

ROLE OF KINESIO TAPE TECHNIQUE ON HIP ANTEVERSION AND GAIT PATTERN IN CHILDREN WITH SPASTIC DIAPLEGIA

تأثير الشريط اللاصق (كينزيوتاب) على الانقلاب الامامى لمفصل الفخذ والنمط الحركى لدى الاطفال المصابين بالشلل التخشبى المزدوج

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- *Special and deepest thanks to **My parents, My Sisters and My Son** for their continuous support, help and encouragement.*
- *No words could express my deeply love and thanks to **My wife** for her patience and great support.*

Introduction

- The primarily functional problem of children with spastic paraplegia includes difficulty with mobility and posture. Other problems include postural deviations such as inability to sit without support, inability to stand, and difficulty in movement transition (**Woollacott and Sveistrup, 2007**).

Lower limbs rotational troubles in spastic diplegic CP children are frequent and difficult to identify by physical examination alone (**Das et al., 2005**).

- Normal skeletal development includes rotational or torsional and alignment changes of bones and joints. These normal developmental processes may be altered secondary to abnormal muscle pull or weight bearing forces. There is much debate about the nature and extent of deformities in the proximal femur in children with cerebral palsy, Most authorities accept that increased HA is common (**Robin, et al., 2008**).

- Hip anteversion is an inward twisting of the thigh bone. It causes a child's knees and feet to turn inward and have a "pigeon-toed" appearance. As child's knees and feet turn in, the legs look bowed. In hip anteversion, child's balance is fairly unsteady when child tries to walk normally with her/his feet close together. The unsteadiness may cause the child to trip and fall more often than usual (**Young, 2011**).

- Children with HA classically sit in W shape position, in toeing gait, tibial torsion deformity, awkward running style **(Able, 2006)**.

- Hip anteversion angle measured by axial Computed tomography (CT) scan based on three-dimensional reference system based on functional axes of the femur, this method is free from variations induced by femoral and condylar geometry, it is appear to be relevant methods for evaluating HA angle **(Yoshioka et al., 2008)**.

- AutoCAD is used across a wide range of industries, by architects, project managers, engineers, medical assistive tool, graphic designers, and other professionals (**Lendio, 2012**).

- Kinesio tape is a very useful physiotherapeutic modality. If applied properly, it is a valuable adjunct to therapeutic rehabilitation. Kinesio tape enables the control of muscle tone, which directly translates into new possibilities of locomotor activity of the patients. The principle is activation instead of fixation a very important difference resulting in the preservation of unrestricted functional movement of the muscles and consequently in the whole body (**Sliwinski et al., 2007**).

- The tape provides proprioceptive feedback to achieve and maintain preferred body alignment. It is a complementary treatment and is designed to facilitate the body's natural healing process while allowing support and stability to muscles and joints without restricting the body's range of motion (**Öhman, 2013**).

Purpose of the study:

To investigate the effect of kinesio tape technique on hip antiversion angle and gait pattern in children with spastic diaplegic cerebral palsy.

Significance of the study

- There are many techniques which used to correct the deformities in the sagittal plane but there is no clear technique that used to correct the rotational deformities. So, if we prove the effectiveness of kinesio tape technique on the correction of the internal rotation of the hip joint, so it may help the realignment of the gait pattern of those children.

Subject, Instrumentation and Procedure

I- Subjects:

- Thirty spastic diplegic CP children from both sexes (23 boys and 7 girls) with hip anteversion angle ranged from 25 degree to less than 50 degree affecting their gait pattern were included in the current study.
- Children participated in this current study were selected from out-patient clinic of the Faculty of Physical Therapy, Cairo University, and the outpatient clinic of the Physical Therapy Department of Amria General Hospital in Alexandria.

Inclusive criteria:

- 1) Age of children ranged from three to five years.
- 2) Degree of spasticity ranged from 1 to +1 according to modified Ashworth scale (**Bohannon and Smith, 1987**).
- 3) They were able to stand and walk without support according to **Denver II developmental scale**.
- 4) Hip anteversion angle ranged from above 25 degree to less than 50 degree according to trochanteric prominence angle test.
- 5) They were able to understand orders and follow simple verbal commands given to them.

Exclusive Criteria

- 1) Visual or auditory defects.
- 2) Fixed deformity of lower limbs.
- 3) Surgical interference in the affected lower limb.

Children were randomly assigned into two groups of equal number:

Group (A): consisted of fifteen children, they received a selected exercise program for spastic paraplegia with an emphasis on facilitation of standing control and walking for one and half hour which was conducted three times per week for successive three months.

Group (B): consisted of fifteen children, they received the same exercises program given to the control group in addition to the application of kinesio tape for the facilitation of knee extensors, hip abductors and hip external rotators. It was applied for five days and rested for two days for three successive months.

II- Instrumentation:

- **Evaluation for sample selection:**

- **A- Modified Ashworth scale:**

It was used to determine the degree of spasticity.

- **B- Denver II developmental scale:**

It was used to determine children who can stand and walk without support.

- **C- Trochanteric prominence angle test:**

It was used to determine the HA angle to be ranged from 25 degree to 50 degree.

- **For evaluation:**
- **A- 3D axial CT scan:**

Hip anteversion angle was measured by 3D axial CT scan based on functional axes of the femur.

B- Benq Lm digital camera mpix 18.2 megapixel:

It was used for video recording of child gait pattern to document data of physician rating scale parameters in addition to record the angles of knock knee and toe in by using the autoCAD software.



C- Auto CAD software:

It was used to measure knock knee, toe in and knee flexion at mid stance (one of the parameters of PRS) to evaluate children with excessive HA angle pattern of gait.

Property

No selection

General

Color	<input type="checkbox"/> ByLayer
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Linetype	ByLayer
Linetype scale	1
Lineweight	ByLayer
Thickness	0
Transparency	ByLayer

3D Visualisation

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Plot style

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Plot style table	None
Plot table attached to	Model
Plot table type	Color-dependent plot style

View

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Center Y	169.8587
Center Z	0
Width	390.2074
Height	185.625

Misc

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UCS icon On	Yes
UCS icon at origin	Yes
UCS per viewport	Yes



Model / Layout1 / Layout2 /

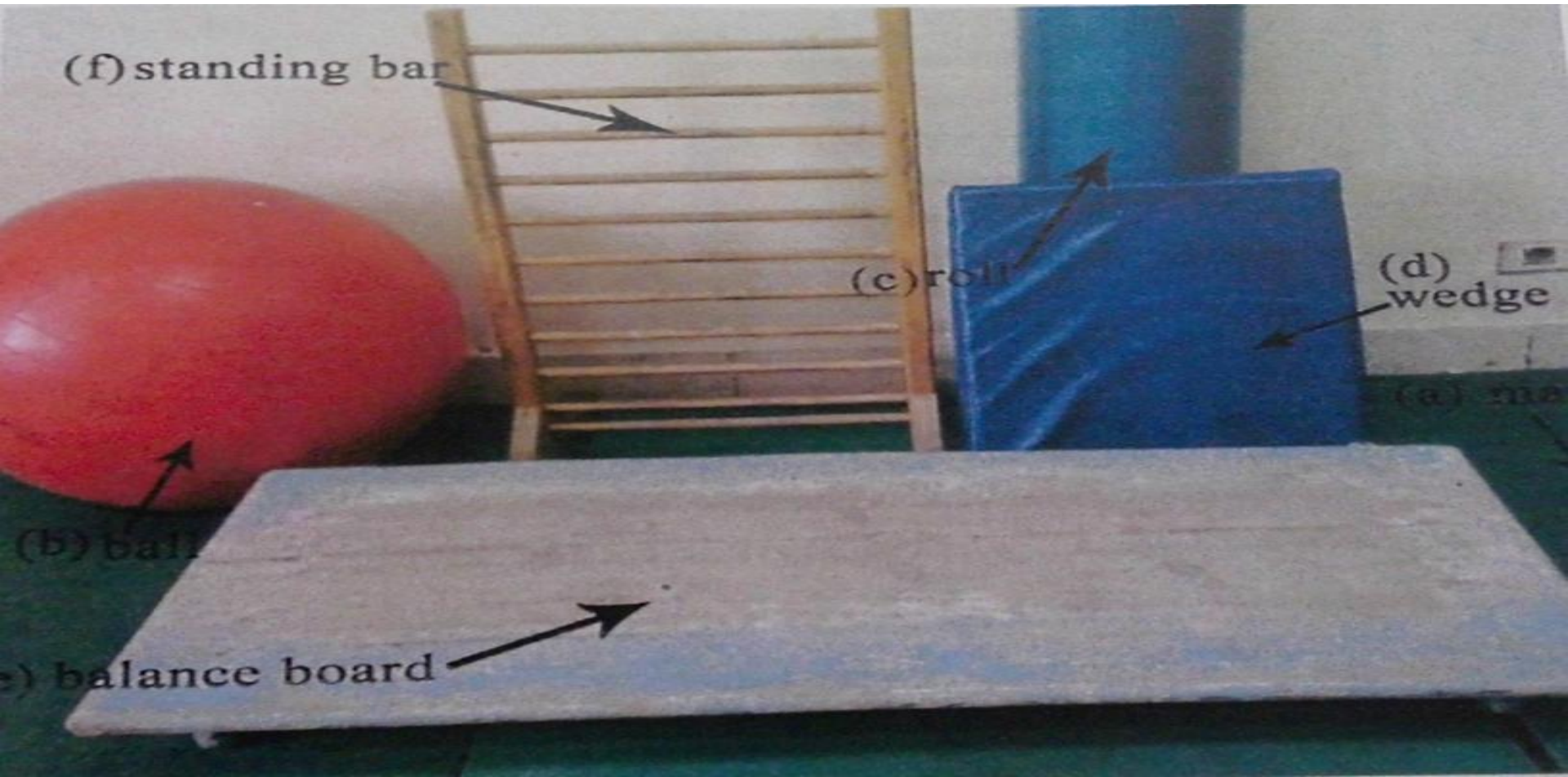
Command:
Command:
Command:

D- Physician rating scale

- Visual assessments of gait using the modified PRS showed the best inter rater reliability for the parameters of degree of knee flexion at mid stance, initial contact, foot contact at mid stance, time of heel rise, hind foot at mid stance, base of support and the use of gait assistive device. These findings held true regardless of the observation technique used (**Koman et al., 2003**).

3) For treatment:

A- Mat, ball, wedge, roll, balance board and standing bar.



B- Kinesio tape:

Elastic adhesive tape 2.5 cm (1 inch) and 7.5 cm (3 inch) width, this tape is elastic as well as adhesive.



III- Procedure:

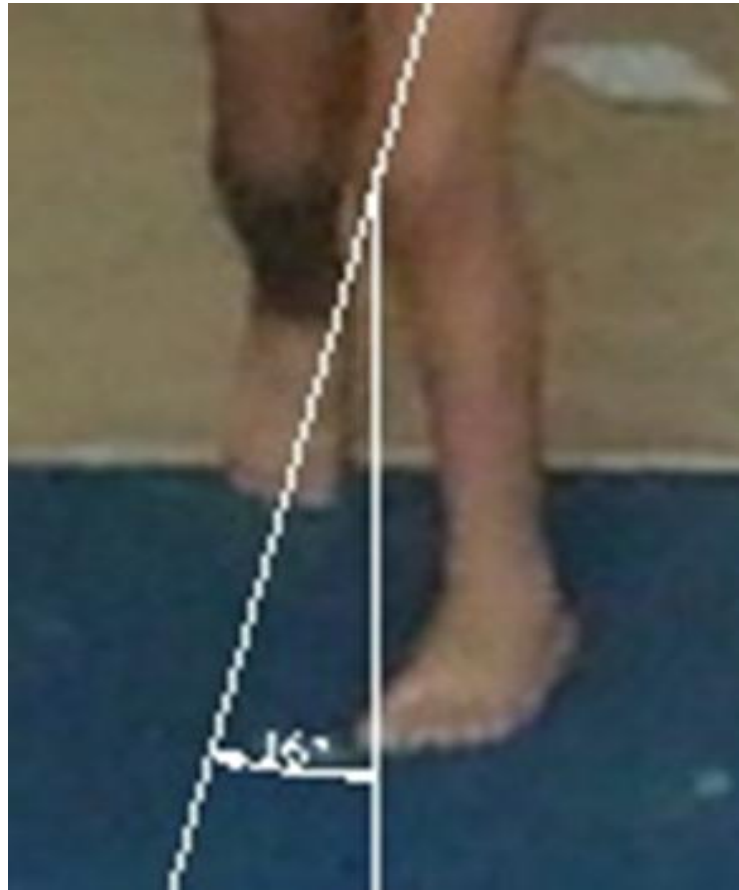
- **A) 3D axial CT scan:**

Hip anteversion was defined as an angle formed to the transverse axis by a line running through the center of the femoral head through the midpoint of the narrowest segment of the femoral neck (**Yoshioka et al., 2008**).

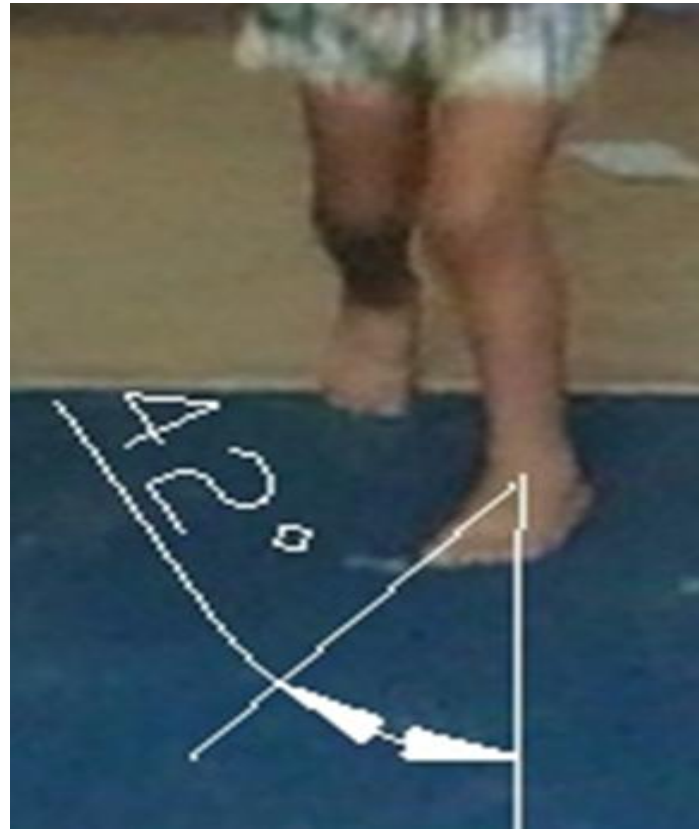
B) Video recording in addition to the use of autoCAD

software:

- **Knock knee:** the angle between a line pass through the center of femoral bone and a line pass perpendicular through tibial tuberosity.



- **Toe in:** the angle between a line Perpendicular on the center of talus and a line path through the center of talus and the center of big toe.



- **Knee flexion at mid stance (one of the parameter of PRS):**
- the angle between a line pass through the center of the thigh and the line pass through the center of the leg.



- **C) Physician rating scale:**

- Physician Rating Scale rated the child's walking pattern of the following: knee flexion at mid stance, initial contact, foot contact at mid stance, time of heel rise, hind foot at mid stance, base of support and the use of gait assistive device, based on an assessment of videotapes of the child's gait before and after treatment, with a maximum score of 22 for each leg indicating normal gait (**Corry et al. 1998**).

Application of tape

- **Skin preparation:**

- The skin should be free of oils and lotions and should be cleaned prior to tape.
- Remove anything that limits adhesive ability to adhere to the skin which limits both effectiveness and period of application.

- **Aims of using kinesio tape:**

- 1) The tape was applied for facilitation of muscle contraction of hip abductors, external rotators and knee extensors.
- 2) To maintain the proper alignment of the child's lower limb during gait to correct the pathological gait pattern.
- 3) To increase knee stability during weight bearing on the child's lower limb.

First, facilitate knee extensors: the patient fully extended his knee, the tape started from the tibial tuberosity and run over skin till it reaches to the anterior superior iliac spine.



- Second, facilitate of hip abductors: from the same position, the tape started from the lower third of the lateral side of thigh till the greater trochanter.



- Third, facilitate of hip external rotators: from the same position, the tape started from the medial tibial condyles and run up in spiral way till it reaches to the greater trochanter.



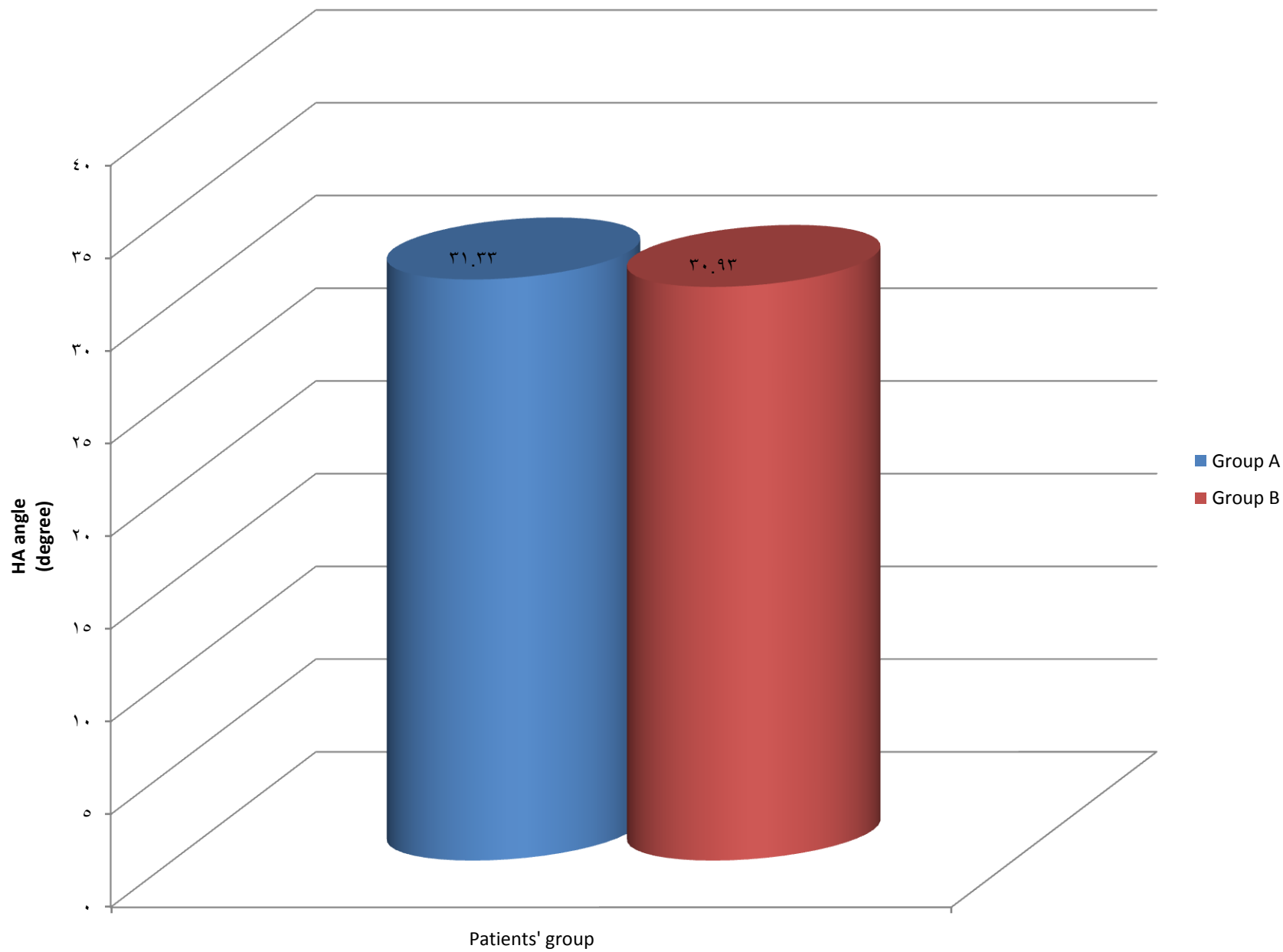
- 1) In the previous three techniques the tape pulls the skin toward the direction of the selected movement which is facilitated.
- 2) After the end of each technique put a collateral tape on the beginning, middle and the end of the tape.
- 3) Give the children instruction to avoid vigorous activities for thirty minute which required for the glue to become fully activated.
- 4) Application was for five days then remove tape for 24 hour to allow skin perspiration then reapply tape again.
- 5) After removal of tape the skin cleaned by a piece of cotton with alcohol.

Result •

I- Measurement of hip anteversion angle by 3D axial CT scan:

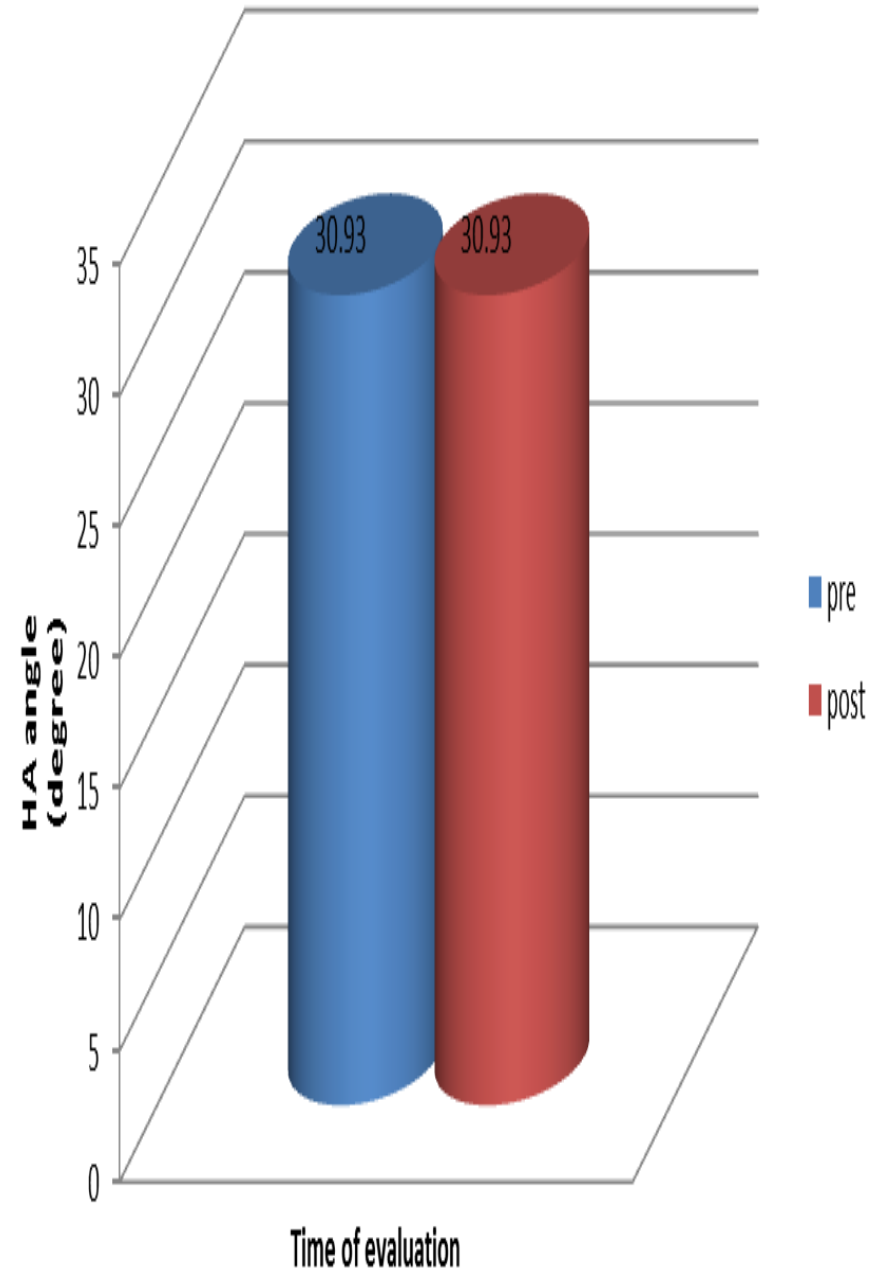
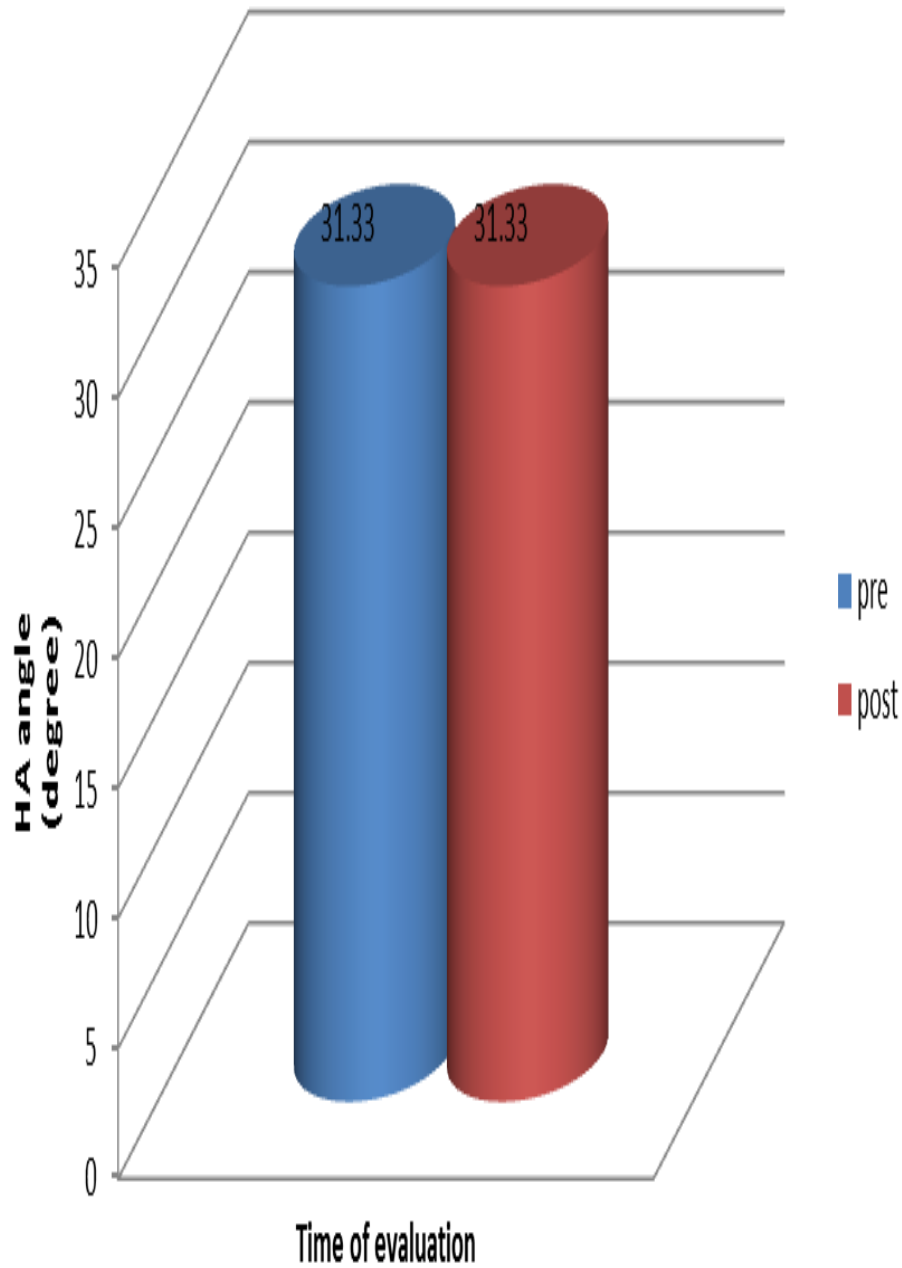
- 1) Comparison between pre-treatment mean values for the two groups (A and B):**

There was no significant difference in hip anteversion angle between the both group pre treatment.



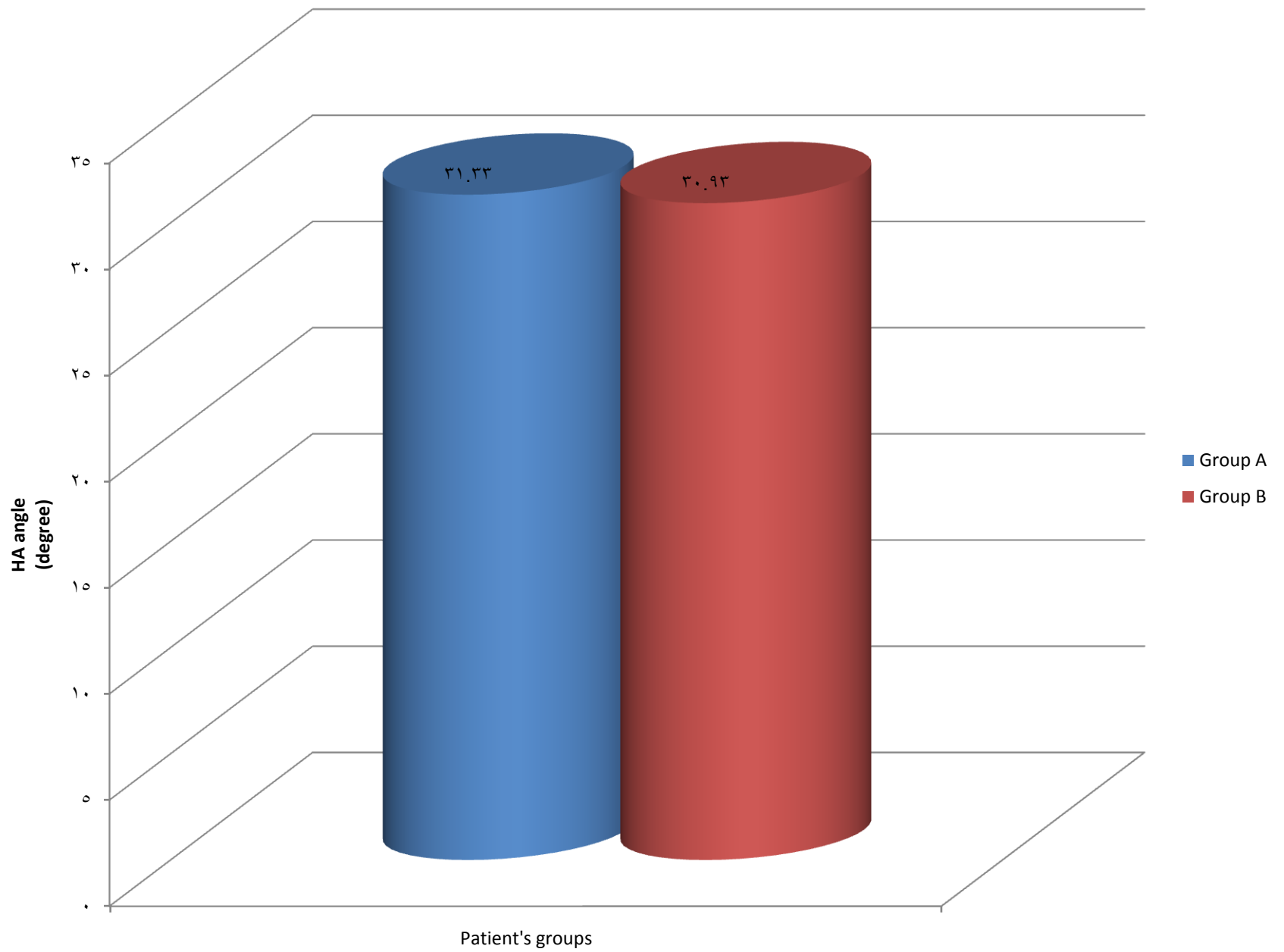
2) Comparison between pre and post- treatment mean values for the two groups (A and B):

There was no significant difference in hip anteversion angle pre and post the treatment in both group.



3- Comparison between post-treatment mean values for both group (A and B):

There was no significant difference between post treatment mean values for both group.

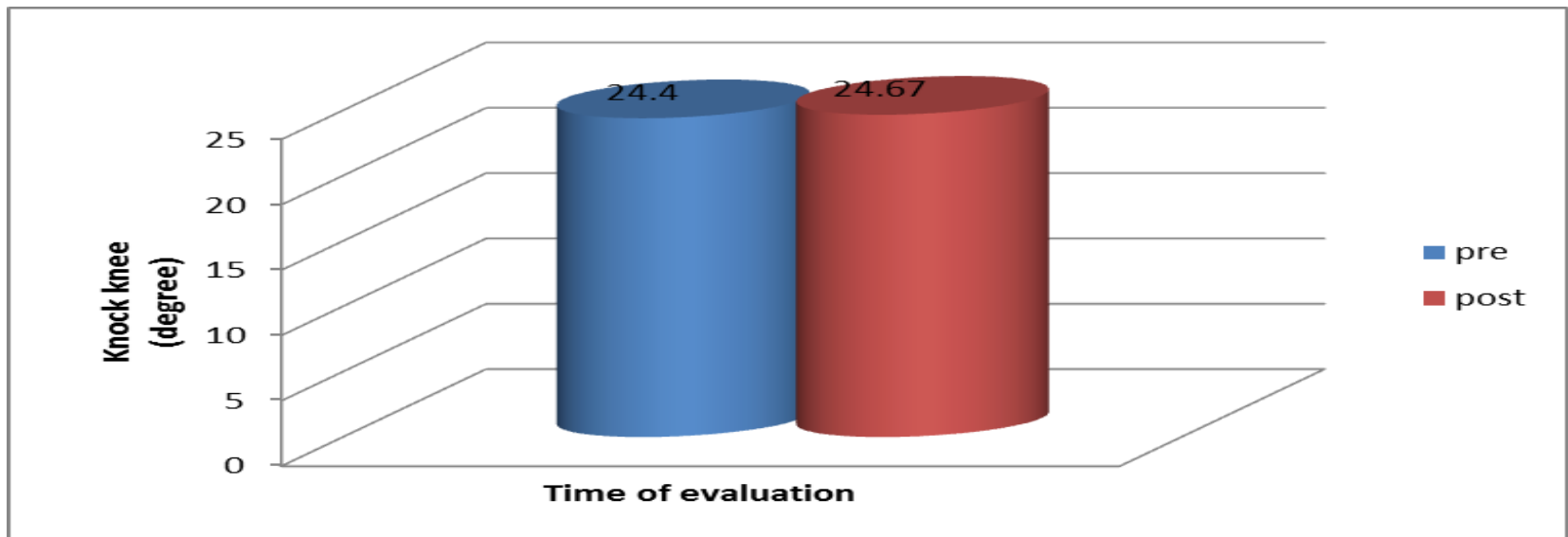


II- Evaluation of gait pattern:

1) Measuring of knock knee degree:

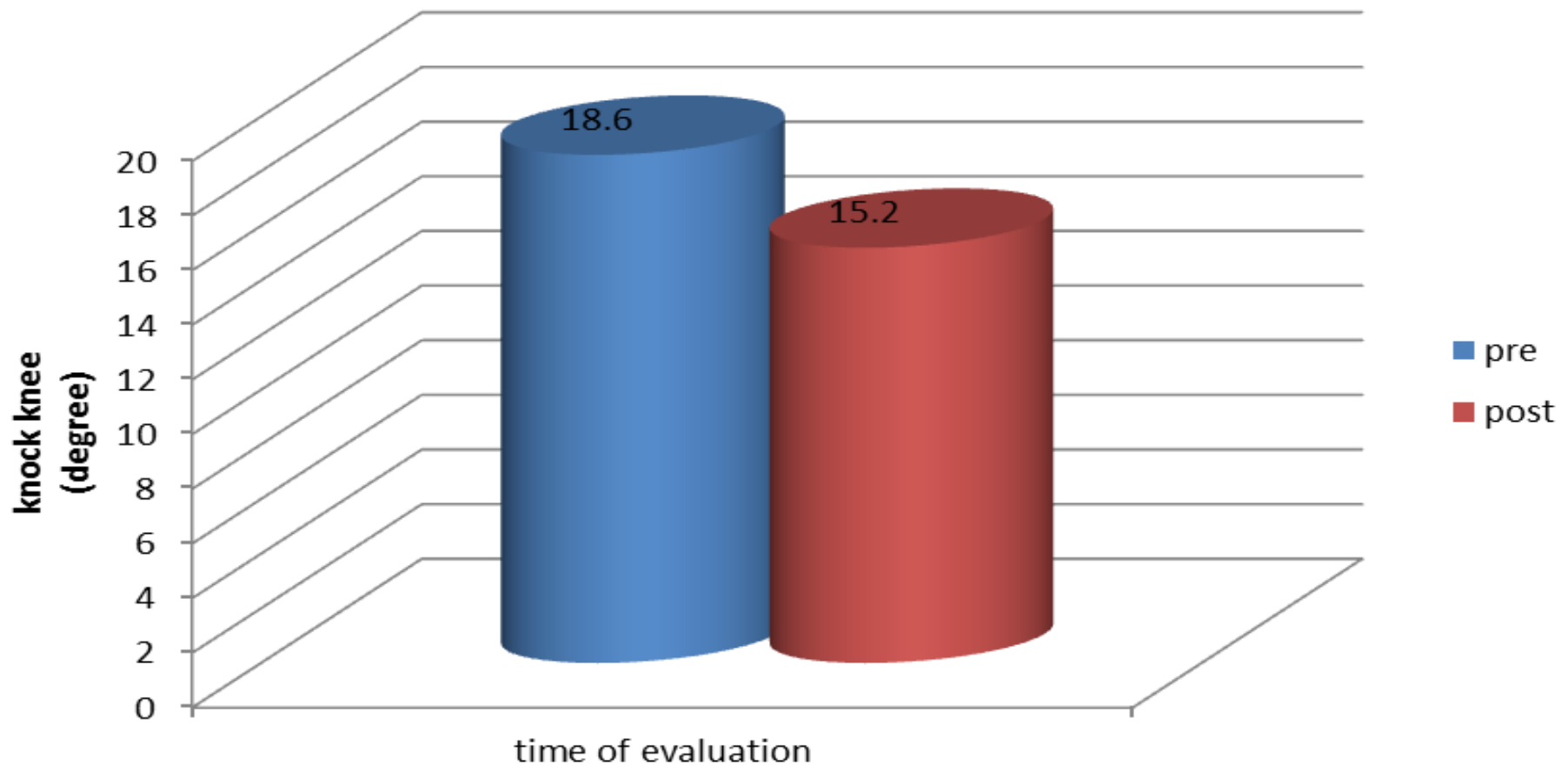
a) Pre- and post-treatment mean values for group A:

there was no significant difference



b) Pre and post-treatment mean values for group B:

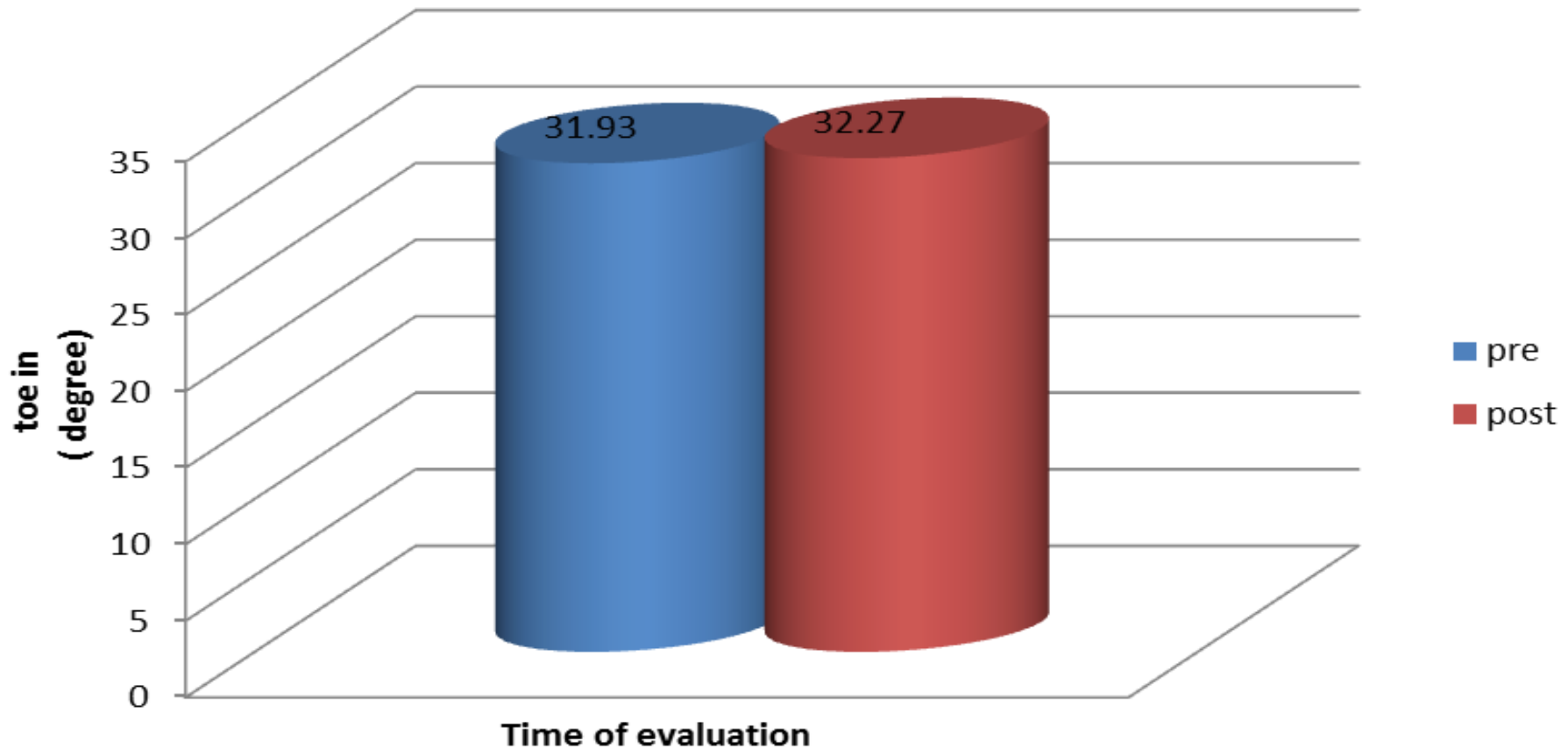
- There was significant difference.



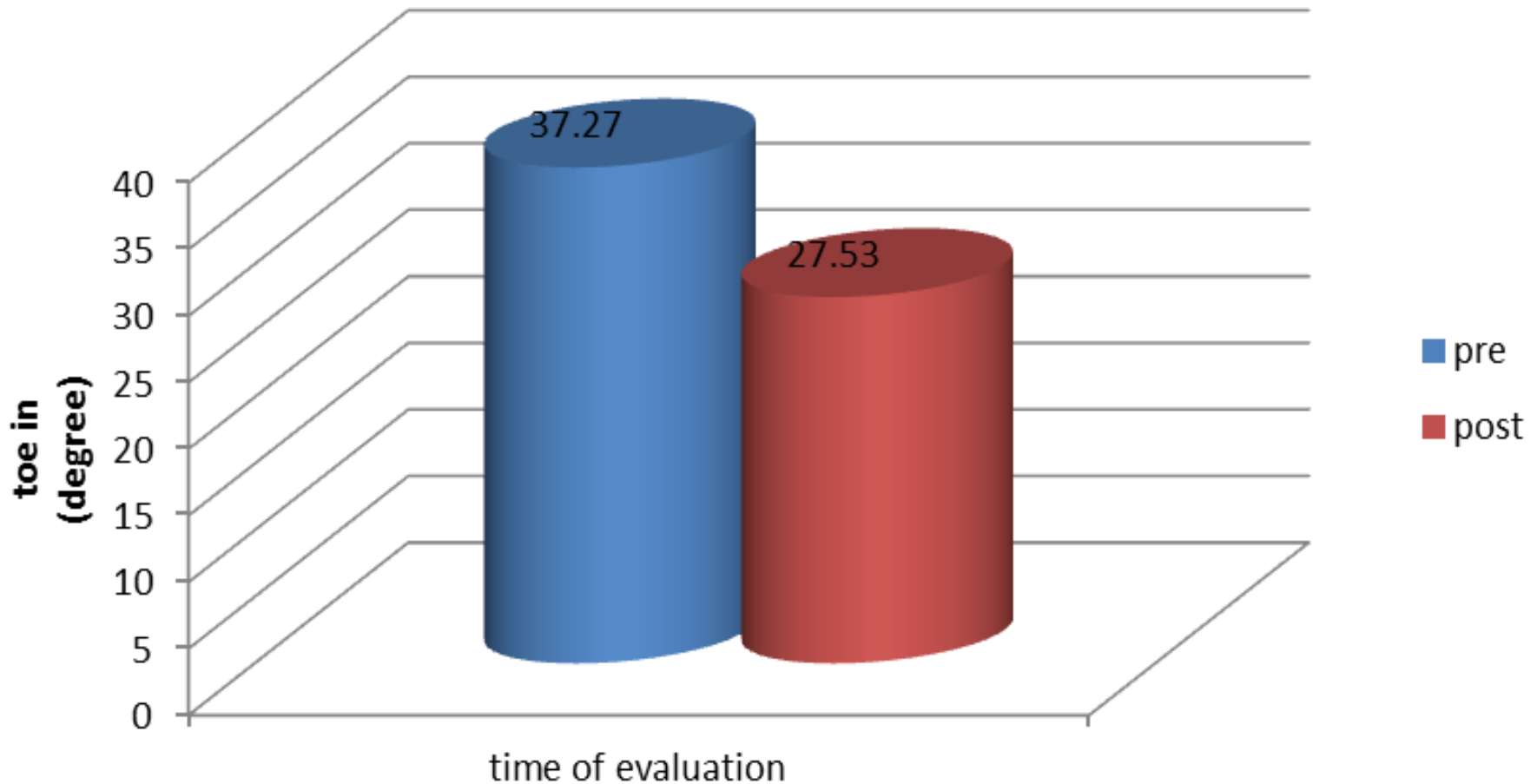
2- Measuring of toe in degree:

a) Pre- and post-treatment mean values for group A:

There was no significant difference.

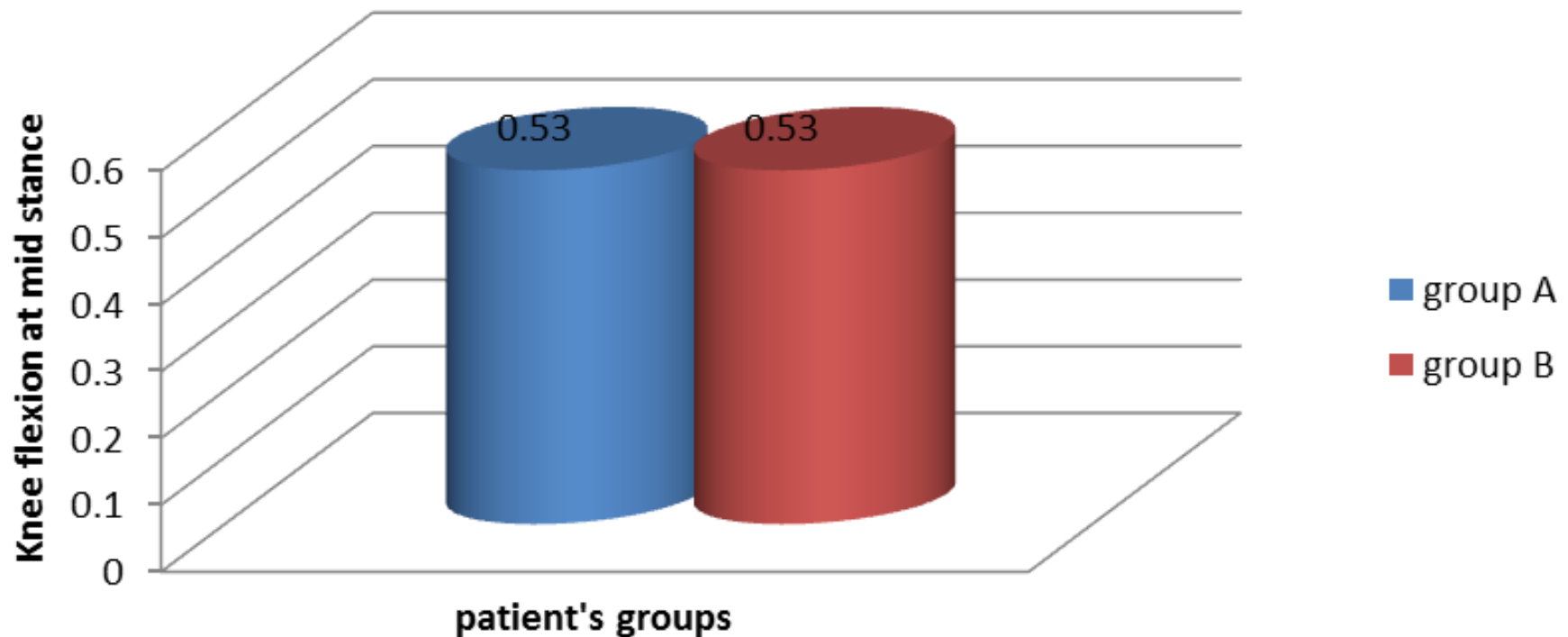


b) Pre- and post-treatment mean values for group B:
There was a significant difference.



3- Physician rating scale parameters:

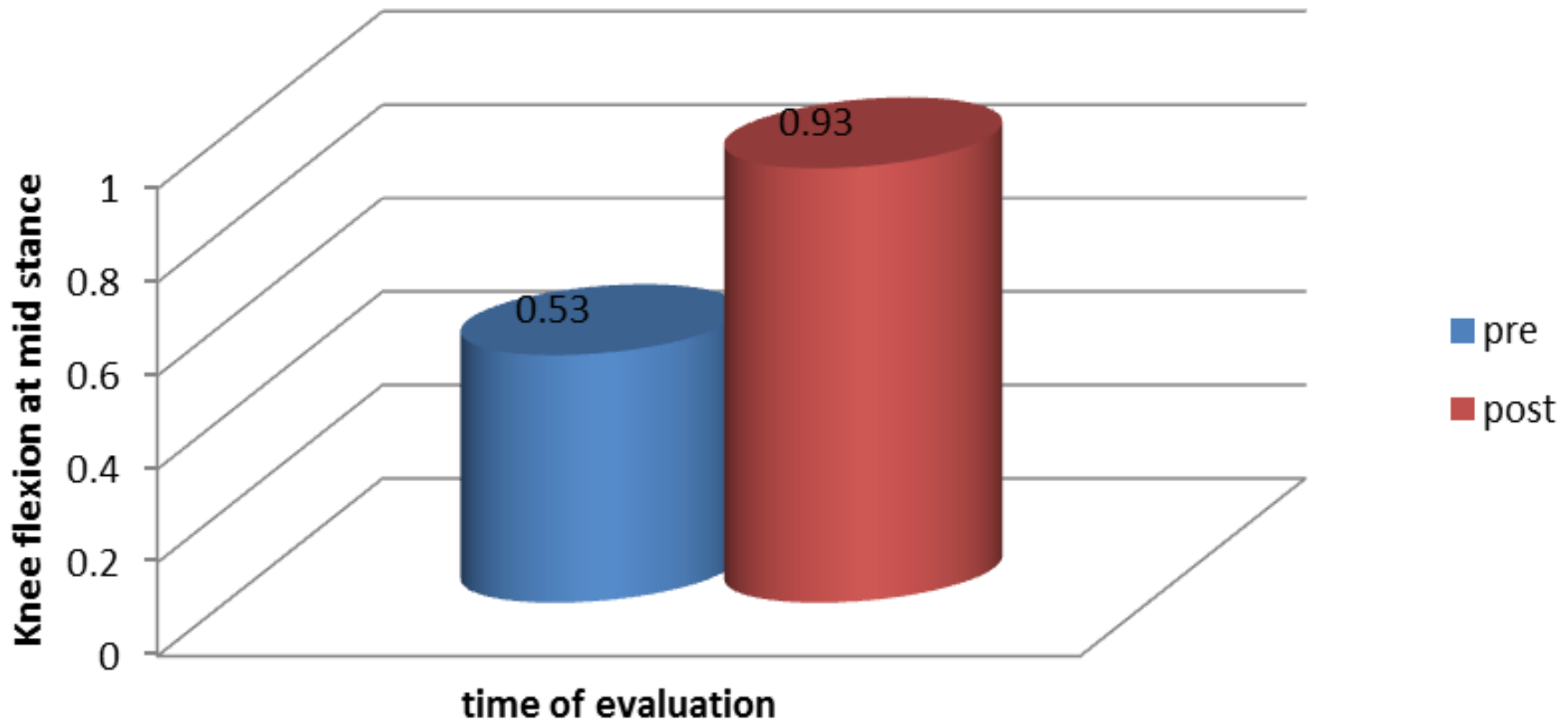
- **A) Knee flexion at mid stance:**
- **a) Comparison between pre-treatment mean values for the two groups (A and B):**
- **There was no significant difference.**



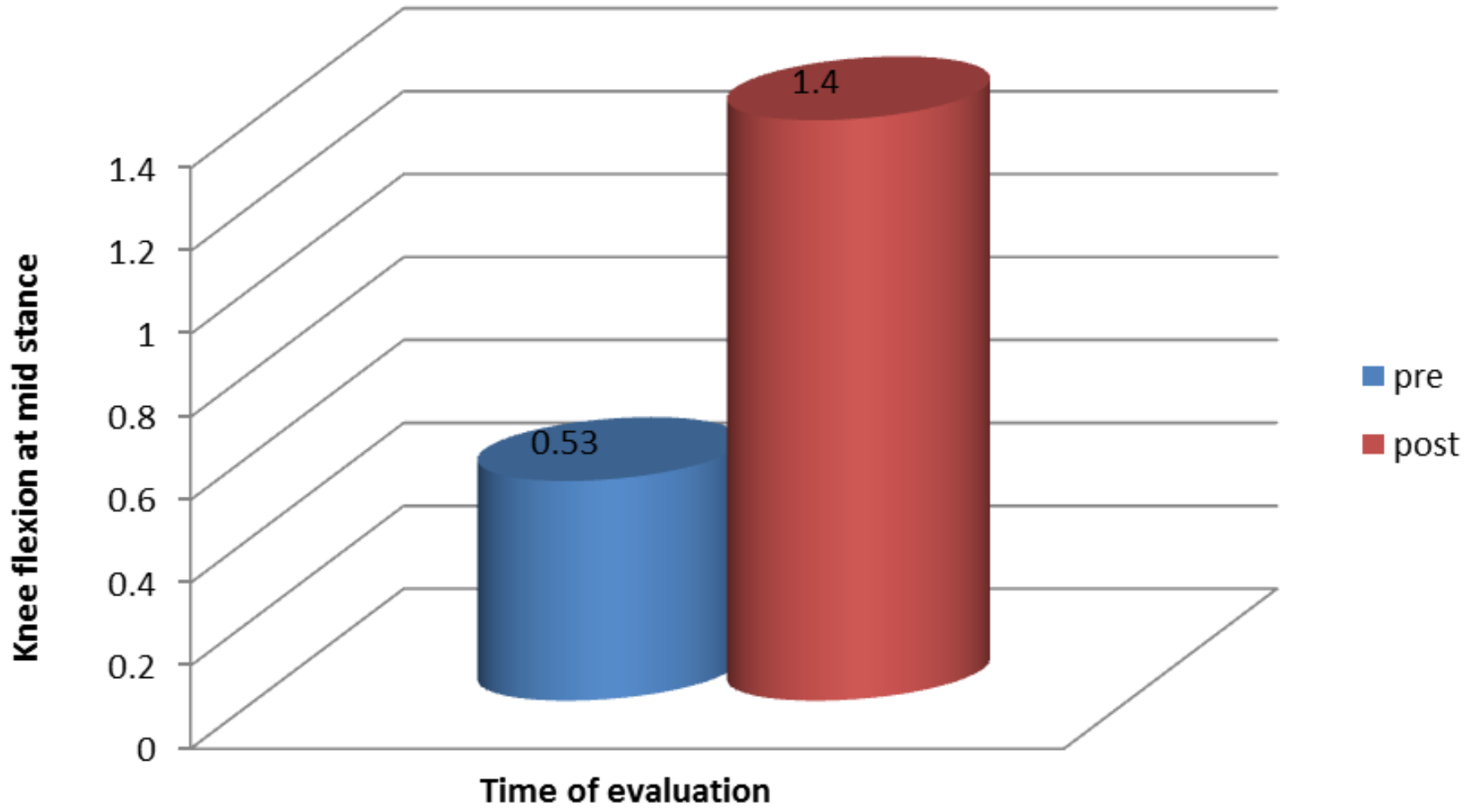
b) Comparison between pre and post-treatment mean values for the two groups (A and B):

- Pre- and post-treatment mean values for group A:

There was no significant difference.

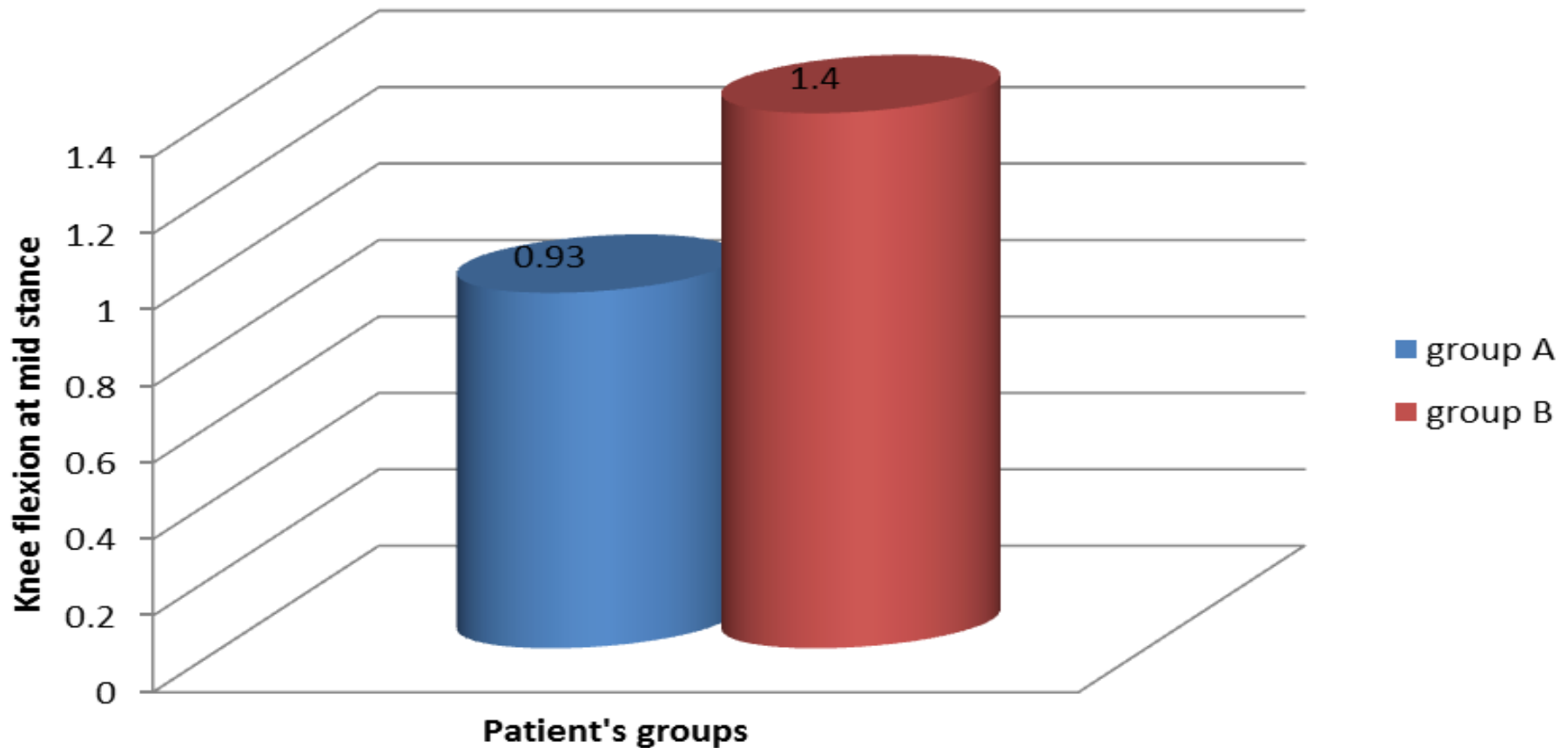


- Pre- and post-treatment mean values for group B:
- There was a significant difference.



c) Comparison between post-treatment mean values for the two groups (A and B):

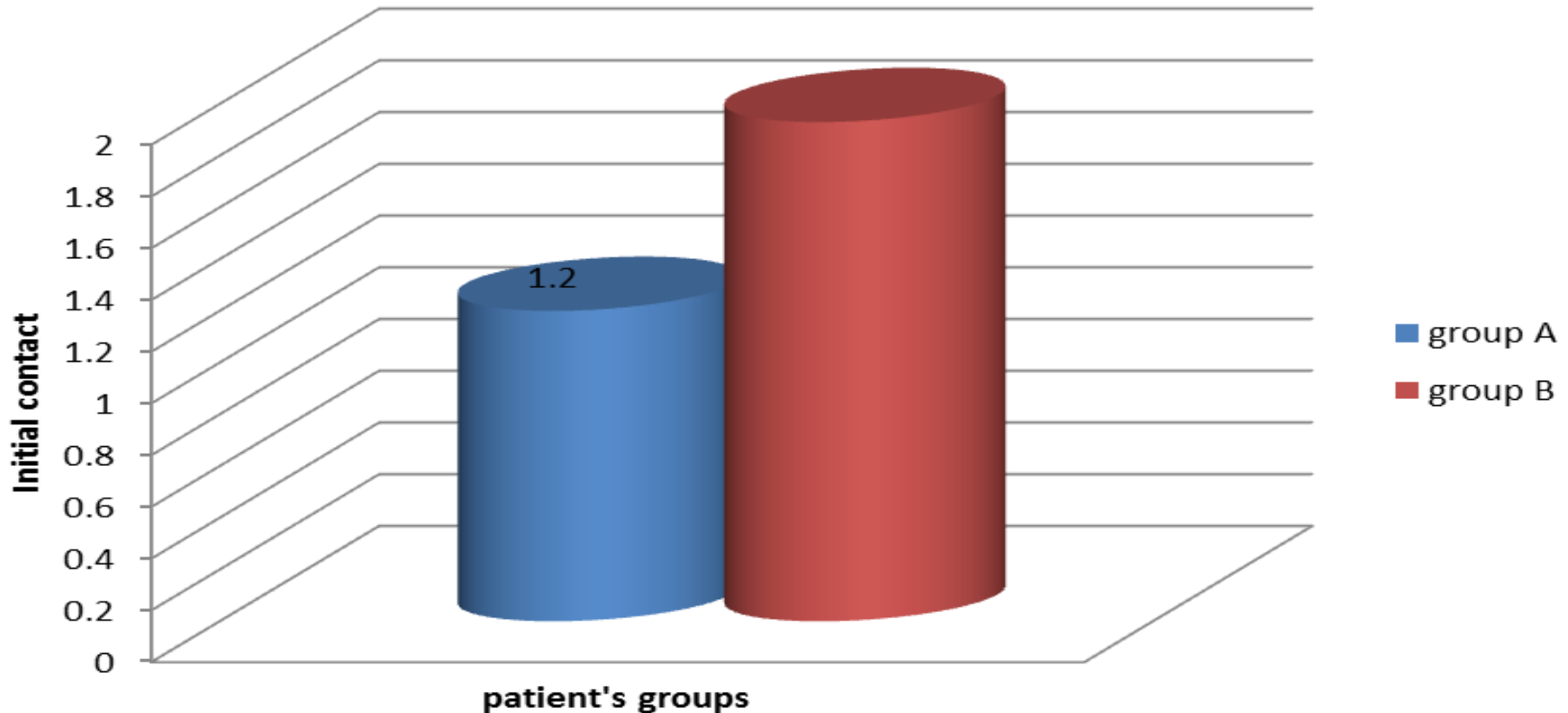
There was no significant difference.



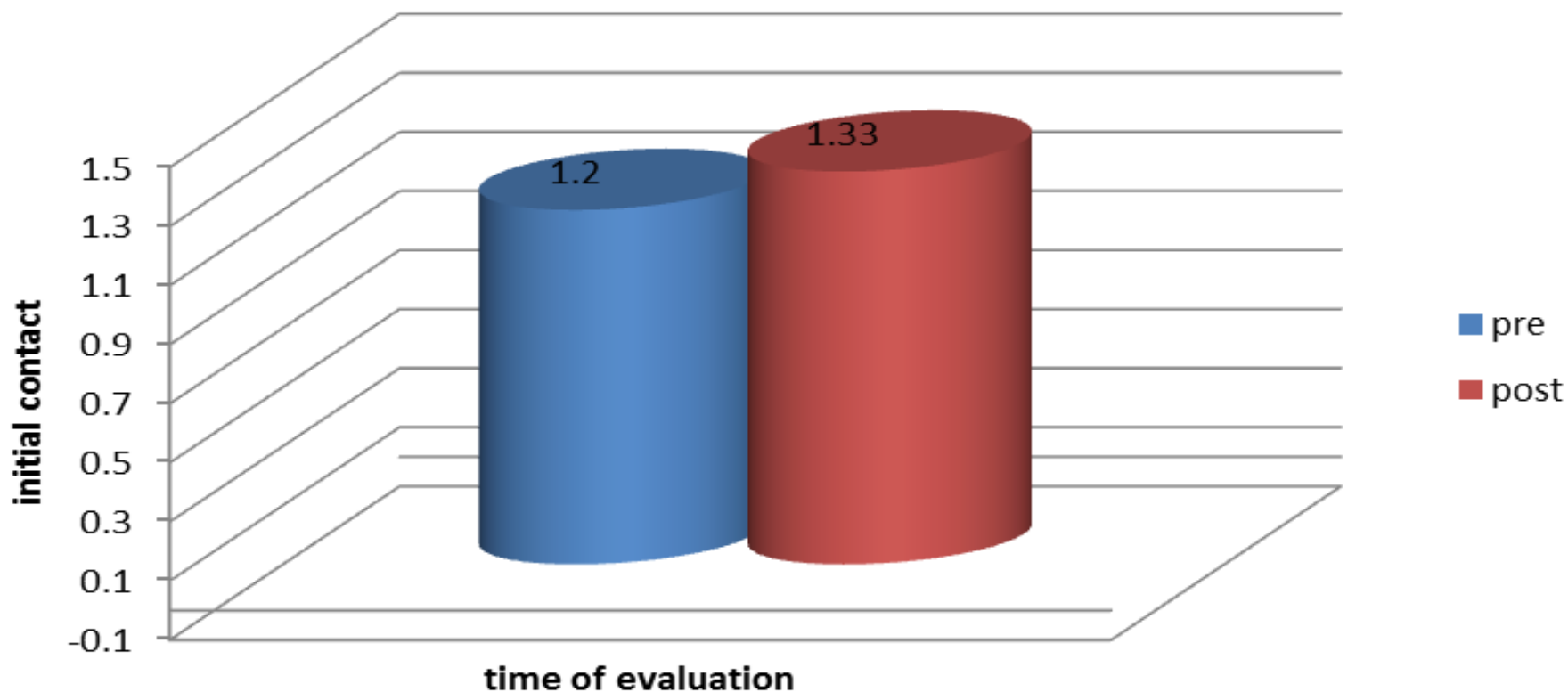
B) Initial Contact:

- a) **Comparison between pre-treatment mean values for the two groups (A and B):**

There was no significant difference.

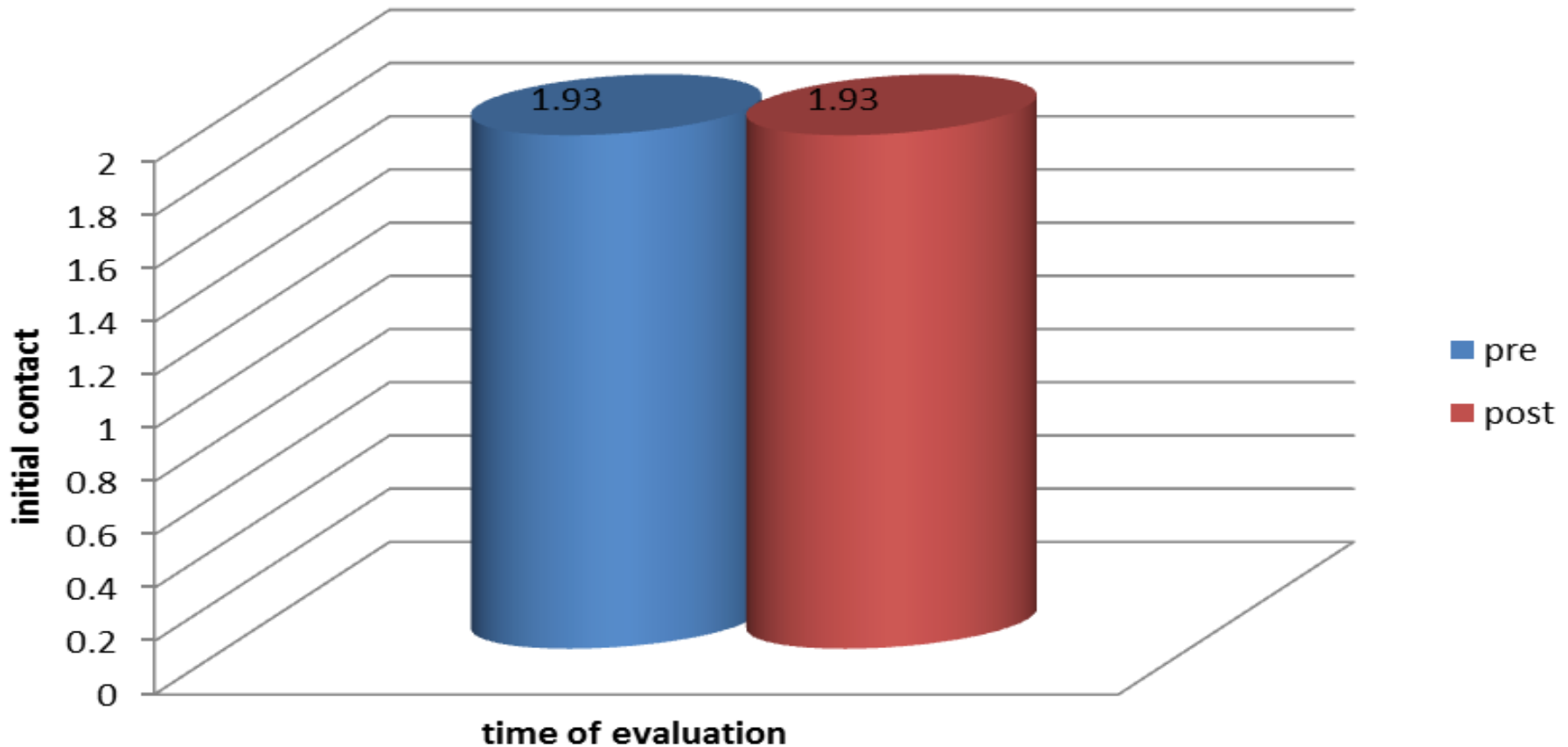


- **b) Comparison between pre and post-treatment mean values for the two groups (A and B):**
 - **Pre- and post-treatment mean values for group A:**
 - **There was no significant difference.**



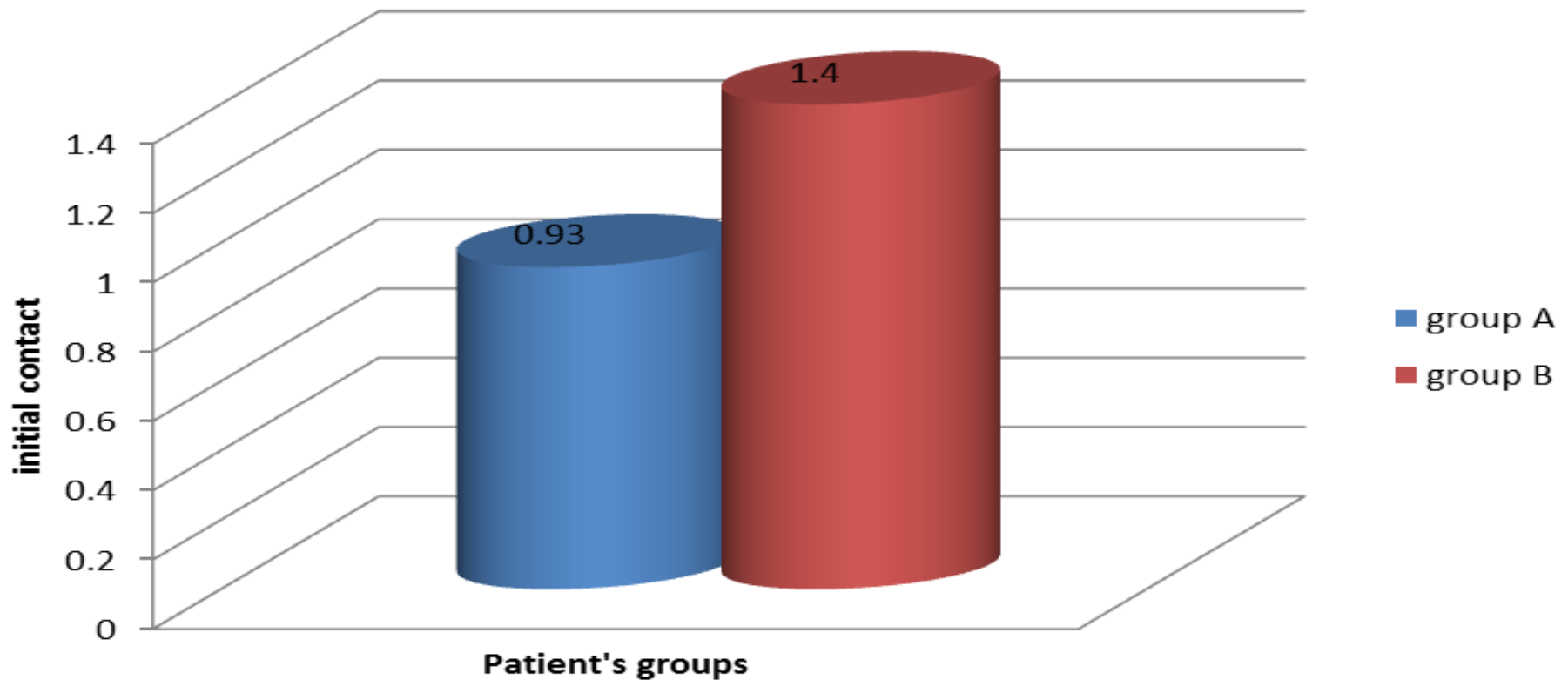
- **Pre- and post- treatment mean values for group B:**

There was no significant difference



c) **Comparison between post-treatment mean values for the two groups (control and study):**

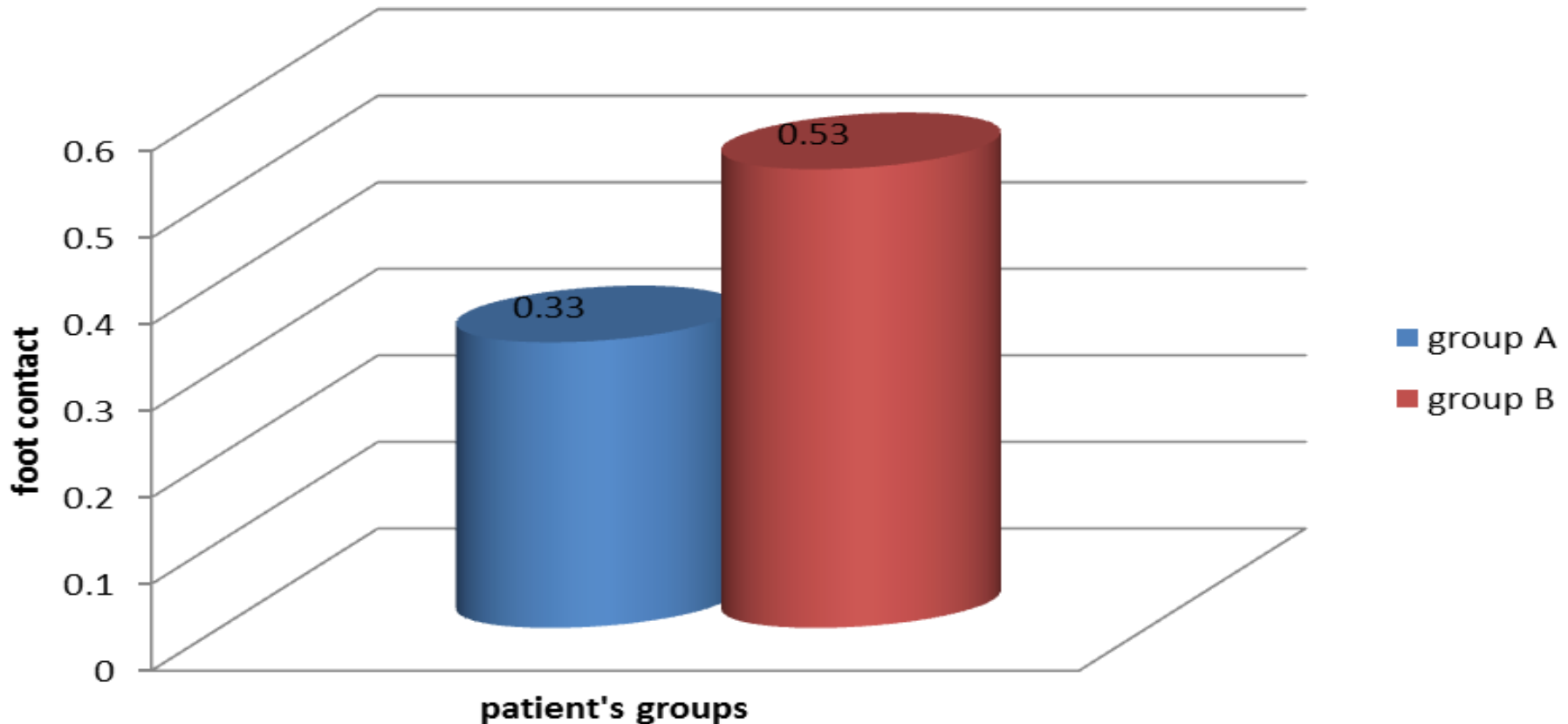
There was no significant difference.



C) Foot contact

- a) Comparison between pre-treatment mean values for the two groups (A and B):

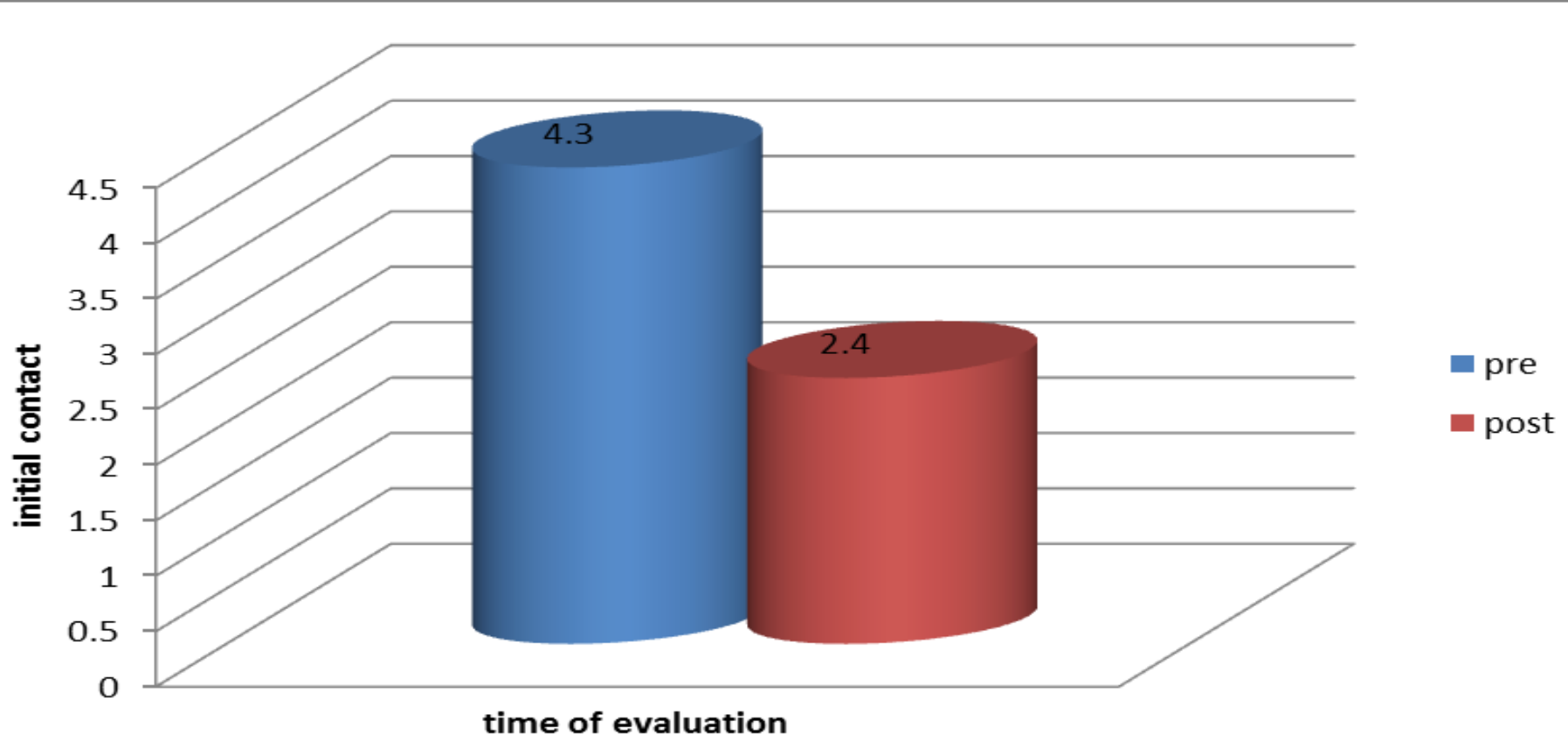
There was no significant difference.



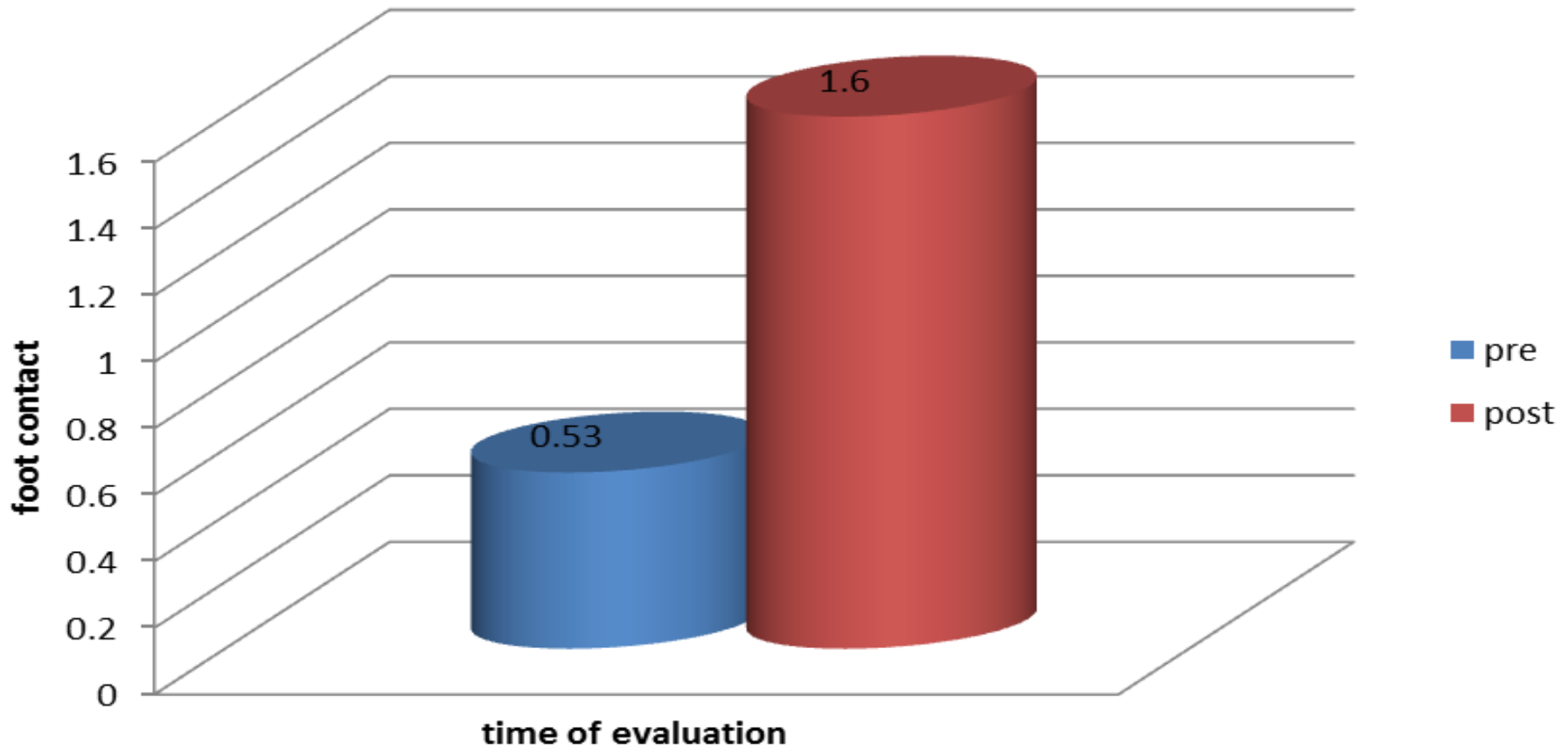
b) Comparison between pre and post-treatment mean values for the two groups (A and B):

- Pre and post- treatment mean values for group A:

There was no significant difference.

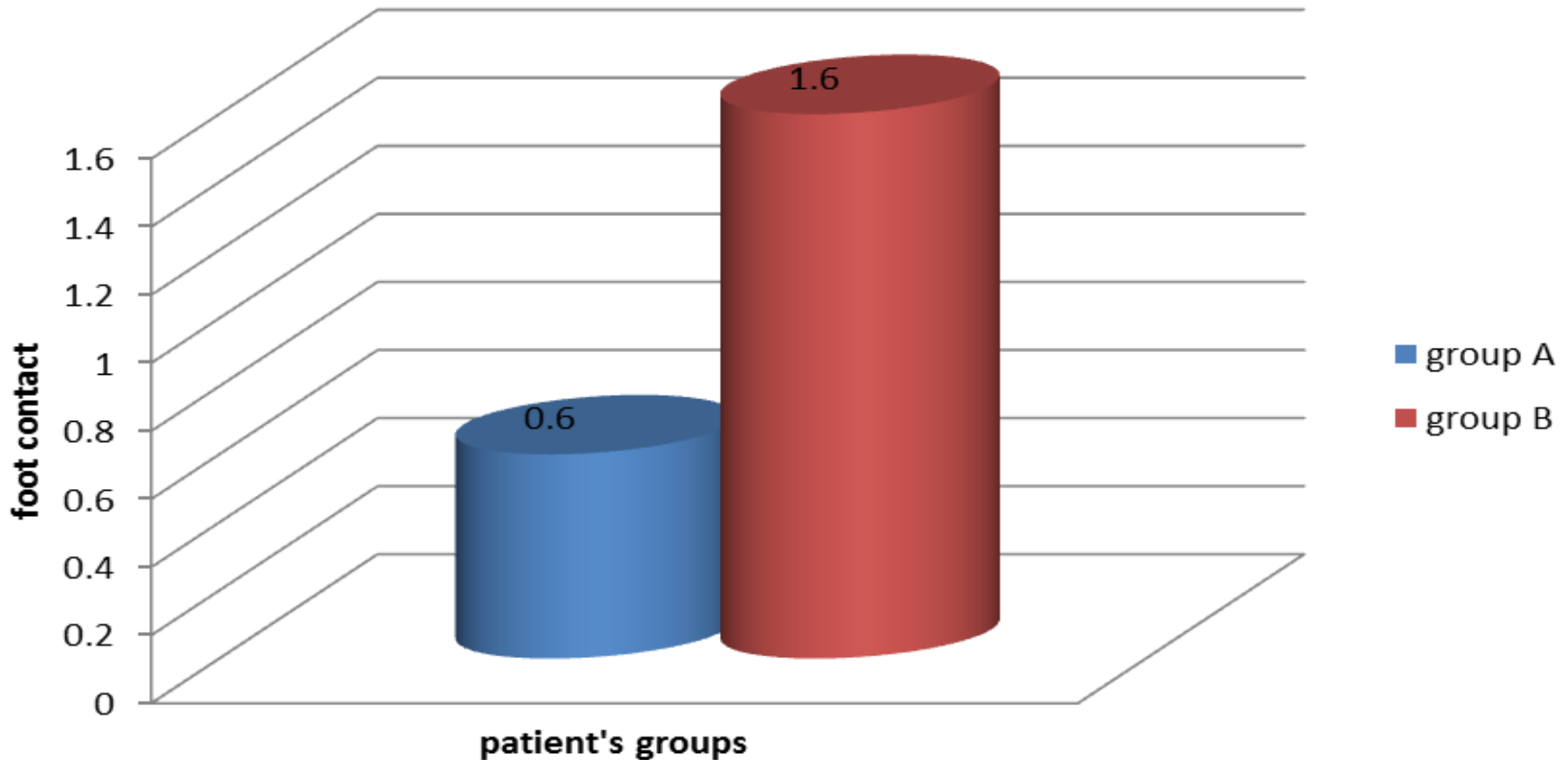


- **Pre- and post- treatment mean values for group B:**
- There was a significant difference.



c) Comparison between post-treatment mean values for the two groups (A and B):

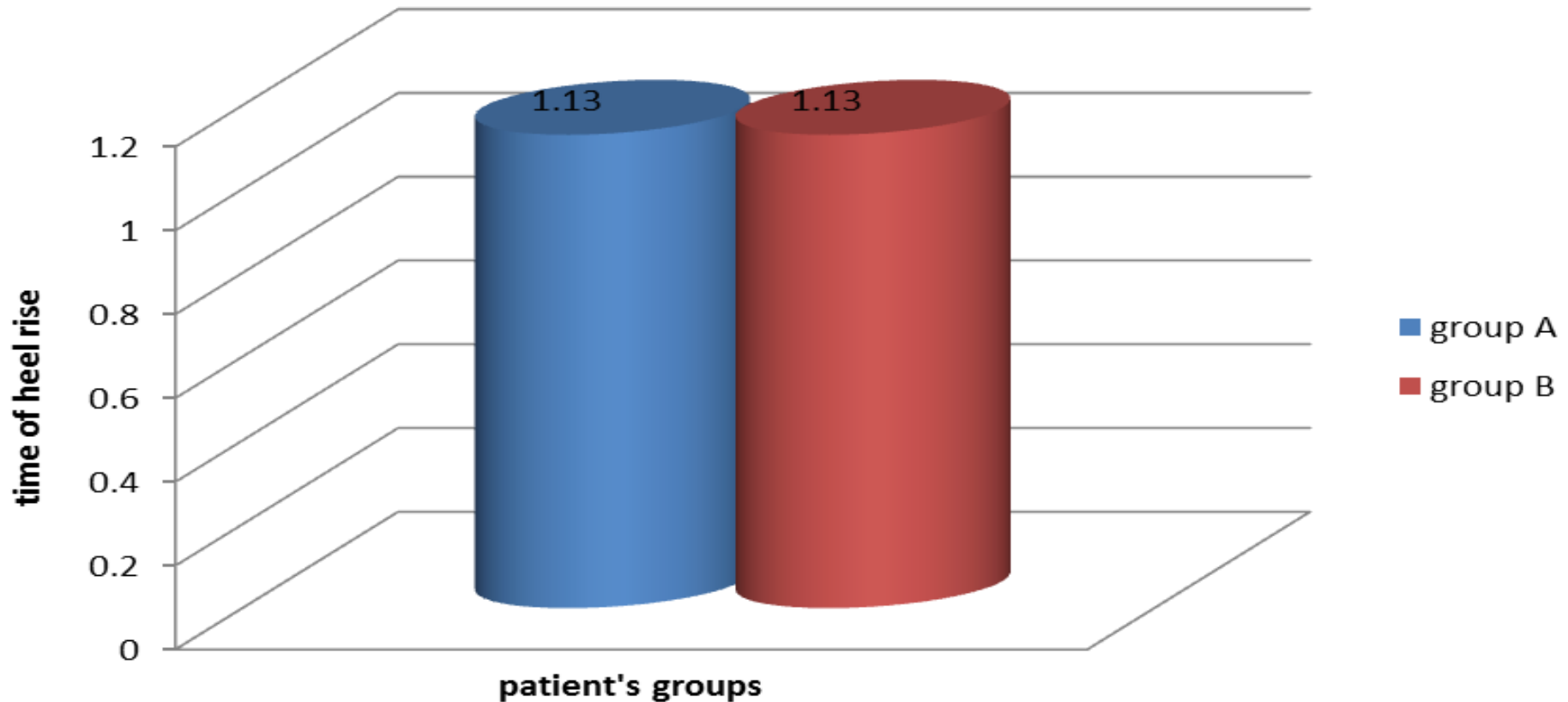
There was a significant difference.



D) Time of heel rise

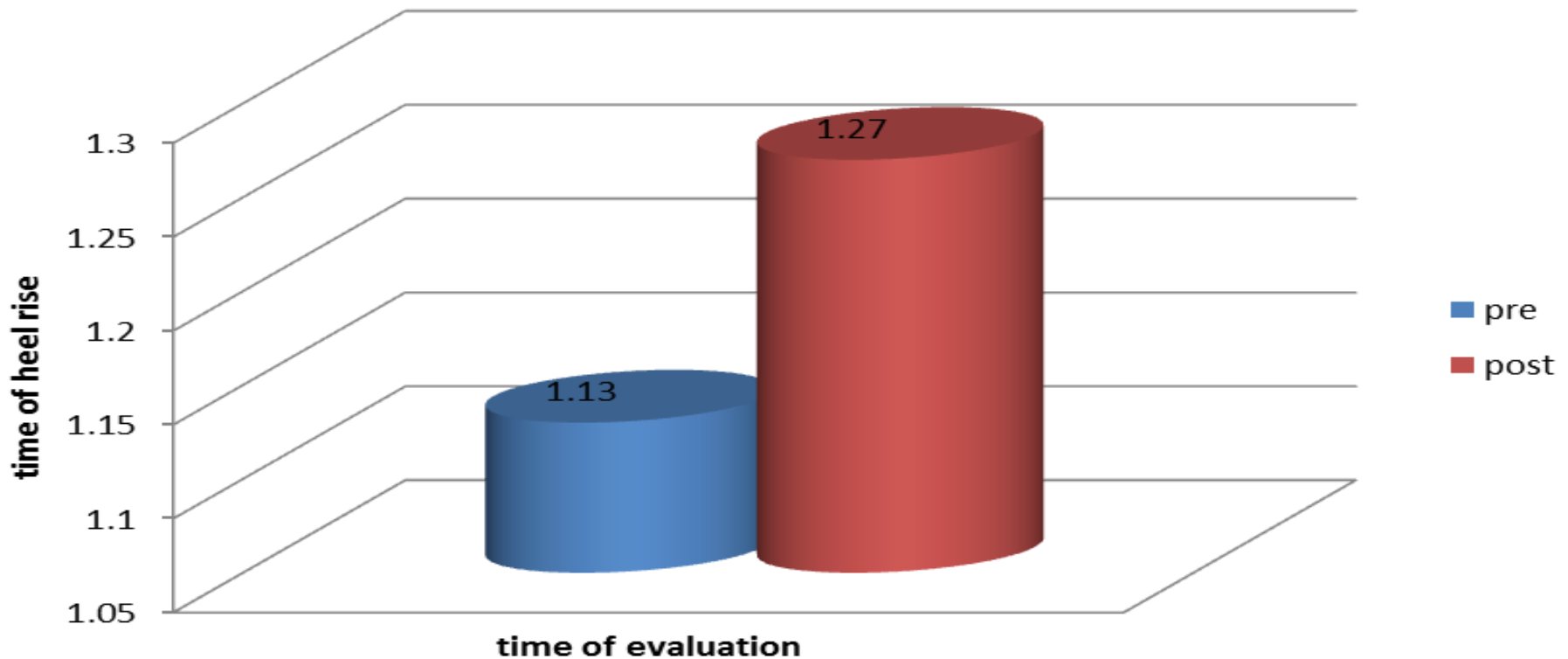
- a) **Comparison between pre-treatment mean values for the two groups (A and B):**

There was no significant difference.

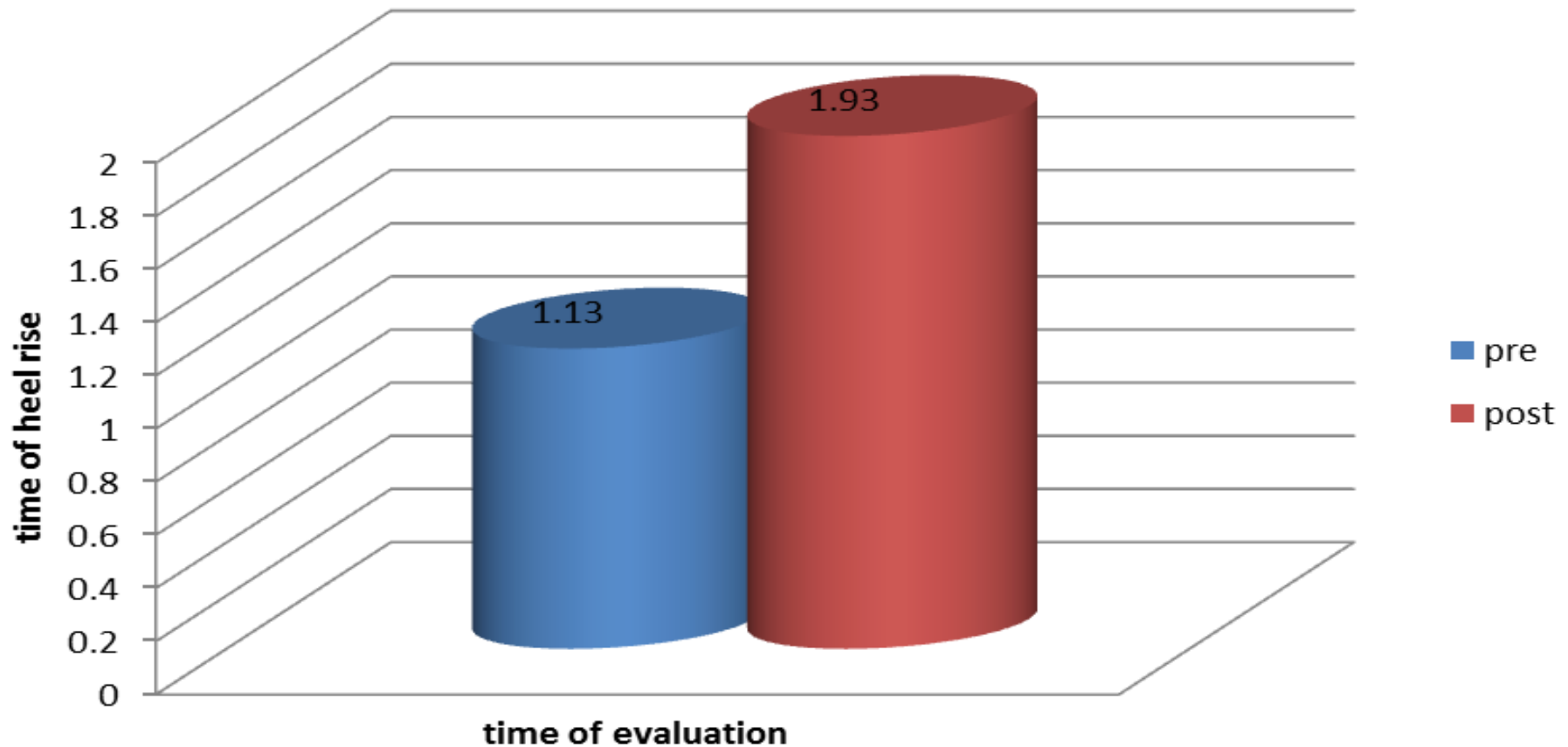


b) Comparison between pre and post-treatment mean values for the two groups (A and B):

- Pre- and post-treatment mean values for control group:
- There was no significant difference.

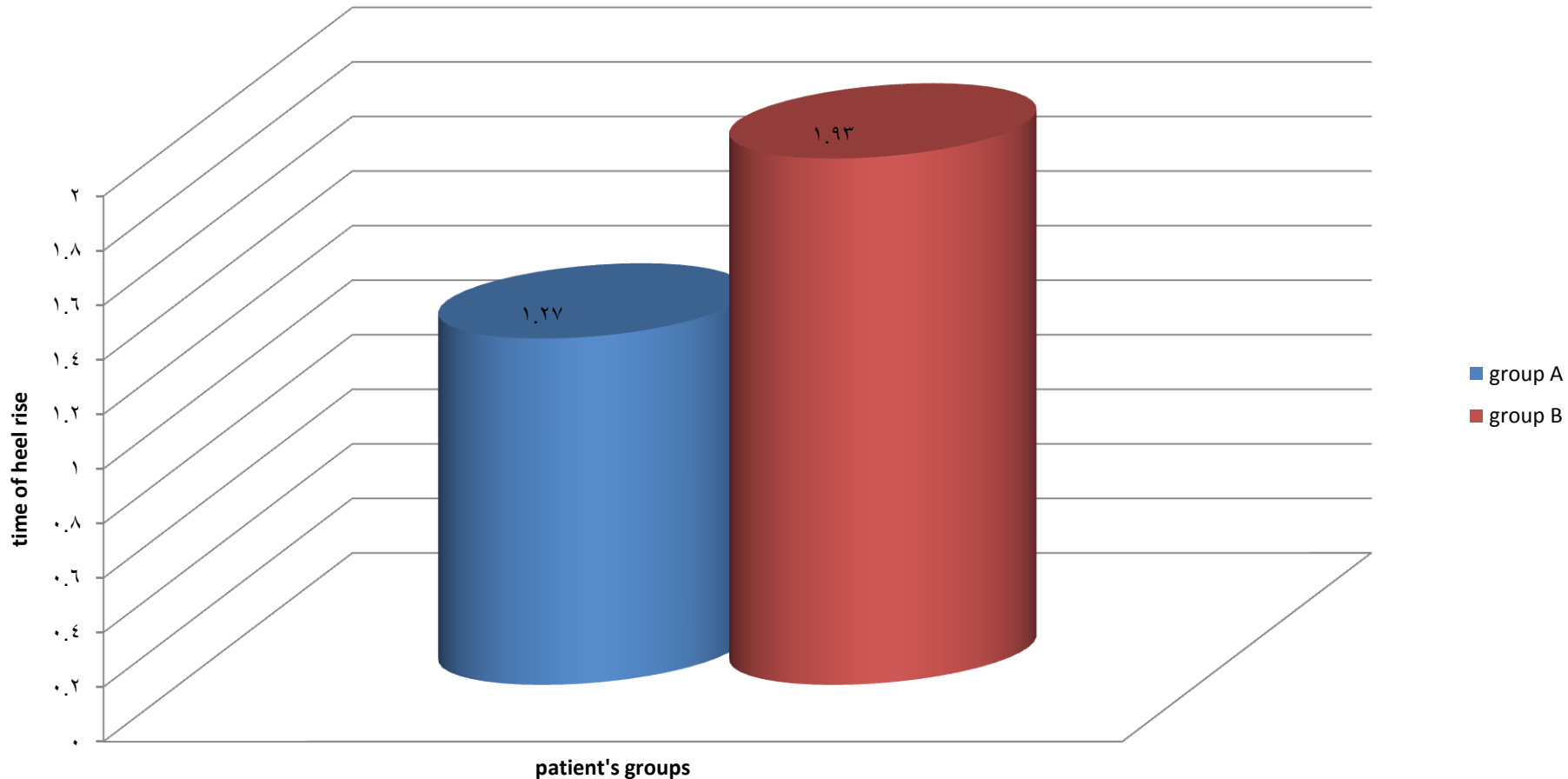


- **Pre- and post-treatment mean values for group B:**
- There was a significant difference.



c) Comparison between post-treatment mean values for the two groups (A and B):

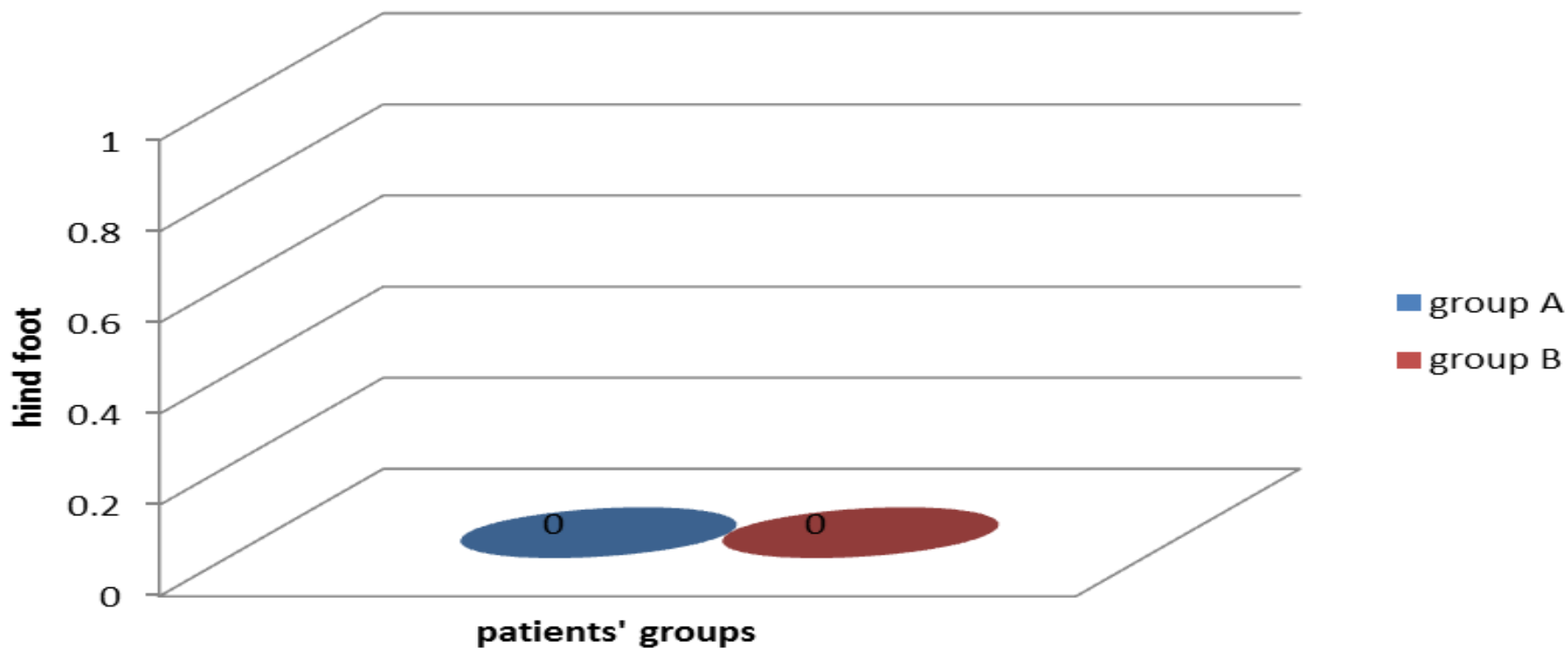
- There was a significant difference.



E) Hind foot:

a) Comparison between pre-treatment mean values for the two groups (A and B):

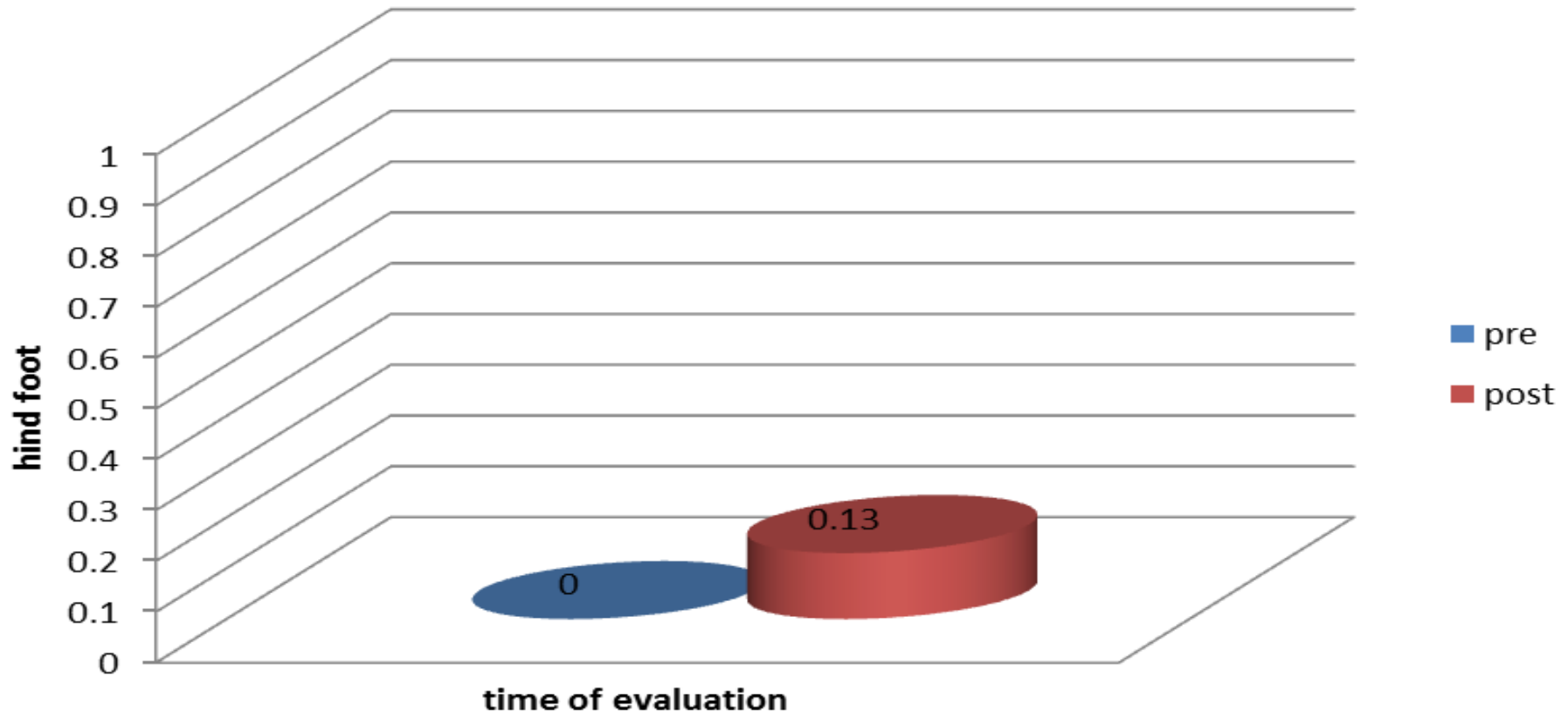
- There was no significant difference.



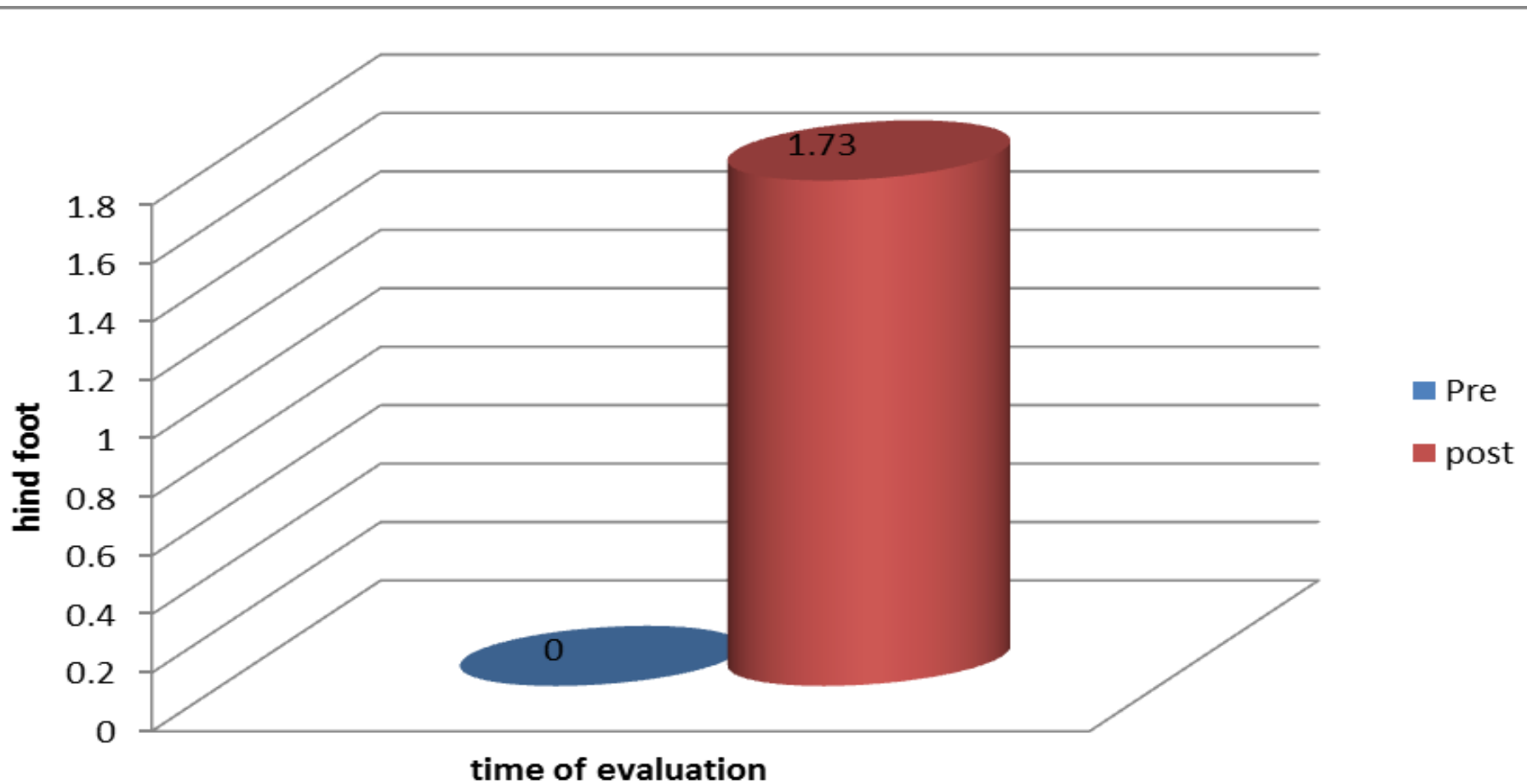
b) Comparison between pre and post-treatment mean values for the two groups (A and B):

Pre and post- treatment mean values for group A:

- There was no significant difference.

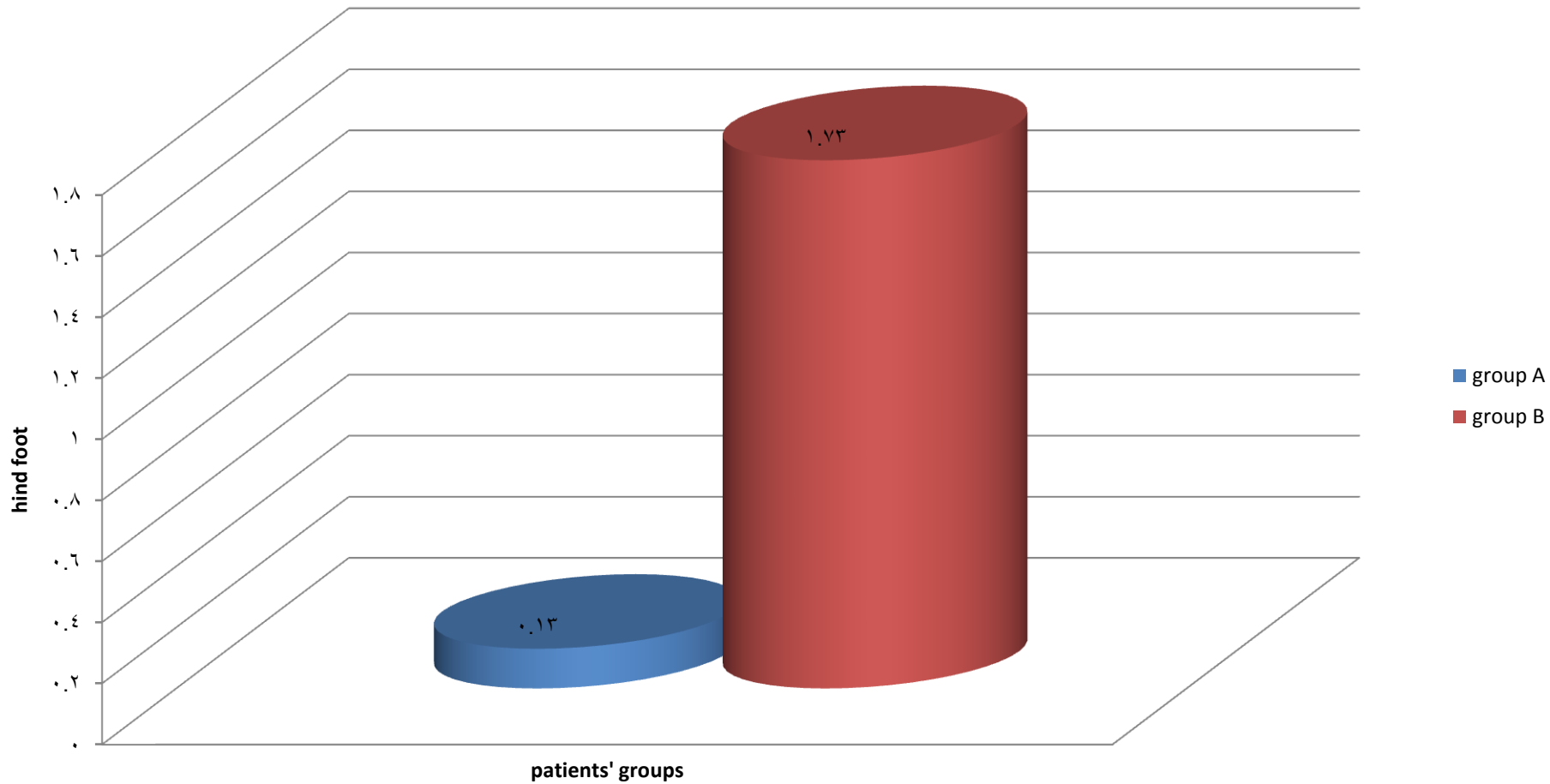


- Pre and post- treatment mean values for group B:
- There was a significant difference.



c) Comparison between post-treatment mean values for the two groups (A and B):

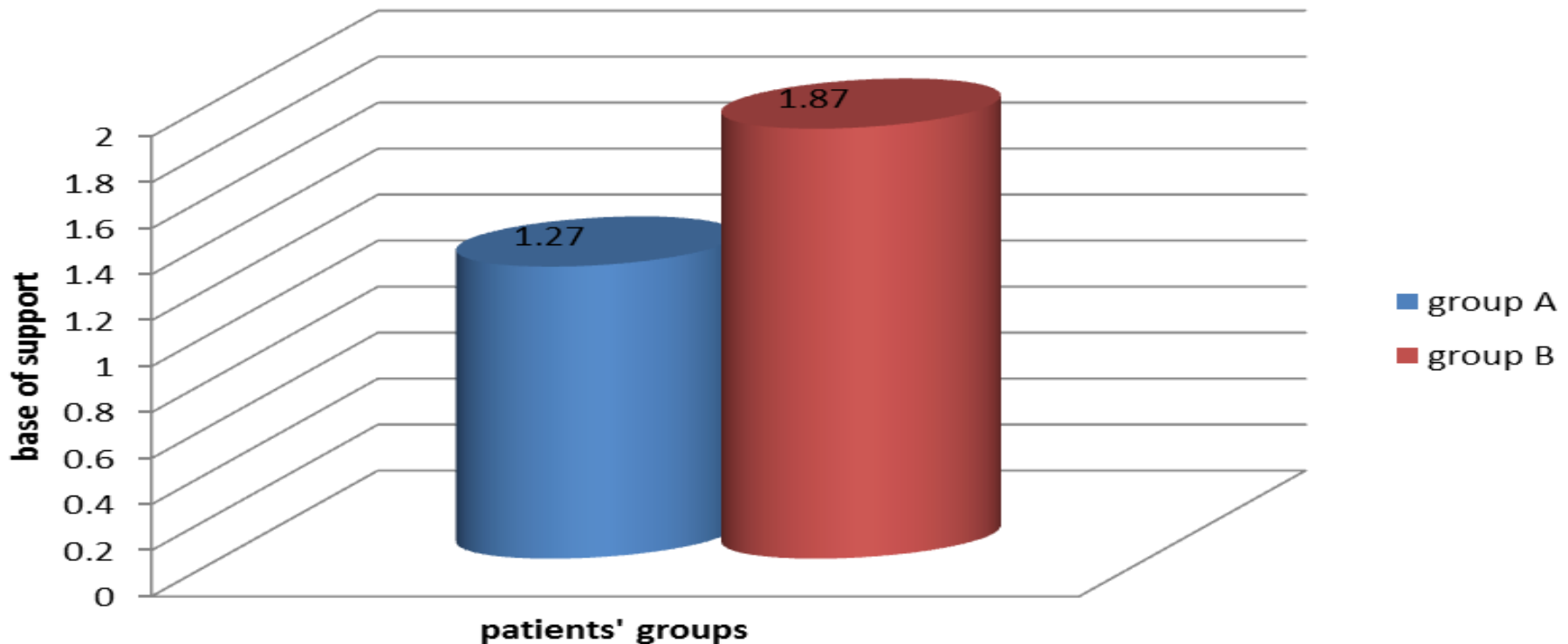
- There was a significant difference.



f) Base of support:

a) Comparison between pre-treatment mean values for the two groups (A and B):

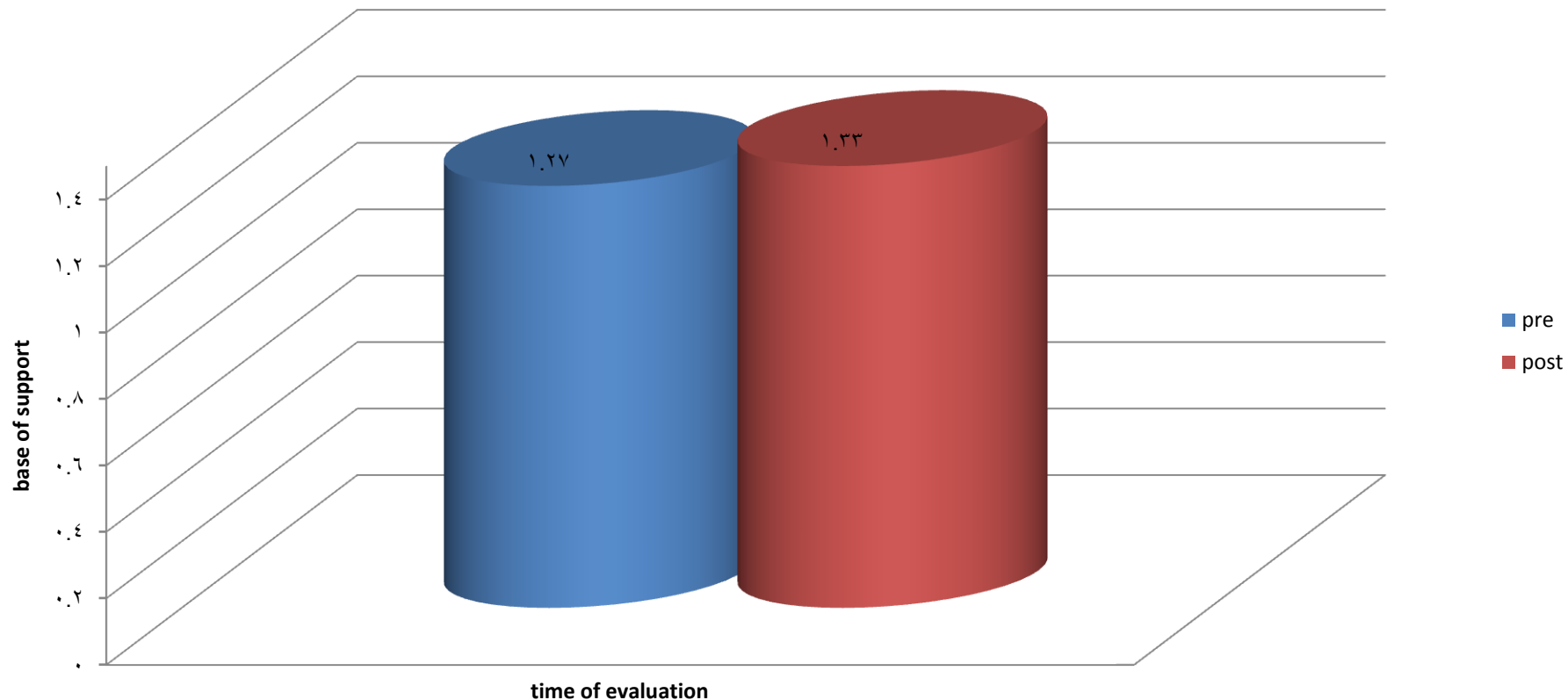
- There was no significant difference.



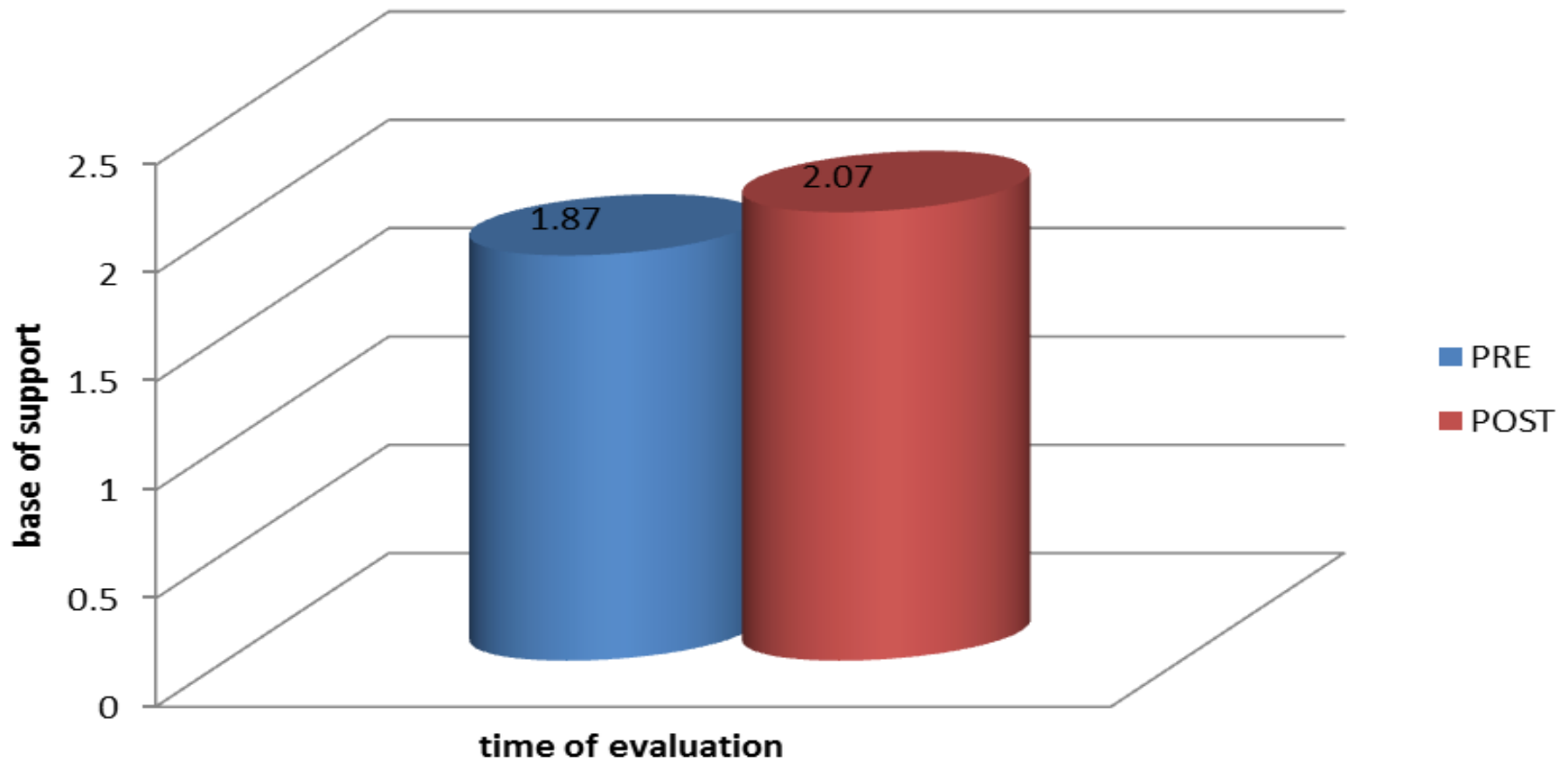
b) Comparison between pre and post-treatment mean values for the two groups (A and B):

Pre and post- treatment mean values for group A:

- There was no significant difference.

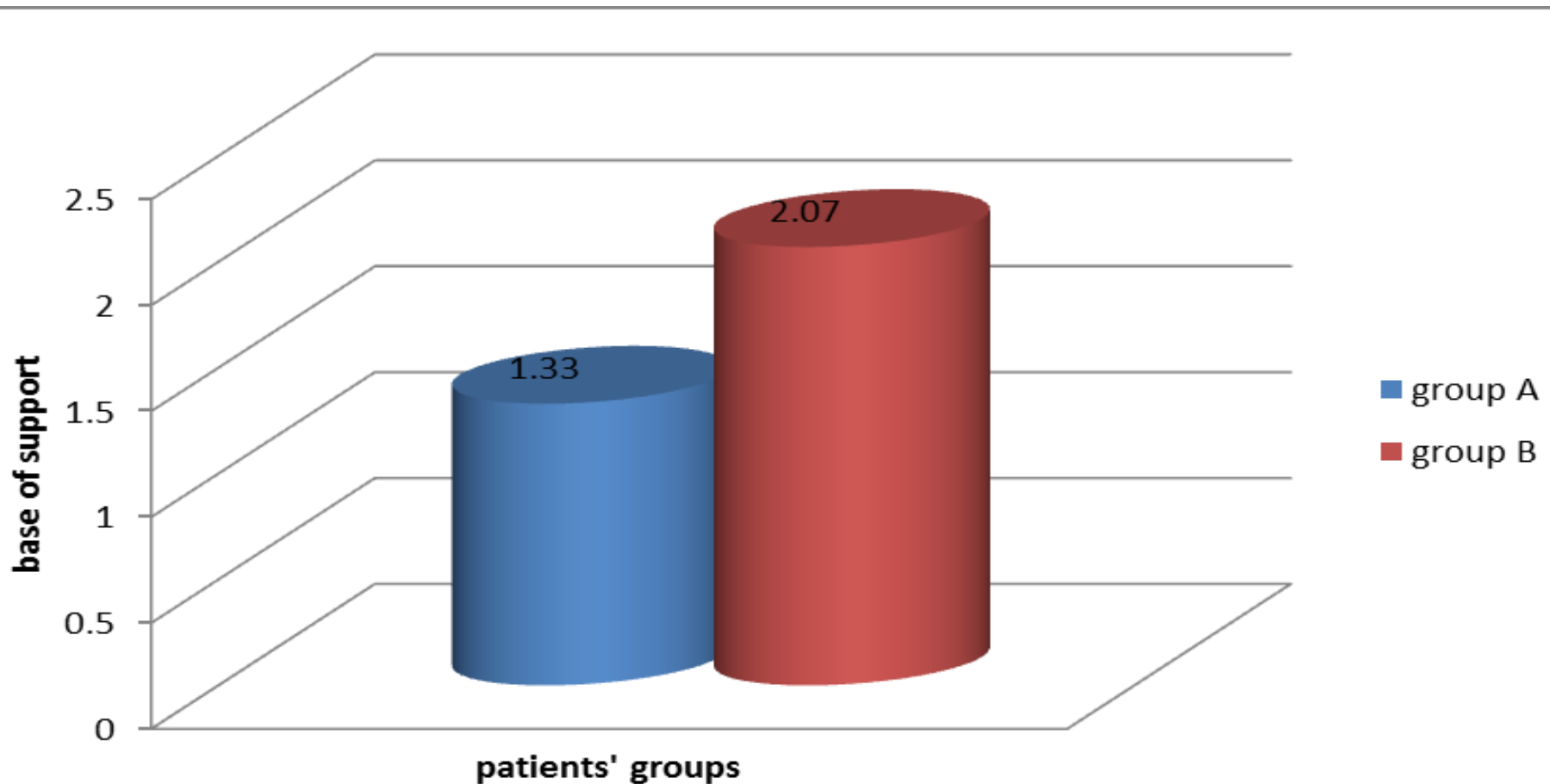


- **Pre and post- treatment mean values for group B:**
- There was no significant difference



c- Comparison between post-treatment mean values for the two groups (A and B):

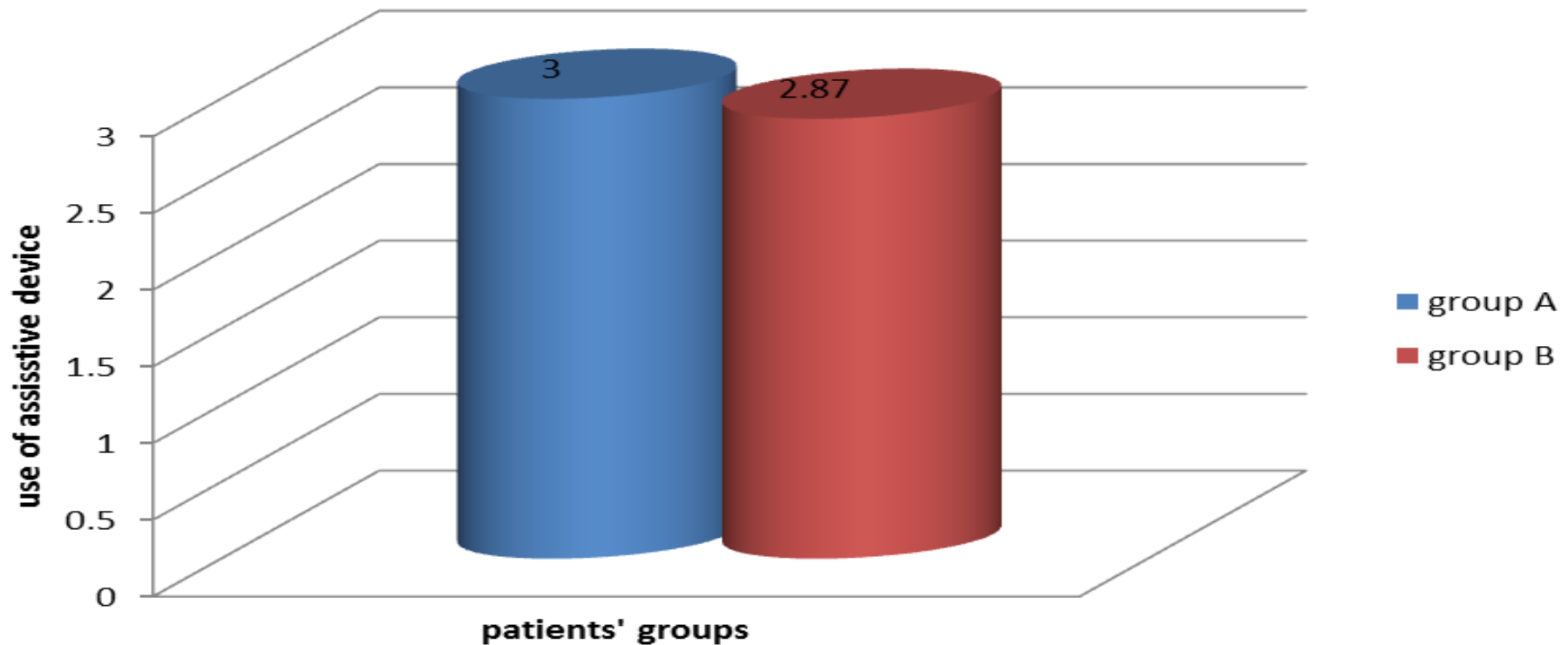
- There was no significant difference



G- Using of gait assistive device:

a- Comparison between pre-treatment mean values for the two groups (A and B):

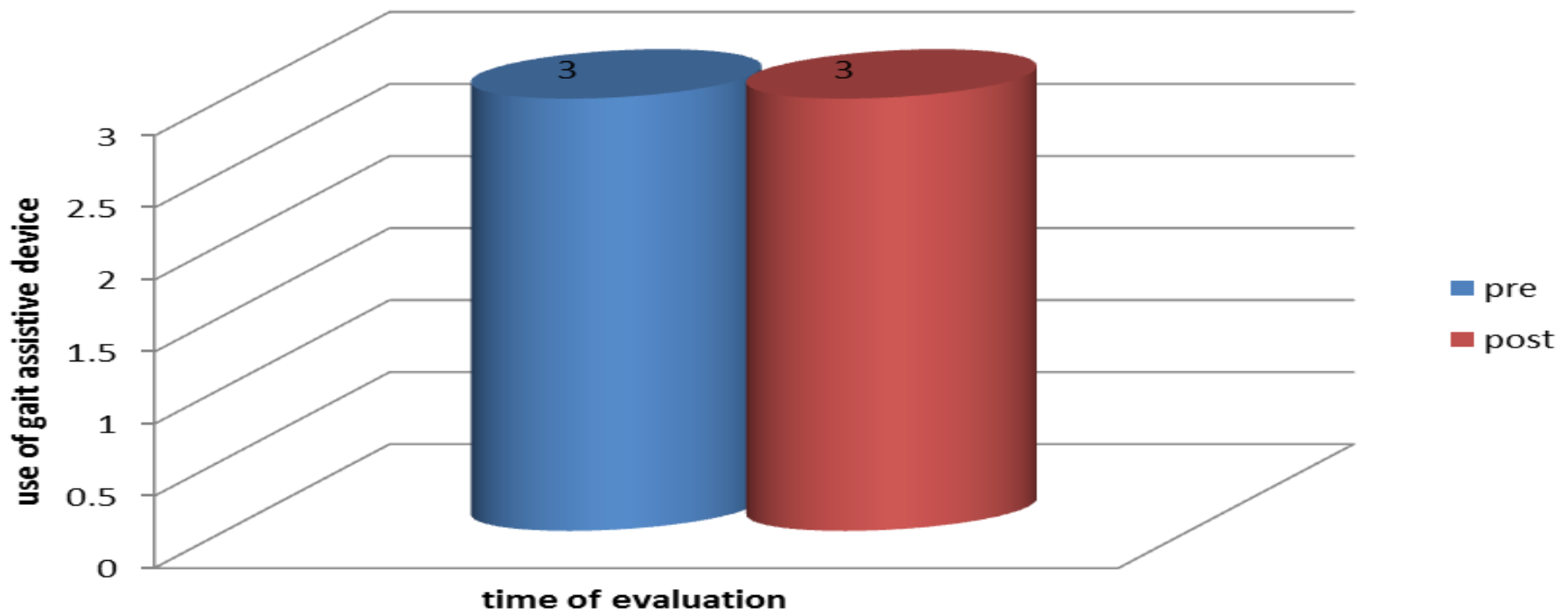
- There was no significant difference.



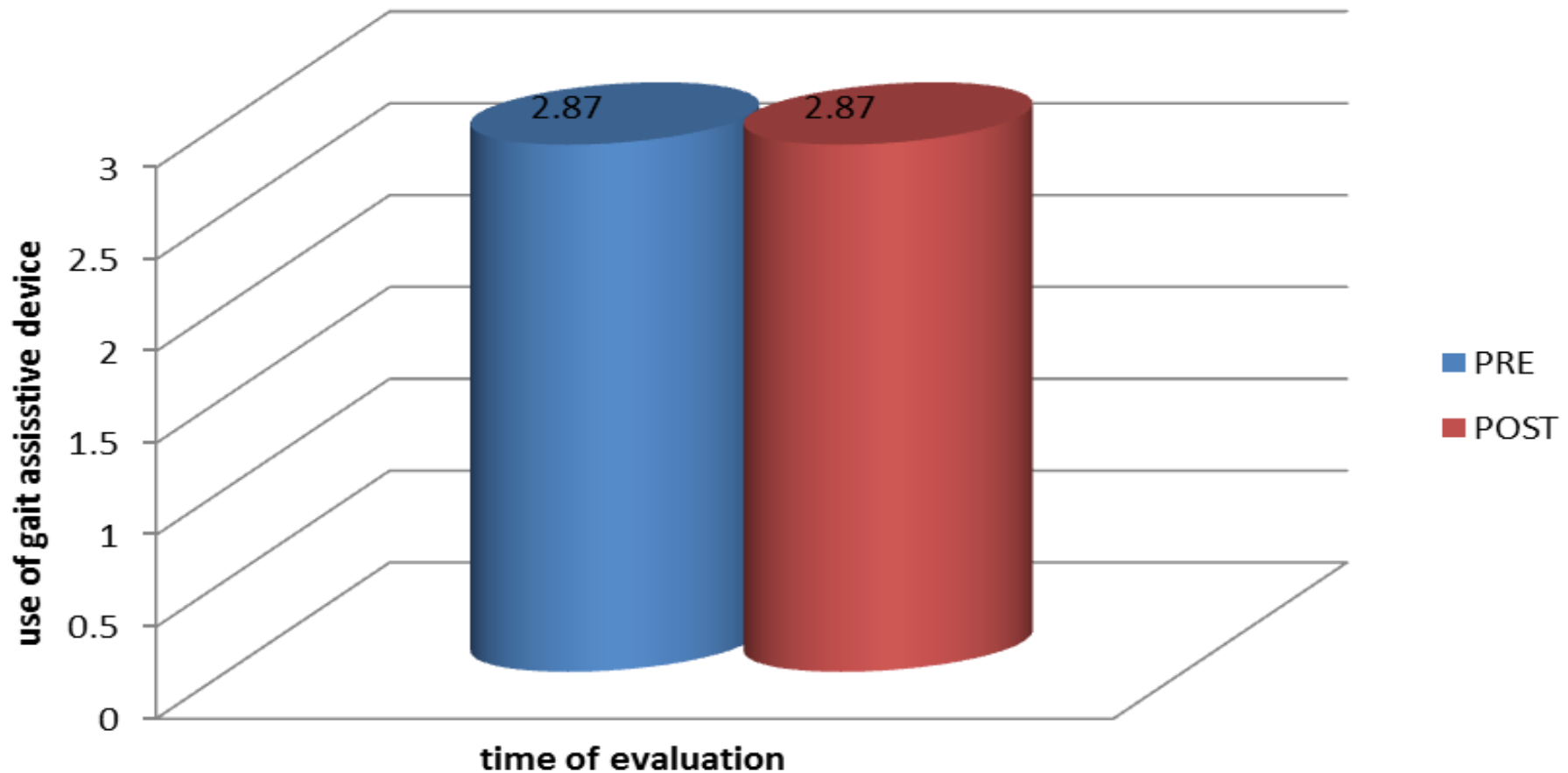
b) Comparison between pre and post-treatment mean values for the two groups (A and B):

Pre and post- treatment mean values for group A:

- There was no significant difference

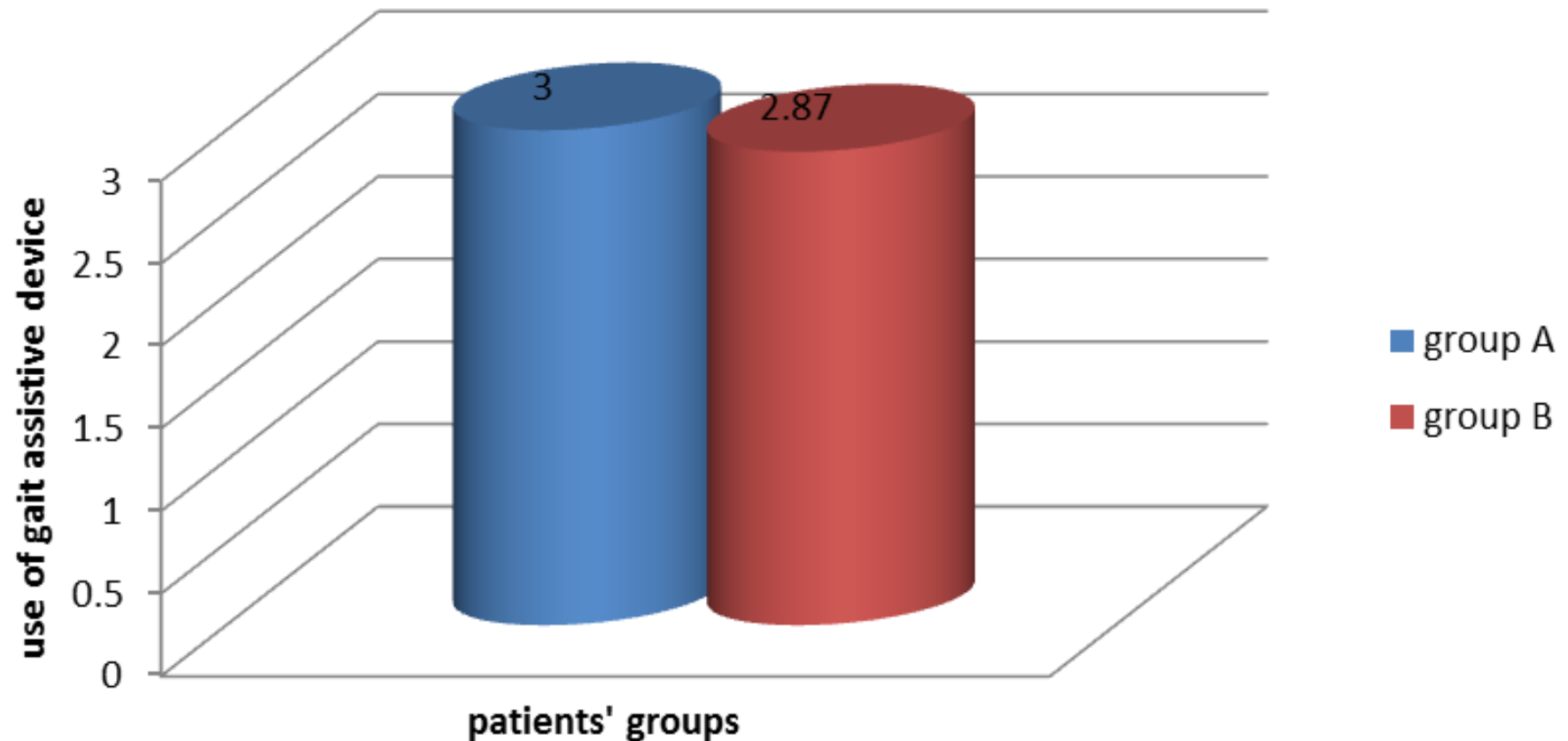


- **pre and post- treatment mean values for group B:**
- There was no significant difference



c- Comparison between post-treatment mean values for the two groups (A and B):

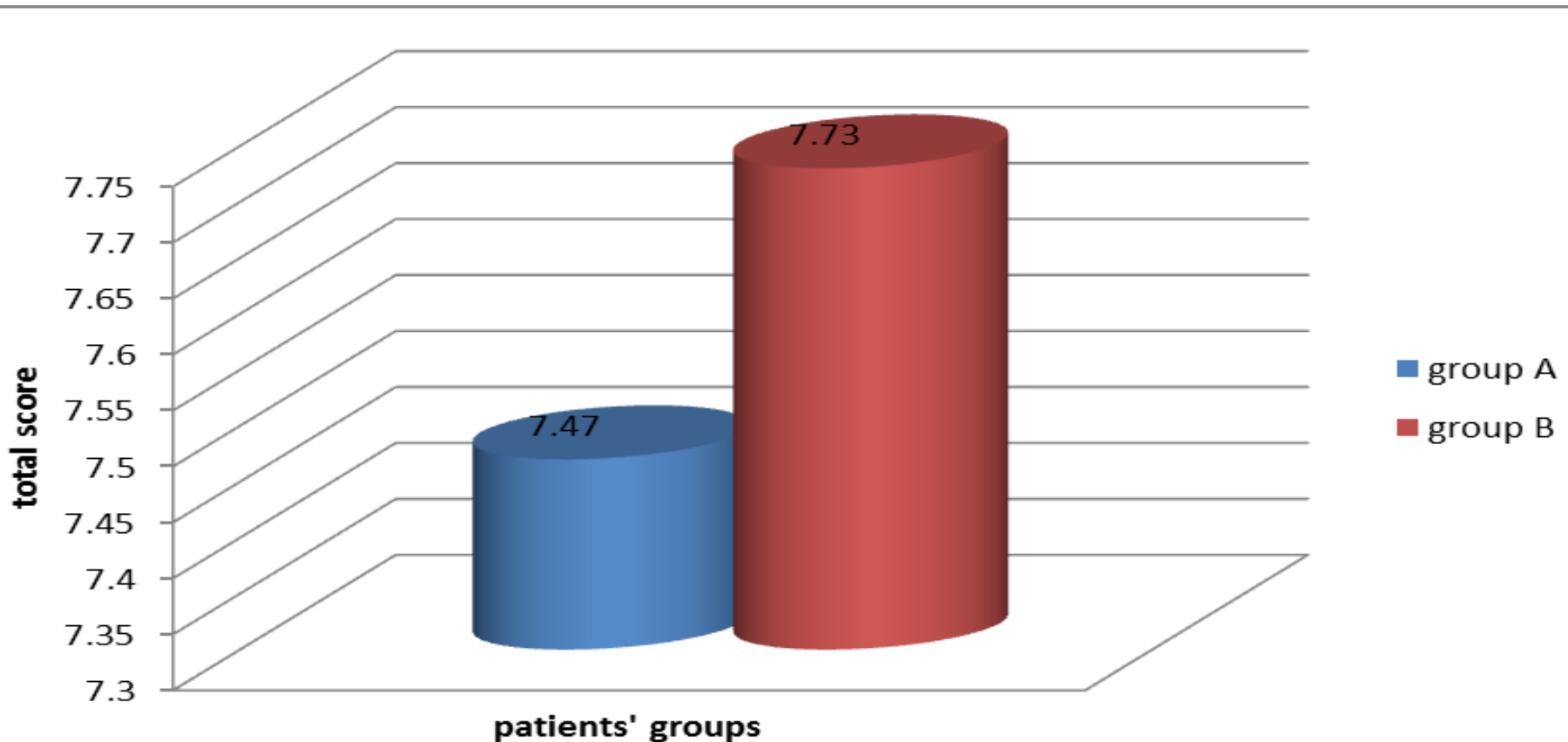
- There was no significant difference.



H- Total score:

a- Comparison between pre-treatment mean values for the two groups (A and B):

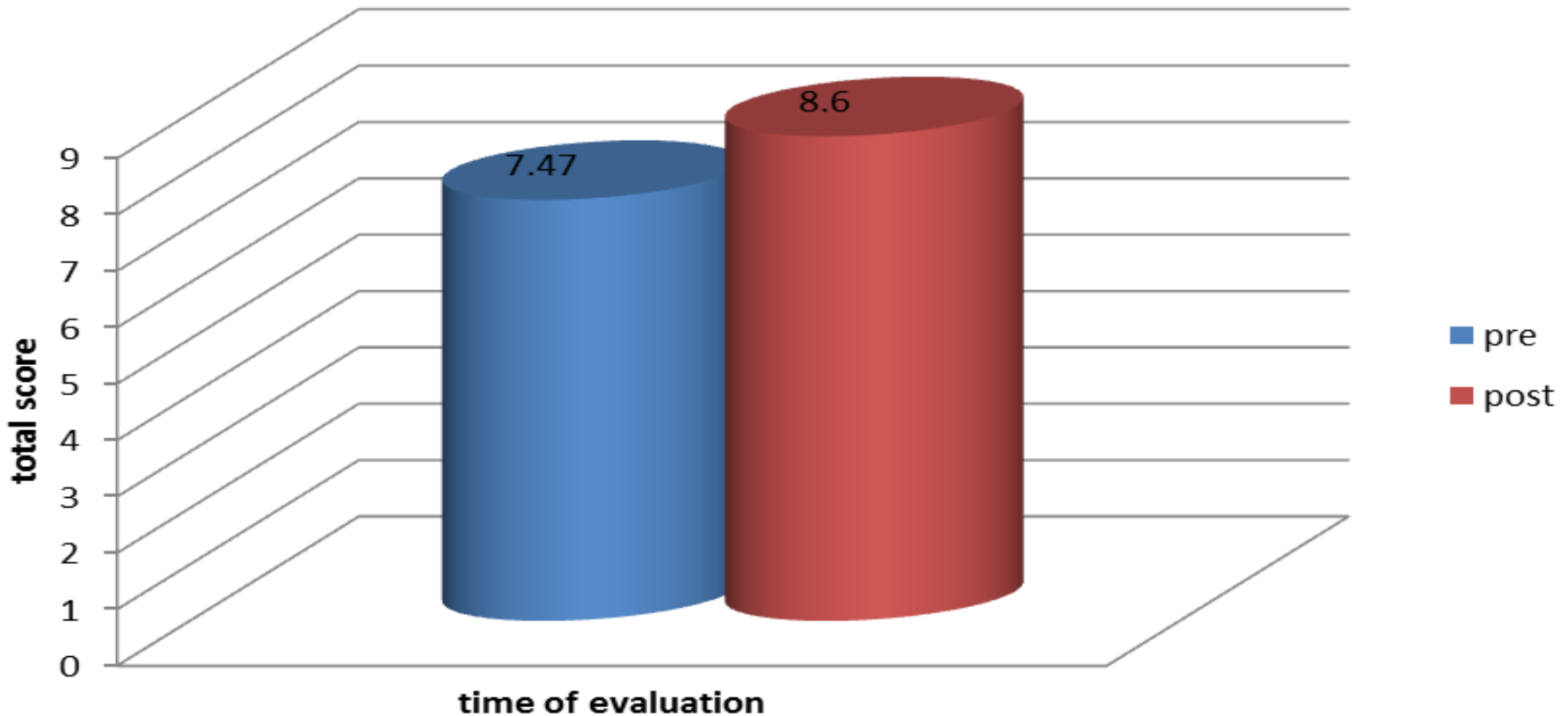
There was no significant difference.



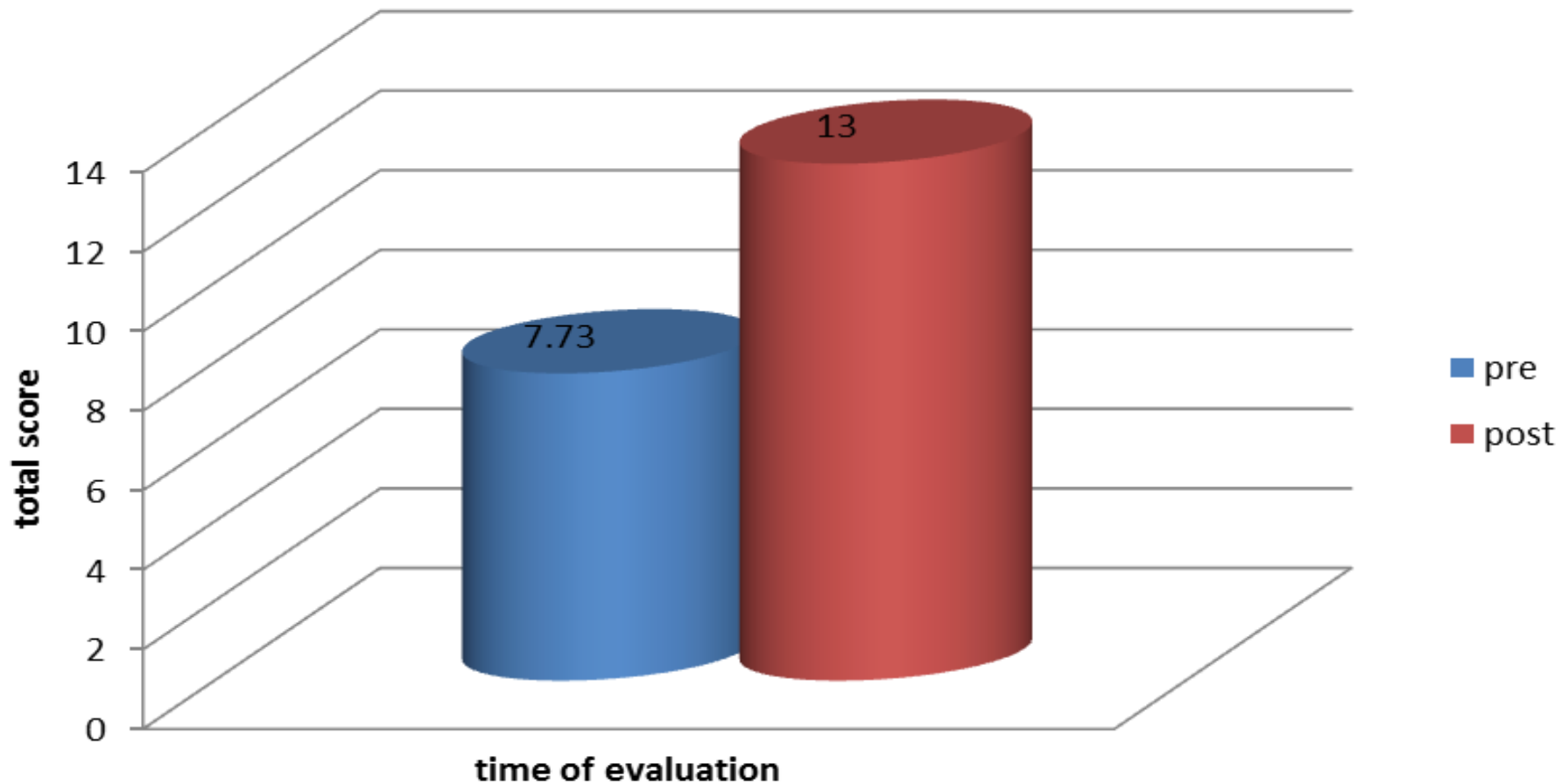
b- Comparison between pre and post-treatment mean values for the two groups (A and B):

- pre and post- treatment mean values for group A:

There was no significant difference.

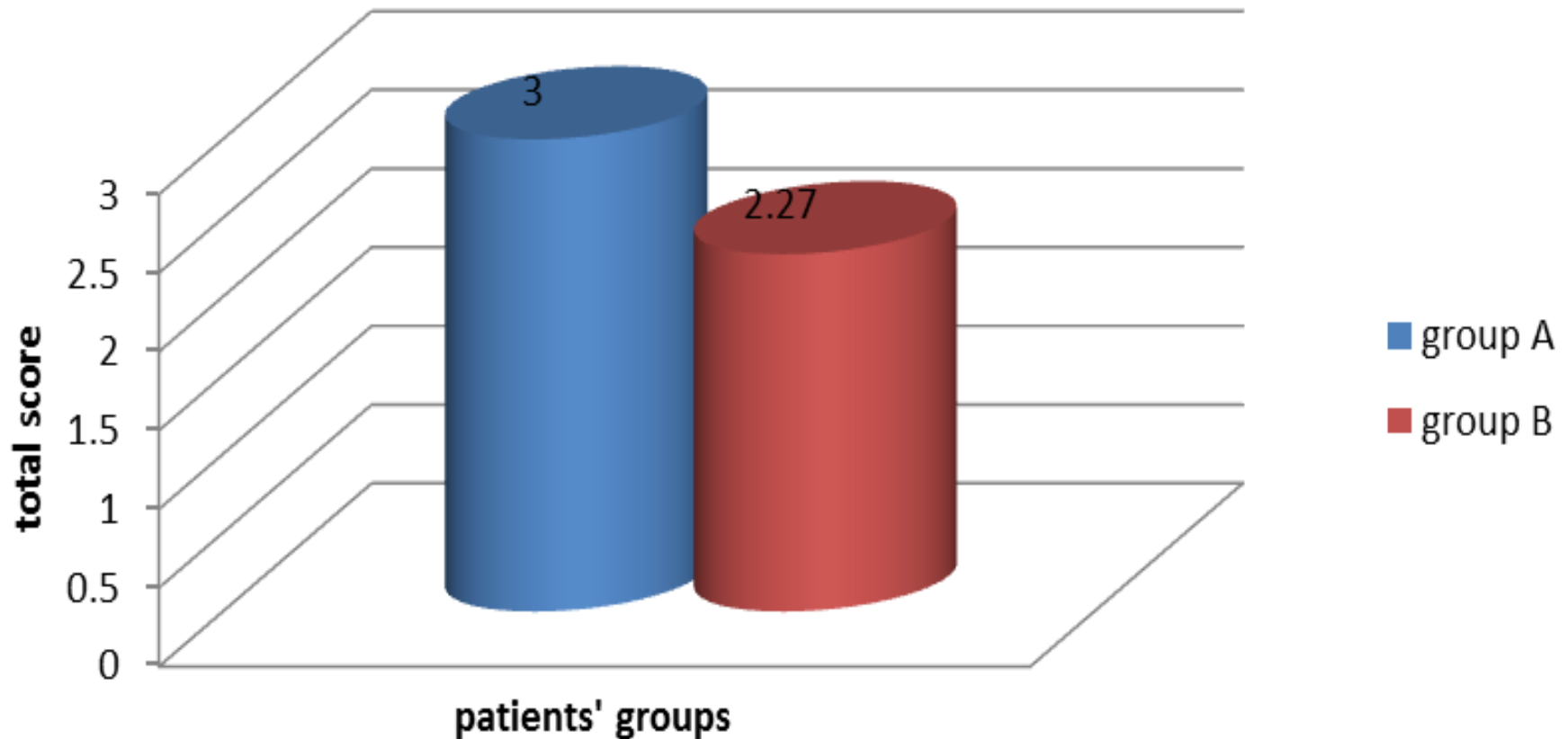


- **Pre and post- treatment mean values for group B:**
There was a significant difference.



c- Comparison between post-treatment mean values for the two groups (A and B):

- There was non significant difference.



DISCUSSION

The purpose of this study was to investigate the effects of the application of kinesio tape technique on hip anteversion and gait pattern in children with spastic diplegic cerebral palsy.

- The results of the present study after the suggested period of treatment showed non-significant difference in the mean values of hip anteversion angle of both group (A and B) when comparing their pre and post treatment mean values. That's come in agreement with **Staheli, (1993)** who reported that non-operative treatment of abnormal hip anteversion angle is ineffective.

- The post treatment results of control group showed improvement but not significant difference in the mean values of the all measuring variables of the gait parameters when comparing their pre and post treatment mean values. That's come in agreement with **Schoenecker, (2007)** who stated that treatment of HA with splinting, shoe modifications, exercises, and braces has proven to be ineffective and also, **Damiano et al., (2010)** who reported that strength training may improve walking function and alignment in some patients for whom weakness is a major contributor to their gait deficits. However, in other patients, it may produce no change or even undesired outcomes.

- The significant improvement obtained in the post treatment mean values of the study group comes in agreement with **Trost et al., (2009)** who reported that strapping system have been developed to provide a gentle, passive force to correct imbalance or alignment through the combination of trunk and short system along with a customized external strapping. It can improve joint stability, posture and gait skills. Adding spiral strapping make the femur externally rotated that occur in combination with gait training may help posture alignment during walking and improve joint angles of lower limbs in transverse and sagittal plane.

- **Blundell et al., (2003)** reported that functional exercises such as step ups, sit to stand, leg presses, and treadmill walking improve functional movement pattern in children with CP.

- The significant improvement in post treatment values of the measured values of the study group may be attributed to the effect of KT in combination with therapeutic exercises, that's comes in agreement with **Miller and Othmotherly, (2007)** who stated that the KT method gives the practitioner the opportunity to actually give the support while maintaining full range of motion, enabling the individual to participate in physical therapy activity with functional activity assistance.

CONCLUSION

- From the obtained results of this study, it can be concluded that selected physical therapy program in addition to kinesio tape technique may result in positive outcomes in the improvement of abnormal gait pattern of spastic diplegic cerebral palsy without change in pathological hip anteversion angle.