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Original Research Article

Lumbar Traction- Effect of Position on Vertebral Separation

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ABSTRACT

Aim: To investigate the effect of position of subject during lumbar traction on the amount of separation caused at three intervertebral segments, L3L4, L4L5 and L5S1. The three positions tested were supine, fowler's and prone.

Material and methods: 45 healthy male volunteers in the age group 18 to 25 years were divided into three groups, supine, prone and fowler's. They were positioned in the required position for 15 minutes. Lumbar traction with a force equal to fifty percent of body weight was applied for 15 minutes and after releasing the traction force, the position of rest was maintained for 10 minutes. Lateral view radiograph was taken before and after each intervention. Each subject served as a control for self for one position.

Results: All the three groups experienced intervertebral separations with traction as compared to the control, i.e. positioning only. Supine positioning during traction caused maximum posterior separation at L4L5 and maximum anterior separation at L5S1 while fowler's position caused maximum posterior separation at L5S1 level. No such pattern was observed with prone position. Moreover after releasing the traction force, the effect of separation was sustained at the segments that experienced maximum separation during traction.

Conclusion: With proper positioning the effect of lumbar traction can be maximized to affect a particular intervertebral segment.

KEY WORDS: Lumbar Traction, Intervertebral separation, Low back pain.

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INTRODUCTION

Traction causes physical separation of vertebral segments, which may cause a decrease in the pressure on sensitive structures and hence aid in the reduction of pain, paraesthesia or tingling [1-4]. The separation of vertebral segments has been documented in literature by various studies on cadavers as well as living subjects. Few investigators reported an increase in height as a result of traction [5-7].

Diagnostic imaging techniques including radiography, computed tomography, MRI, discography, epidurography etc. have also demonstrated separation of individual segments and reduction of disc herniations, resulting in clinical improvements in the patients in whom the disc defects were reduced [8-13].

The patient may be positioned prone or supine during traction, considering the patient's comfort, degree of pain and/or limitation of lumbar movement [14-16].

However, there is little evidence in support of these recommendations. Weatherall observed that traction in prone caused significant lumbar paraspinal muscle relaxation and less EMG activity as compared to the supine position [17]. Reilley et al used X-rays to study the relationship between hip position and the amount of vertebral separation produced by intermittent lumbar traction [18]. Subjects were positioned supine with hips in three positions; 0 degrees, 45 degrees and 90 degrees. Results showed significant maximal posterior intervertebral separation at L4L5 and L5S1 with hips flexed at 90 degrees.

Few studies have also aimed to record the amount of residual vertebral separation after releasing the traction force. Colachis et al., observed that some degree of separation was still present ten minutes after the removal of traction force while Twomey found that the elongation was lost thirty minutes after traction [7,8].

Hence, there is evidence in the literature that traction causes increase in the intervertebral distance. Furthermore, there is some evidence to suggest that position of the spine during traction can affect the degree of vertebral separation [18]. However, studies comparing the amount of intervertebral separation in different positions of lumbar traction are lacking in the literature. Such knowledge is clinically important, as it will help to provide a basis on which to rationalize the application of traction in a particular position for an effective outcome.

The purpose of this study was

1. To determine the effect of three positions (supine, fowler's and prone) on the amount of vertebral separation in anterior and posterior margins of intervertebral joints

2. To determine the effect of releasing the traction force after 10 minutes on the vertebral separation.

The measurement was taken on the anterior and posterior margins of the intervertebral spaces between the bodies of the adjacent vertebrae at 3 levels - L3L4, L4L5 and L5S1 on the X-ray films.

MATERIALS AND METHODS

The study was conducted in Swami Vivekanand National Institute of Rehabilitation Training and Research (SVNIRTAR), Cuttack, India in 2005. This study had the approval of the Academic Committee of the Institute. Written information about the procedure was provided to the volunteers. Informed consent was obtained from those who were interested in participating.

The study sample comprised of 45 healthy male volunteers in the age group 18-25 years with mean age of 20.9 years.

Subjects with history of backache, trauma to spine or spinal surgery, prolonged systemic steroid use, congenital ligament laxity were excluded. Subjects were randomly allocated into three groups of 15 subjects in each; Supine group, Fowler group and Prone group. They were advised not to take a large meal prior to application of traction.

Static traction was applied with ELTRAC-471, a microcomputer controlled unit for lumbar traction (ENRAF- NONIUS), provided with a split table. Lateral view X-ray before, during and after traction application was taken with an X-ray unit, ERGOPHOS 4M (SIEMENS company) of 300 mA.

The trunk was exposed till waist level for the application of the harness over the skin. Harnesses were applied in the standing position, so that the lower margin of the thoracic harness was just at the level of inferior thoracic cage and upper margin of pelvic harness at the level of iliac crest [4]. The subject was positioned on a split traction table in such a manner that the upper edge of split section of the traction table coincided with the upper margin of pelvic harness. He was instructed not to move or cough during traction therapy and try to be relaxed. He was provided with a safety switch in order to turn off the machine in case of any discomfort.

The gonadal area was shielded properly with lead vinyl shield. A lateral radiograph was taken with the centre of beam directed horizontally 7.5 cm anterior to the spinous process, at the level of the lower costal margin and a film tube distance of 110 cm was maintained [15].

The subject was instructed to maintain the same position for 15 minutes and second radiograph was taken maintaining the distance and the angle of beam constant. Static lumbar traction was applied with a force equal to half of body weight. After 15 minutes, with the spine still under traction load, third lateral radiograph was taken. The traction force was released and same posture maintained for 10 minutes without traction load. After 10 minutes, fourth radiograph was taken.

On the X-ray films, corners of the vertebral bodies from L3 to S1 were marked with a fine marker. Farfan et al defined disc height in the lateral radiograph from four landmarks placed at the corners of adjoining vertebrae. In the lateral image, the lines connecting two corners run more or less in the direction of the end plates [19]. The intervertebral spaces were measured in millimetres at the anterior and posterior aspects; with the help of a fine-point Vernier caliper.

All values were noted at anterior as well as posterior corners respectively at three segmental levels i.e. L3L4, L4L5 and L5S1. The data analysis was done using SPSS software (version 7.5). The calculated difference scores were analyzed using a 3x3x3 ANOVA. In this design there was one between-factor with three levels (i.e. three groups –supine, prone, fowler's), and three within-factor each with three levels (i.e. segments, L3L4, L4L5 and L5S1) and three interventions (control, traction and release). Post Hoc comparisons were evaluated using Tukey's HSD. A 0.05 level of significance was used for all post-hoc, pair-wise compar

RESULTS

Posterior interspaces:

The results are depicted in Tables 1 and 2.

Subjects in all the three groups showed significant posterior intervertebral separation with traction at all three levels as compared to control i.e., positioning only. (Graph 1,2 and 3)

At L3L4 segment, all the three groups showed significant differences between the control and traction. This effect was also sustained ten minutes after releasing the traction except in prone group, which showed no significant difference after traction, and release. Moreover no significant differences were noticed between the groups for separations caused due to traction.

At L4L5 level, the separation caused by supine group was significant as compared to the fowler's and prone groups. Supine group was also found to sustain the separation post-release.

At L5S1 level, the fowler group showed maximal separation as compared to the supine and prone position. Moreover fowler group also showed significant differences after releasing the traction that means that the effect was sustained.

Tukey's HSD post-hoc analysis also demonstrated that there were significant differences in amount of separations caused at three segments, with supine group causing significant differences at L3L4 and L4L5 as well as L4L5 and L5S1 levels while fowler group caused more differences between the L3L4 and L5S1 segments. However, no such pattern was observed in the prone group.

Table 1: ANOVA Test (Posterior Interspaces).

Tests of Between-subjects effects					
	Sum of squares	df	Mean square	F	Significance
Group	0.178	2	8.92E-02	0.072	0.931
Error	52.115	42	1.241		

Tests of within-subjects effect					
	Sum of squares	df	Mean square	F	Significance
Intervention	170.384	2	85.192	214.378	0.0001
Intervention x Group	1.126	4	0.282	0.708	0.588
Error (Intervention)	33.381	84	0.397		
Level	2.766	2	1.383	1.646	0.199
Level x Group	14.345	4	3.585	4.268	0.033
Error (Level)	70.587	84	0.84		
Intervention x Level	2.834	4	0.708	2.761	0.029
Intervention x Level x Group	10.004	8	1.251	4.874	0.0001
Error (Time x Level)	40.104	168	0.257		

Anterior Interspaces

Table 2: ANOVA Test (Anterior Interspaces)

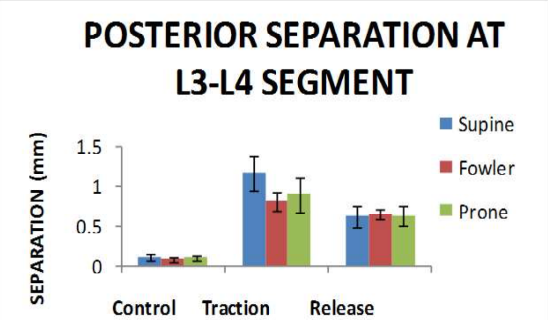
Tests of Between subjects effects					
	Sum of squares	**df**	**Mean square**	**F**	**Significance**
Group	2.471	2	1.236	4.48	0.017
Error	11.585	42	0.276		
Tests of within-subjects effects					
	Sum of squares	**df**	**Mean square**	**F**	**Significance**
Intervention	61	2	30.535	204.4	0.0001
Intervention x Group	1.568	4	0.392	2.625	0.4
Error (Intervention)	12.549	84	0.149		
Level	11.096	2	5.548	14.323	0.001
Level x Group	1.18	4	0.295	0.762	0.553
Error (Level)	32.537	84	0.387		
Intervention x Level	8.89	4	2.223	10.024	0.0001
Intervention x Level x Group	0.84	8	0.105	0.473	0.874
Error (Time x Level)	37.25	168	0.222		

Anterior Interspaces

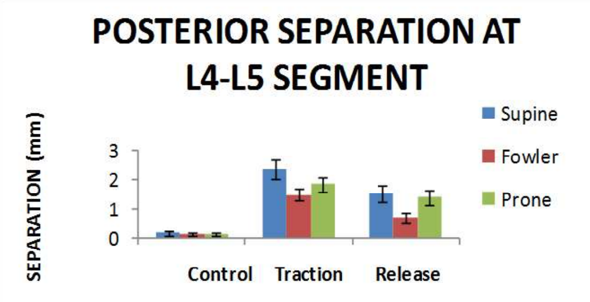
Subjects in all the three groups experienced anterior separation at levels L3L4, L4L5 and L5S1 as a result of traction as compared to the control, i.e., positioning only (Graphs 4, 5 and 6).

Tukey's HSD post hoc analysis showed no significant differences in separation between the groups at L3L4 and L4 L5 levels, but at L5S1 level, supine group experienced better separation

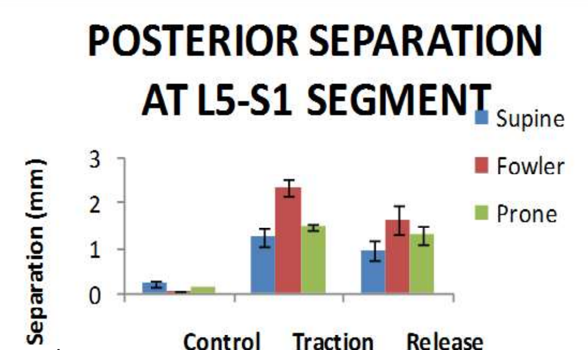
as compared to fowler and prone groups. Moreover on releasing, no significant differences were found between the traction and release except in supine group at L5S1 segment, indicating that anterior separation is not sustained 10 minutes after releasing the force. On analyzing the effects seen at segments, level L5S1 showed significantly more separation as compared to L3L4 level in all the three groups, while in supine group, significant differences were found between L5 S1 and L4L5 levels also.



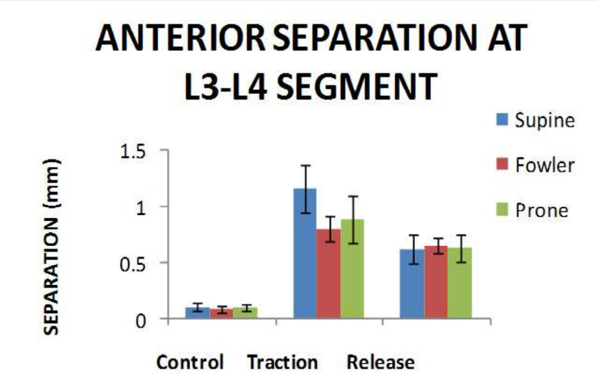
Graph 1



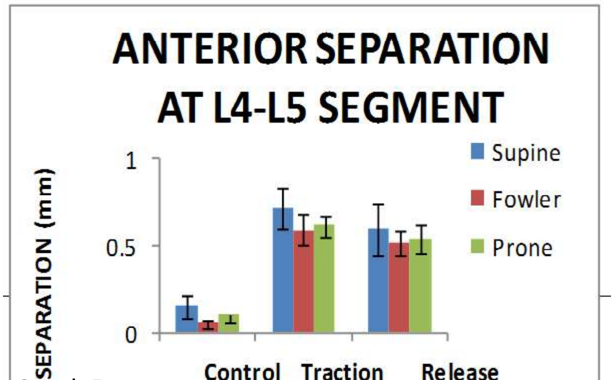
Graph 2



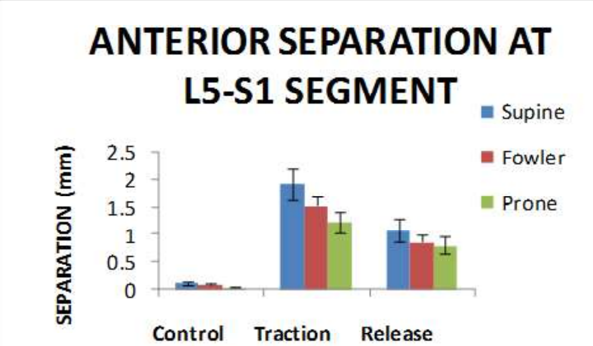
Graph 3



Graph 4



Graph 5



Graph 6

DISCUSSION

Overall the results of this study provide support for the fact that lumbar traction causes an increase in the intervertebral space. This effect was found true for all three positions, which are commonly used in clinical practice, i.e. supine, fowler and prone. These results are similar to the previous studies done on lumbar traction [5-12].

In the three segments observed in the study, ie. L3L4, L4L5 and L5S1, it was found that the position of the subject during traction affected the amount of vertebral separation. At L4L5 segment, supine group experienced maximum posterior separation while at L5S1 segment, positioning the subject in fowler's position caused maximum posterior separation. This finding would be attributed to the difference in laxity of posterior structures at the two vertebral levels. In supine position, much of the traction force would be used in taking up the initial slack of posterior structures at L5S1 segment, hence more separation posteriorly at L4L5 level.

At L5S1 level, the flexion moment caused due to the fowler position could be the reason behind getting maximum posterior separation. The experimental study done by Lee et al showed that adoption of fowler's position during traction caused a significant flexion moment on the spine, which was large (29Nm) at L5S1 as compared to the upper segments.[21] At L3L4 level, no significant difference was found between the three positions both at anterior and posterior interspaces.

With prone positioning, no significant differences were observed at various segments. This could be attributed to the fact that since the prone position is predominantly an extension position of spine, hence the posterior structures are lax. Most of the traction force might be used to take up the initial slack of the posterior structures, hence causing less separation as compared to other positions.

On the anterior interspaces, there was a progressive increase in separation from L3L4 to L5S1. This was in contrast with the study by Reilley et al, which showed a decrease in anterior interspaces as a result of traction [18].

This could be attributed to the difference in the angle of pull of the traction rope. They used a 24-degree angle of pull, which might have caused a much more flexion moment at the spine, hence causing a decrease in anterior intervertebral distances. Use of 0 degree angle of pull in the present study, as suggested by Lee et al must have caused a balanced separation at anterior and posterior interspaces [20,21].

Moreover, the three groups experienced similar amount of anterior separation with traction at L3L4 and L4L5 segments while the supine positioning caused maximum anterior separation at L5S1 segment.

Another important observation was that separation at the posterior interspaces was more as compared to the anterior aspect at each segment, irrespective of the groups. This may be due to the fact that anterior annular fibers as well as the anterior longitudinal ligaments are stronger and stiffer than their posterior counterparts [23].

On releasing the traction force, all the positions showed some amount of residual separation still present after ten minutes. The maintenance of the effect was found to be sustained significantly in supine position at L5S1 segment anteriorly. On the posterior aspect, at L4L5 segment, the supine position could sustain maximum amount of separation while at L5S1 segment, the fowler position was superior to other groups. In other words levels that experienced greater deformation sustained it for a longer period. This effect is due to the hysteresis property of the viscoelastic structures, according to which there is a loss of energy between the load and unload cycles. Hence, if the amount of creep after tensile loading is considerable, recovery back to original starting position is slow [23].

CONCLUSION

Low back pain has been shown to respond favourably to lumbar traction. One argument against using traction is that it is non-specific and simultaneously affects several segments. In contrast, the results of this study have clearly shown that with proper positioning the effect of lumbar traction can be maximized to affect a particular segment.

All the three groups experienced intervertebral separations with traction as compared to the control, i.e., positioning only. Supine positioning during traction caused maximum posterior separation at L4L5 and maximum anterior separation at L5S1 while fowler's position caused maximum posterior separation at L5S1 level whereas no such pattern was observed with prone position. Moreover after releasing the traction force, the effect of separation was sustained at the segments that experienced maximum separation during traction.

This study was done on healthy young individuals and not on patients with low back pain. It is hoped that the present study will stimulate further research to have a more comprehensive view of effects of positioning on clinical outcome in patients with low back pain. The long-term sustainability effects of the technique might need further evaluation.

Conflicts of interest: None

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