation increased with flexion of the cervical spine.<sup>3,4</sup> Neck extension during traction should be avoided, especially in older patients with existing disease of the vertebrobasilar system.<sup>1,2,9,18</sup> In Crue's study of 20 patients, all patients had little or no relief in the supine position, whereas 19 had moderate-to-complete relief in neck flexion 15-30°. Some authors believe that slight flexion could open the posterior articulations, widen the intervertebral foramen, disengage the facet surface, and elongate the posterior muscular tissues and ligament.<sup>2,5,9,17</sup>

For the patients with cervical spinal fracture, traction can be used for reduction of the cervical spine as well as for temporary maintenance of spinal stability. Crutchfield introduced skeletal traction with tongs inserted into the skull in 1933<sup>6</sup>; Gardner-Wells tongs are now being used with equally good results and have largely replaced Crutchfield tongs.<sup>8</sup>

The position of traction, however, usually depends on types of fracture-dislocation. There are many different types of traction machines for traction in a sitting position. Some of them have fixed seats with the chair to the back of the machine. This will produce neutral or mildly extended neck position during traction, but usually will still be well tolerated by patients.

The following study was performed to evaluate the effects of separation of IVS under different traction angles (Figure 1).

## MATERIALS AND METHODS

The study included 17 young normal adults (7 men, 10 women) without a history of neck trauma or pain. Their age ranged from 18 to 25 years (average, 22.3 years); body height from 152 to 169 cm (average, 157.7); and body weight from 46 to 62 kg (average, 51.3 kg).

Intermittent cervical traction was applied to subjects with a motorized Digit-Trac E 60 KS machine (Zuer Prosperous Instrument, Inc., Taipei, Taiwan) in the supine position with a pillow under the knee for relaxation. Superficial moist heat was given by hydrocollator over the neck posteriorly for 20 minutes before traction. A traction force of 13 kg for a duration of 8 seconds was followed by unloading for 6 seconds alternately, with a total traction time of 20 minutes.

The positions of traction were measured by a goniometer in a neutral position at 30° flexion and at 15° extension between the head and trunk without rotation or side flexion. The head and trunk received traction in different neck positions in a time interval of 24-48 hours.

A radiographic study of the cervical spine in lateral views was performed before and after each traction (at the end of the 20-minute cycle). The distances between x-ray machine, traction table, and x-ray film were fixed.

The data of measurements in the distance of anterior or posterior facet joint separation of IVS for each vertebrae were stored on a computer. Each case was compared with a paired *t* test before and after traction position.

## RESULTS

In this study, 17 subjects received cervical traction in neutral-position (0°) neck traction: 4 discontinued the flexion or extension traction because illness developed after coming to the hospital (2 influenza, 2 Dengue fever); 1 refused further examination because of the development of neck pain during extension traction.

The change of anterior IVS before and during the end of the traction cycle in different traction angles of each segment is shown in Table 1. Anterior IVS was increased more remarkably in 30° flexion traction in C2-3 (21%), C4-5 (16%), C5-6 (15%), and C3-4 (10%), as well as in neutral position in C4-5 (12%) and C3-4 (8%), but was decreased in all levels by extension traction except in C2-3 (+2%), which was still not statistically significant.

The separations of posterior IVS were more prominent in neutral-position traction in C6-7 (37%), C3-4 (22%), and C4-5 and C5-6 (19%); they also were significant in 30° flexion in C6-7 (20%), C5-6 (19%), and C4-5 (17%). The IVS of C2-3 was the only segmental level that had an increase in separation posteriorly (+4%) (Table 2).

There was significant decrease in IVS posteriorly in extension traction, especially 15°: C6-7 (-50%), C5-6 (-37%), C4-5 (-26%), and C3-4 (-14%). Increase of IVS in the facet joint was significant only in two segments by 15° extension traction in C5-6 (17%) and C4-5 (15%) (Table 3).

## DISCUSSION

The greatest motion in the anterior and posterior directions occurs at the C5-6 intervertebral level.<sup>4</sup> The mobility of the neck or effect of traction depends on the flexibility of the disc, structure of the articular process, and laxity of the ligaments.

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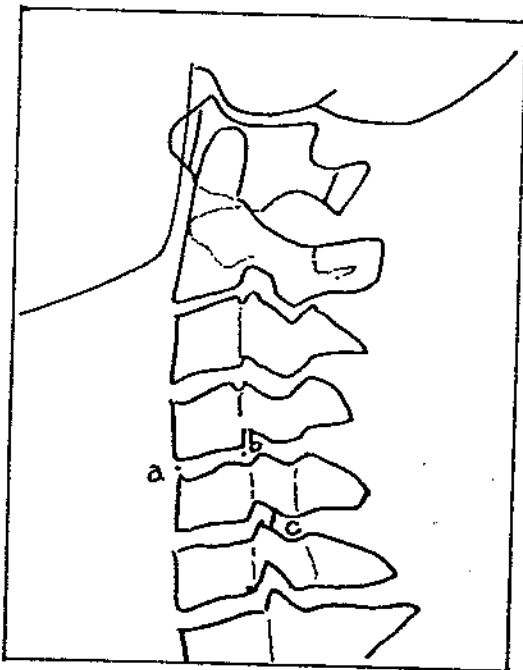


Fig 1. A, Anterior IVS. B, Posterior IVS. C, Facet joint space.

Horizontal traction is most commonly used for hospitalized patients with an acute condition.<sup>9</sup> Many authors report poor results with "bed traction" because of higher myoelectric activity during pull, resulting in protective spasm of neck muscle<sup>13, 15, 16</sup>; however, the case is quite different in this study. With a hot pack placed on the neck before traction for muscle relaxation, horizontal neck traction could provide the best effect, especially in the posterior IVS (C6-7 [37%], C3-4

Table 1. Anterior Intervertebral Space (in Millimeters) Before and After Cervical Traction in Different Traction Angles

Segment of Spine	Traction Angle (Mean ± Standard Deviation)		
	0° (n = 17)	Flex 30° (n = 13)	Ext 15° (n = 12)
C2-3			
Before	3.99 ± 0.63	3.57 ± 0.52†	4.03 ± 0.53
After	4.23 ± 0.81	4.27 ± 0.46	4.08 ± 0.55
Increase (%)	6	21	2
C3-4			
Before	4.55 ± 0.60†	4.17 ± 0.58*	4.89 ± 0.77
After	4.90 ± 0.58	4.57 ± 0.68	4.80 ± 0.66
Increase (%)	8	10	-1
C4-5			
Before	4.65 ± 0.58†	4.24 ± 0.64*	5.26 ± 0.88
After	5.19 ± 0.60	4.87 ± 0.83	5.13 ± 0.79
Increase (%)	12	16	-1
C5-6			
Before	4.97 ± 0.56	4.33 ± 0.81*	5.92 ± 0.74
After	5.17 ± 0.56	4.84 ± 0.53	5.77 ± 1.01
Increase (%)	5	15	-2
C6-7			
Before	5.57 ± 1.21	4.56 ± 0.77	6.21 ± 0.68
After	5.58 ± 0.72	4.98 ± 0.72	6.32 ± 0.88
Increase (%)	0	9	-2

\*P < .05.  
†P < .01.  
Flex = flexion; Ext = extension.

Table 2. Posterior Intervertebral Space (in Millimeters) Before and After Cervical Traction in Different Traction Angles

Segment of Spine	Traction Angle (Mean ± Standard Deviation)		
	0° (n = 17)	Flex 30° (n = 13)	Ext 15° (n = 12)
C2-3			
Before	3.35 ± 0.93	3.34 ± 0.82	3.58 ± 0.70
After	3.72 ± 0.71	3.42 ± 0.83	3.63 ± 0.63
Increase (%)	15	5	4
C3-4			
Before	3.57 ± 0.70*	3.84 ± 0.80	4.87 ± 0.74
After	4.24 ± 0.58	3.91 ± 0.79	4.14 ± 0.56
Increase (%)	22	4	-14
C4-5			
Before	3.48 ± 0.84*	3.52 ± 0.72*	5.28 ± 0.88
After	4.02 ± 0.57	4.03 ± 0.63	3.86 ± 0.77
Increase (%)	19	17	-26
C5-6			
Before	3.38 ± 1.02*	3.63 ± 0.88*	5.92 ± 0.74
After	3.89 ± 0.98	4.19 ± 0.79	3.68 ± 0.98
Increase (%)	19	19	-37
C6-7			
Before	2.73 ± 0.85*	3.22 ± 0.67*	6.21 ± 0.68
After	3.61 ± 1.02	3.81 ± 1.00	3.13 ± 0.72
Increase (%)	37	20	-50

\*P < .01.  
Flex = flexion; Ext = extension.

[22%], and C4-5 and C5-6 [19%]], although it was less effective in the anterior IVS (significant only in C4-5 [12%] and C3-4 [8%]).

Anterior IVS separation was more effective with cervical traction in 30° flexion: C2-3 (21%), C4-5 (16%), C5-6 (15%), and C3-4 (10%). In flexion traction, posterior IVS increased only at C6-7 (20%), C5-6 (19%), and C4-5 (17%).

That traction in neck extension position could not provide an increase in IVS was also proved in this study, as in other studies.<sup>2, 5, 9, 17</sup> With

Table 3. Facet Joint (in Millimeters) Before and After Cervical Traction in Different Traction Angles

Segment of Spine	Traction Angle (Mean ± Standard Deviation)		
	0° (n = 17)	Flex 30° (n = 13)	Ext 15° (n = 12)
C2-3			
Before	1.99 ± 0.39	2.08 ± 0.77	1.94 ± 0.18
After	2.04 ± 0.52	1.84 ± 0.28	2.08 ± 0.29
Increase (%)	2	-12	7
C3-4			
Before	1.95 ± 0.46	2.34 ± 1.36	2.01 ± 0.32
After	1.99 ± 0.41	1.03 ± 0.36	2.09 ± 0.48
Increase (%)	2	-14	3
C4-5			
Before	1.89 ± 0.48	2.30 ± 1.52	1.88 ± 0.19*
After	1.99 ± 0.38	1.88 ± 0.29	2.18 ± 0.42
Increase (%)	5	-19	15
C5-6			
Before	1.87 ± 0.42	2.23 ± 1.24	1.96 ± 0.27*
After	1.94 ± 0.27	2.01 ± 0.37	2.30 ± 0.47
Increase (%)	3	-10	17
C6-7			
Before	1.87 ± 0.40	1.87 ± 0.29	1.99 ± 0.28
After	2.06 ± 0.48	1.97 ± 0.23	2.11 ± 0.39
Increase (%)	10	-5	6

\*P < .05.

the increase of space in the facet joint of pars interarticularis and decrease of IVS, cervical traction in the extension position may increase the risk of injury in cases of cervical instability or vertebral arterial insufficiency. A number of subjects complained of discomfort during traction in extension; one even insisted on immediate discontinuation of the traction. There were no such complaints in traction under neutral or flexion position.

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