بسم الله الرحمن الرحيم

(وعلم ادم الاسماء كلها ثم عرضها على الملائكة

قال انبئوني بأسماء هؤلاء،قالو سبحانك

لاعلم لنا الا ما علمتنا)

صدق الله العظيم

EFFECT OF NITROGIN-BASED CRYOTHERAPY ON THE CALF MUSCLE SPASTICITY IN STROKE PATIENTS

Cryotherapy and spasticity

- Its local application can

1. Reduce the resistance of spastic muscle to rapid stretching.
2. Decrease or abolish clonus.
3. Has homodynamic effect into muscle and the skin.

Why I choose this modality definitely

- Previous effects can be achieved by all of old modalities such as(cold water, ice packs and evaporative sprays). But using of Nitrogen-based cryotherapy **(cryo flow)(cold air)** is more effective as:

Cryo flow

- Avoidance of pain and burning sensations due to indirect skin contact.
- This leads to long term application which leads to long term effect.
- Temperature can be induced and abrupt all over the session time.
- Some patients with cold hypersensitivity can be induced.

Materials and methods

A- Subject selection:

30 patients diagnosed clinically as cerebral stroke, referred by neurologist and confirmed by MRI, both sexes and from out clinics of Mansoura general and university hospitals.

❖ Inclusion criteria

1. Subjects' age ranged from 45 to 60 years old.
2. Duration of disease ranged from 6 to 12 months.
3. Degree of calf muscle spasticity ranged from +1 to 2 according to (MAS).
4. Patients were oriented and can follow commands.
5. All subjects provided a written informed consent before the study.

❖ Exclusion criteria

1. Patients with cryoglobulinemia .
2. Patients with peripheral vascular disease
3. Patients with paroxysmal cold hemoglobinuria .
4. Patients taking antispastic drugs (dose taken less than two hours before session).
5. Patients with diabetes mellitus.

B- Instrumentation:

For evaluation:

1. MAS.
2. Electrophysiological testing (EMG).
3. 2D motion analysis.

For treatment:

1. Cryo flow 700/1000 machine.
2. Ankle foot orthosis (AFO).

Electrophysiological testing (EMG)

- Measures changes in spasticity objectively pre and post treatment.
- H/M ratio test was used which is normally ranged from(0.24 to 0.28) and increase with spasticity.

two dimensions (2D) motion analysis.

- It's a modality to detect the improvement in ankle dorsiflexion ROM.

- Ankle joint was captured perpendicularly from lateral plan during walking 10 meters with a video camera pre and post treatment.

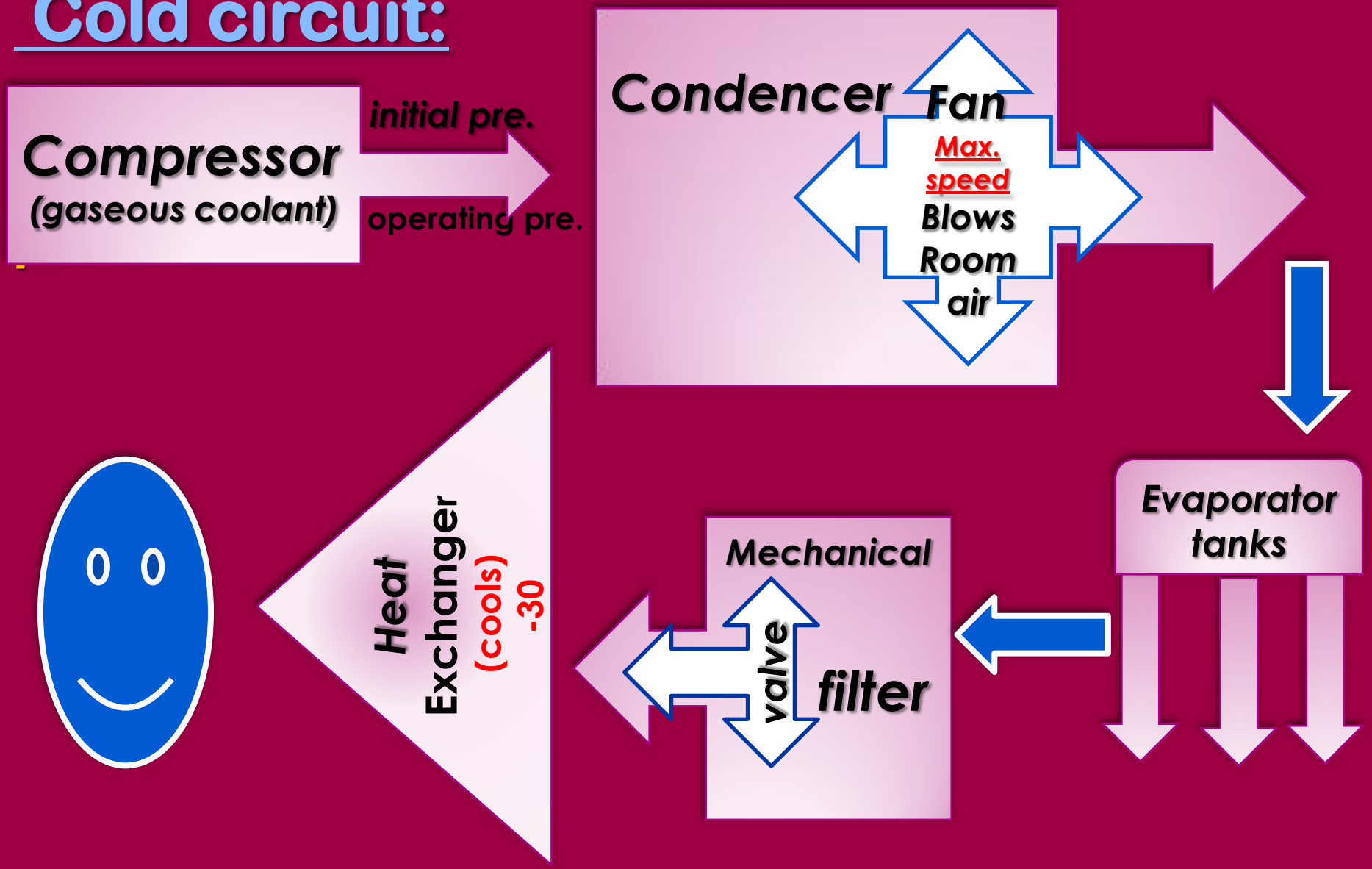
- These videos were analyzed into 2D plan using AutoCAD software to detect improvement in dorsiflexion ROM.

For treatment:
1- cryo flow 700/1000 machine:

- It is a mobile therapeutic device with compressor cools a heat exchanger.
- Room nitrogen air is blown into compressor by this exchanger and cooled to -30◦c
- Cold air gets to patient skin surface via flexible tube.

Cryo flow 700/1000 consists of

Cold circuit:



regulating coldness:

1- temperature sensor → reading temperature on evaporator → when reach -30→→it switch off fan and compressor of condenser via 2- Opto relay →→when temperature rise up to -25→→→this sensor switch them back on.

Ankle-foot orthosis

- AFO is an orthosis or brace (usually plastic) that surrounds the ankle joint and at least part of the foot.
- intended to control position and motion of the ankle.
- compensate for spasticity of calf muscle and prevent deformities. It is attached to the calf with a strap.
- The unbroken "L" shape of some designs provides rigidity which is important to overcome the spasticity.

C- Methods and procedures

1- patient preparation.

2- Instrument preparation.

a- MAS

c - EMG preparation.

d - 2D motion analysis.

3- Treatment program.

Electromyography:
(for calculating H/M ratio)
Electrodes placement:

- The patient was placed in prone position comfortably on the examining table.
- The head of the patient was held in mid position to avoid alteration tone over the patient's body during recording.
- The feet were placed over the edge of the table, so that the ankles were placed in a relaxed position.
- Recording was conducted from the soleus muscle as follows:

a. *The active (negative) electrode was placed along the mid-dorsal line of the lower leg, 2cm below the point of separation of the gasterocnemius and secured by adhesive plaster.*

b. *The other reference (positive) electrode was placed distal to the active electrode (five cm) in a straight line and secured by adhesive plaster.*

c. The ground electrode was placed between the stimulating and recording electrode.

d. The stimulating electrode was placed over the tibial nerve just medial to the midpoint of the knee crease in the popliteal fossa.

3- Treatment program:

❖ For group (A):

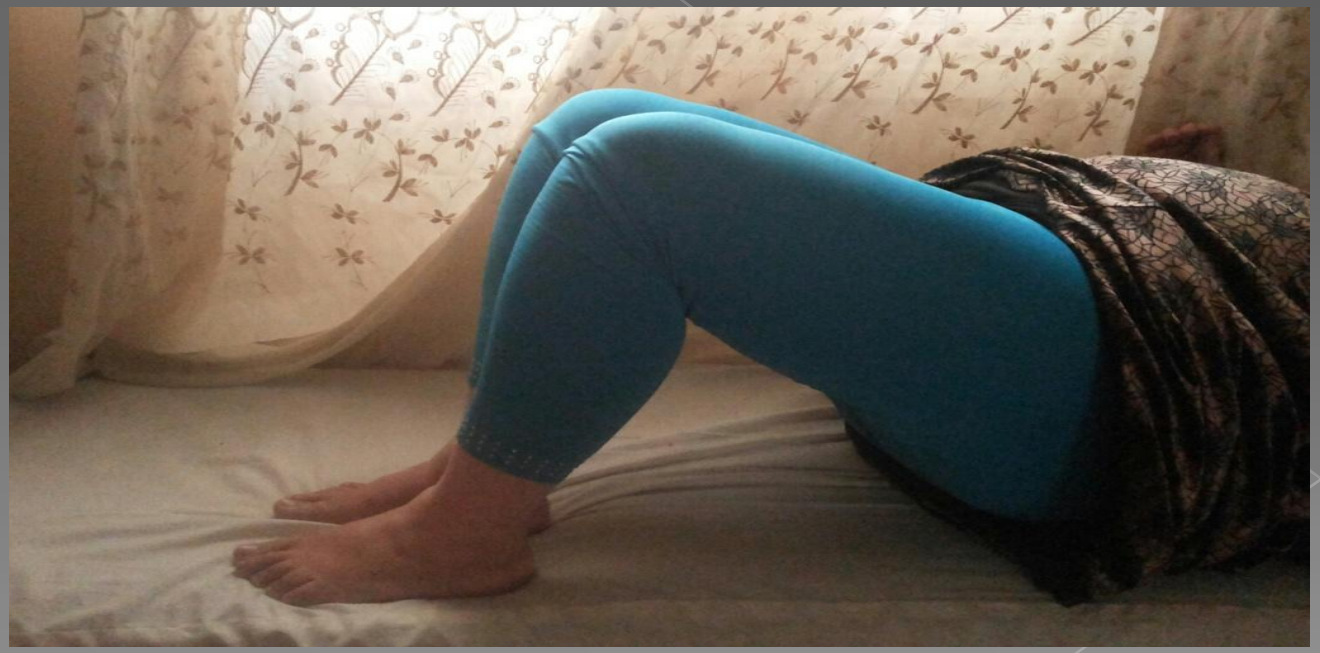
1- *All patients received cryo flow according to the following:*

- Parameters used in the treatment were:
  - Time : 20 minutes.
  - Temperature of -20.

2- All patients received therapeutic exercises program as following:

Each exe. Repeated 20/session with 5 min. rest in between

Bridging exercise



Foot forward and backward dorsiflexion exercise

Heel strike step up and down exercise in right hemiplegic patient.

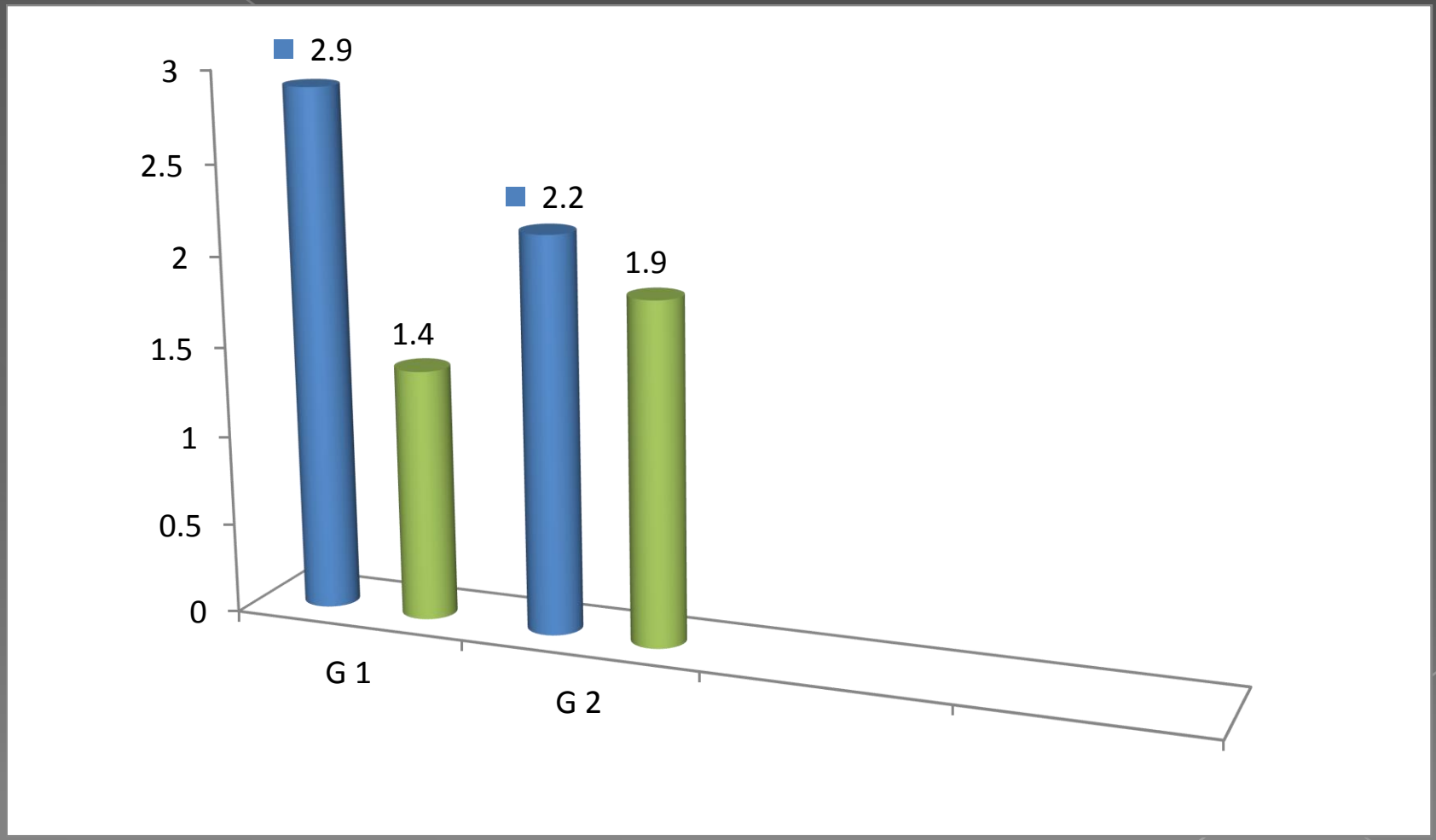
3- Wearing night ankle foot orthosis at night all over the period of the treatment.

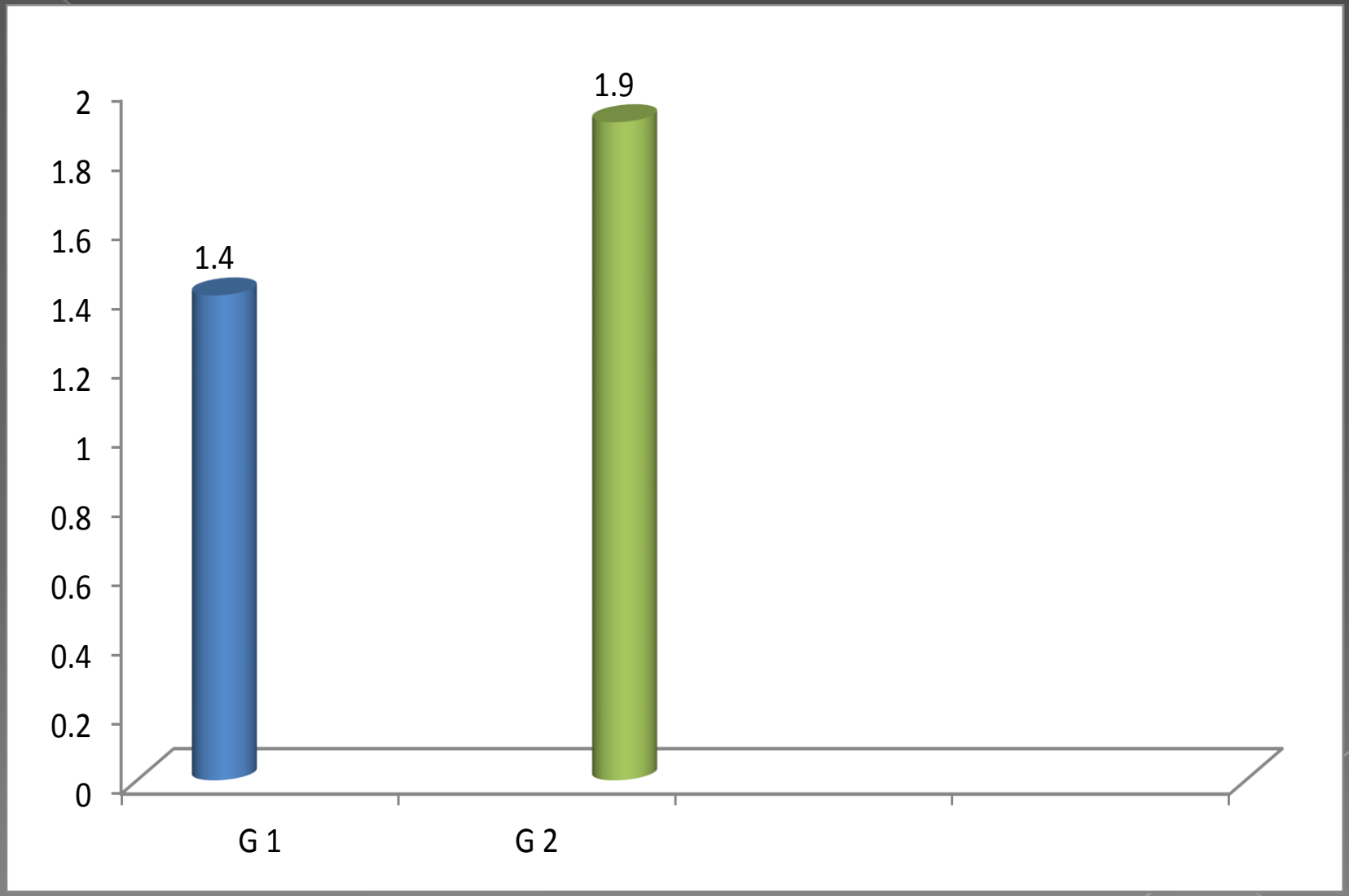
- **For group (B):**

all patients received the same exercises program and AFO without cryo flow

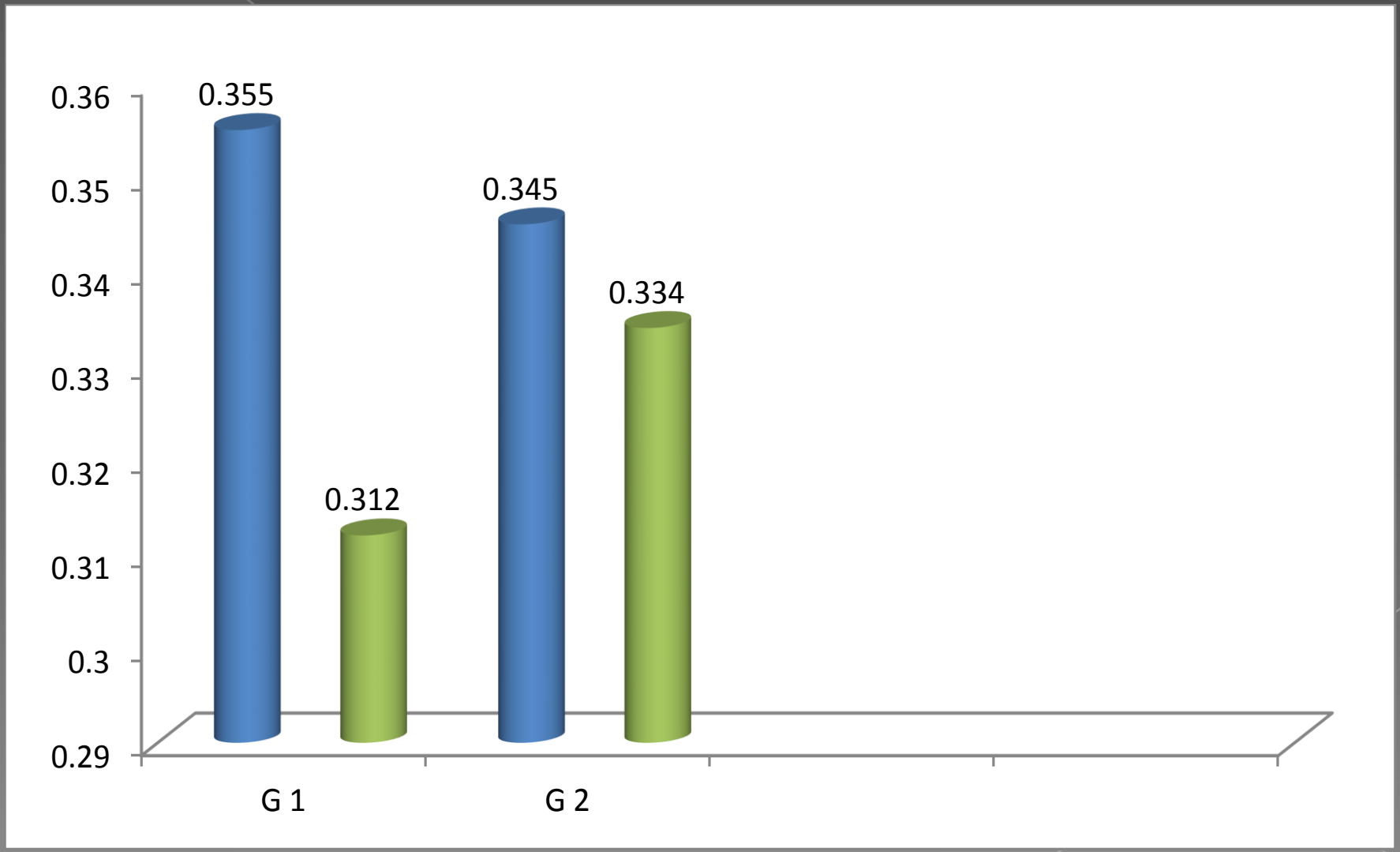
Results

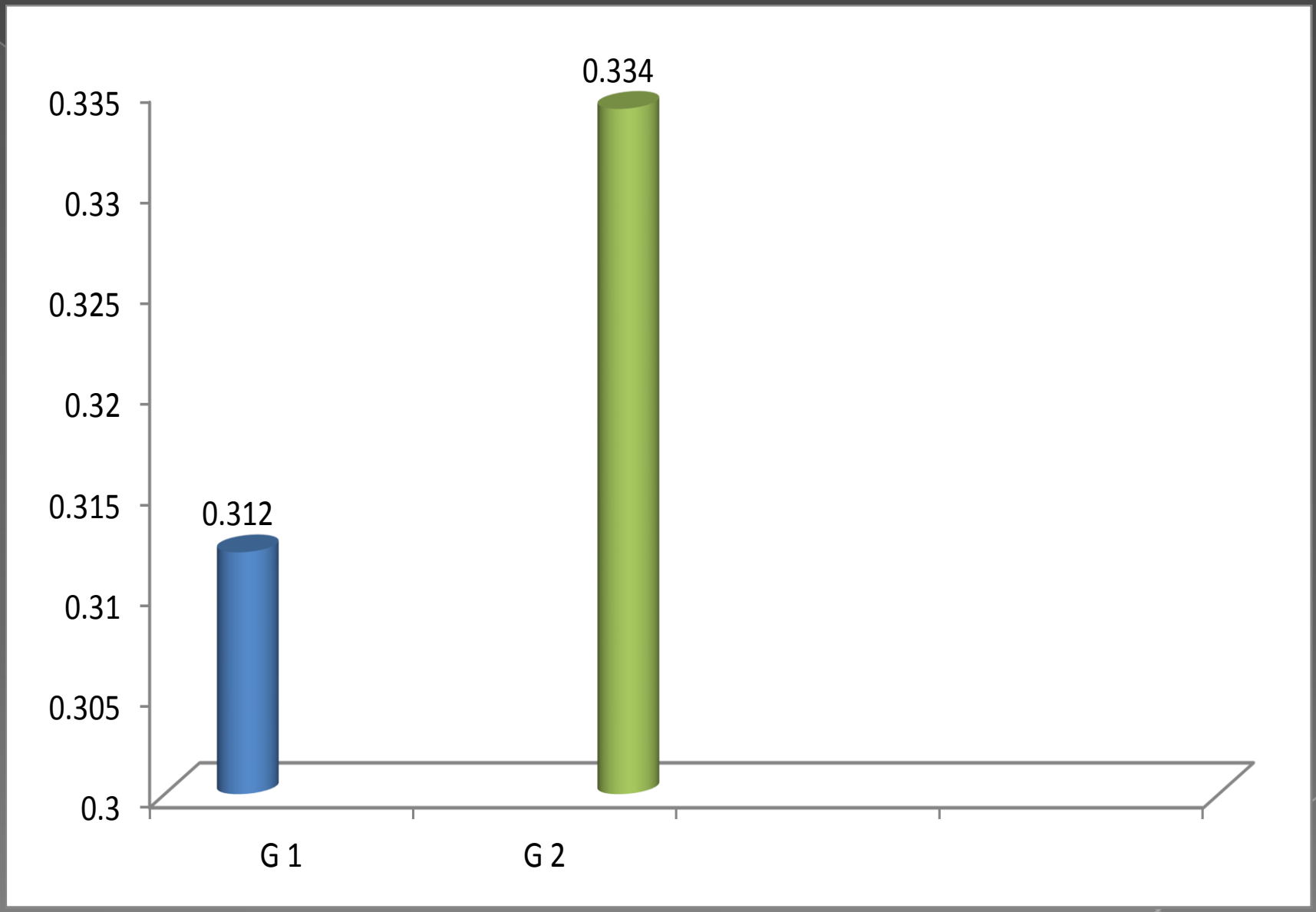
Mean value of MAS grades before and after treatment in both groups



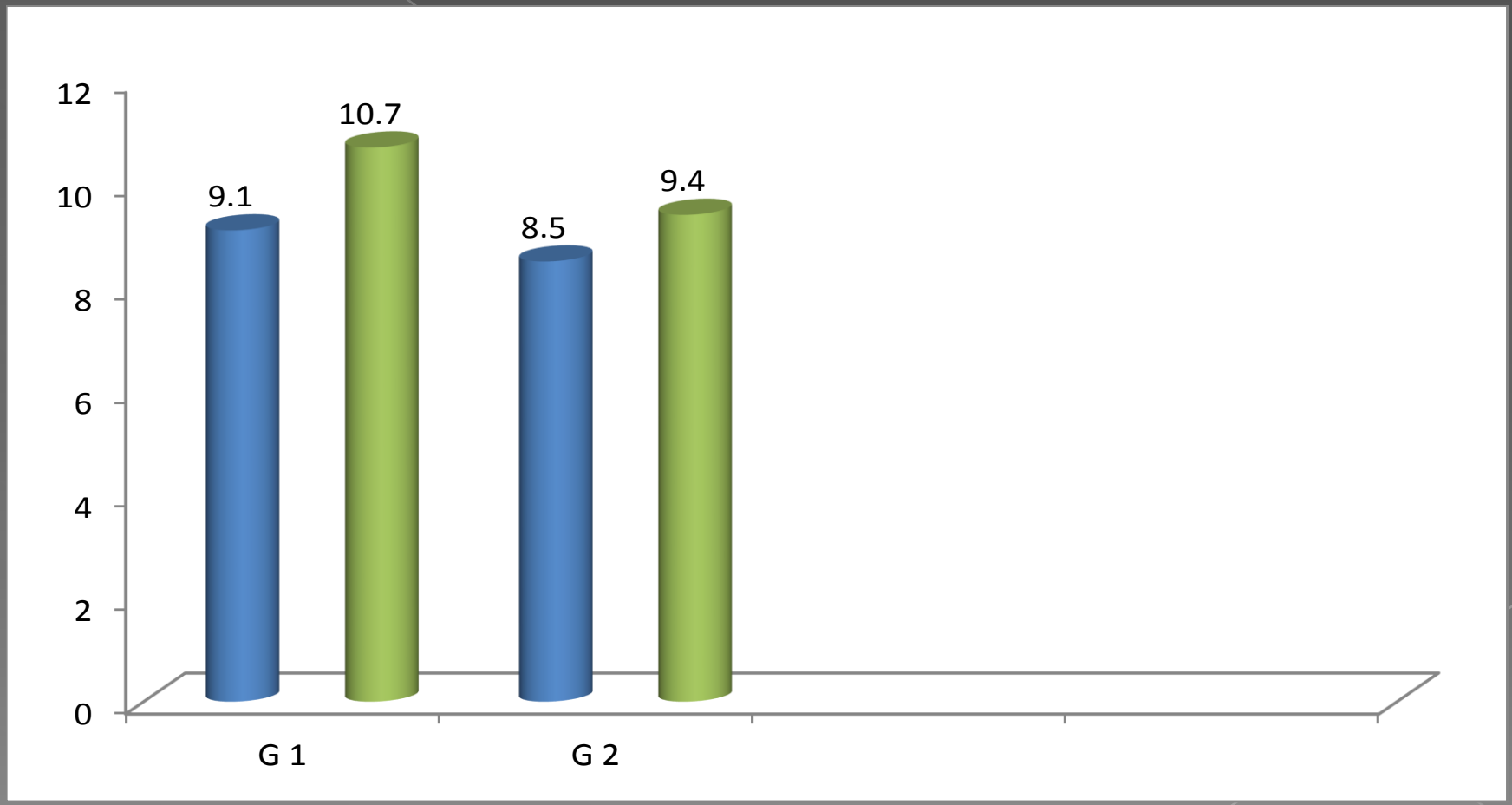

2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1.4
1.9
G 1
G 2

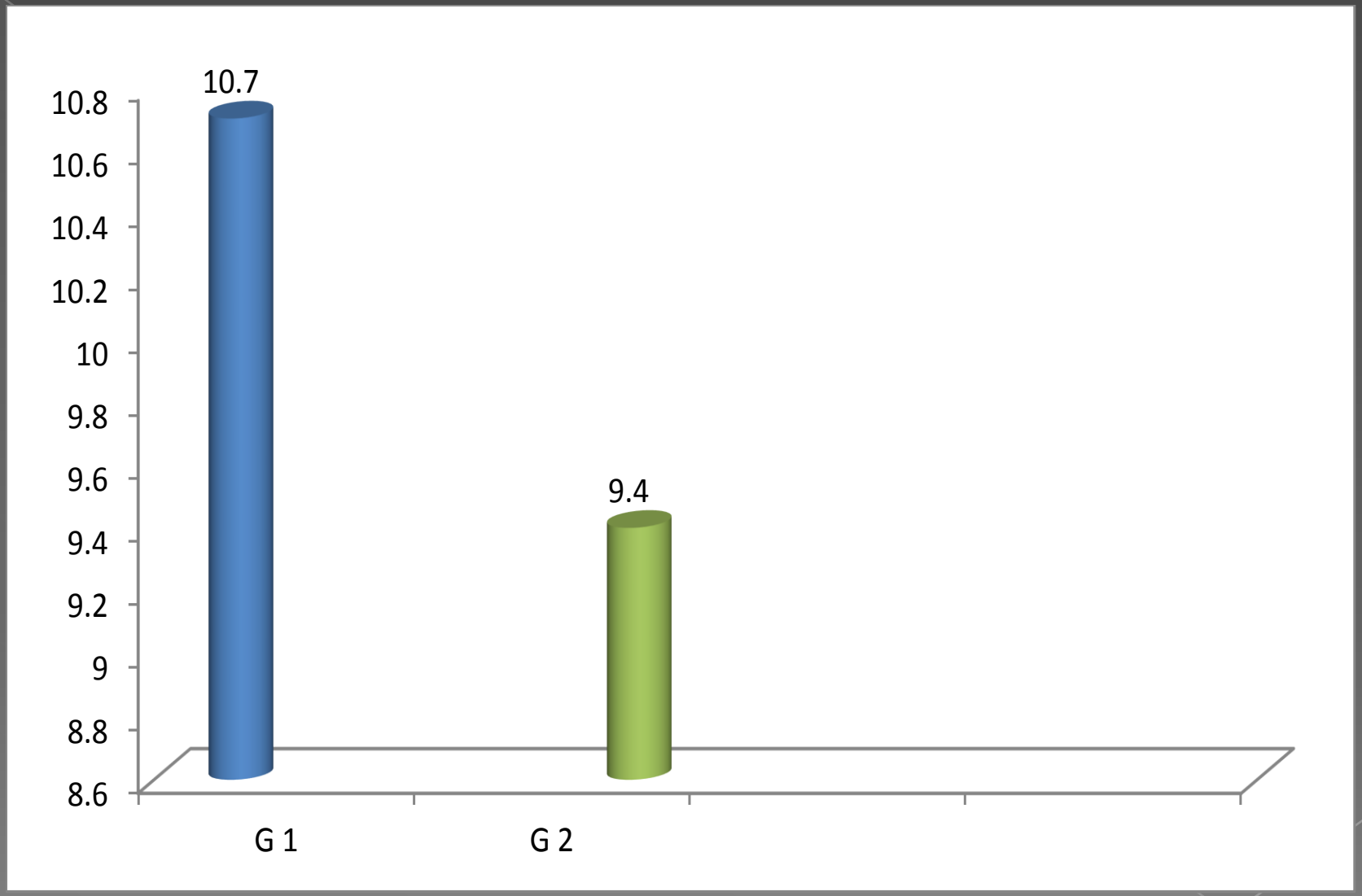
mean values of H/M ratio before and after treatment in both groups:



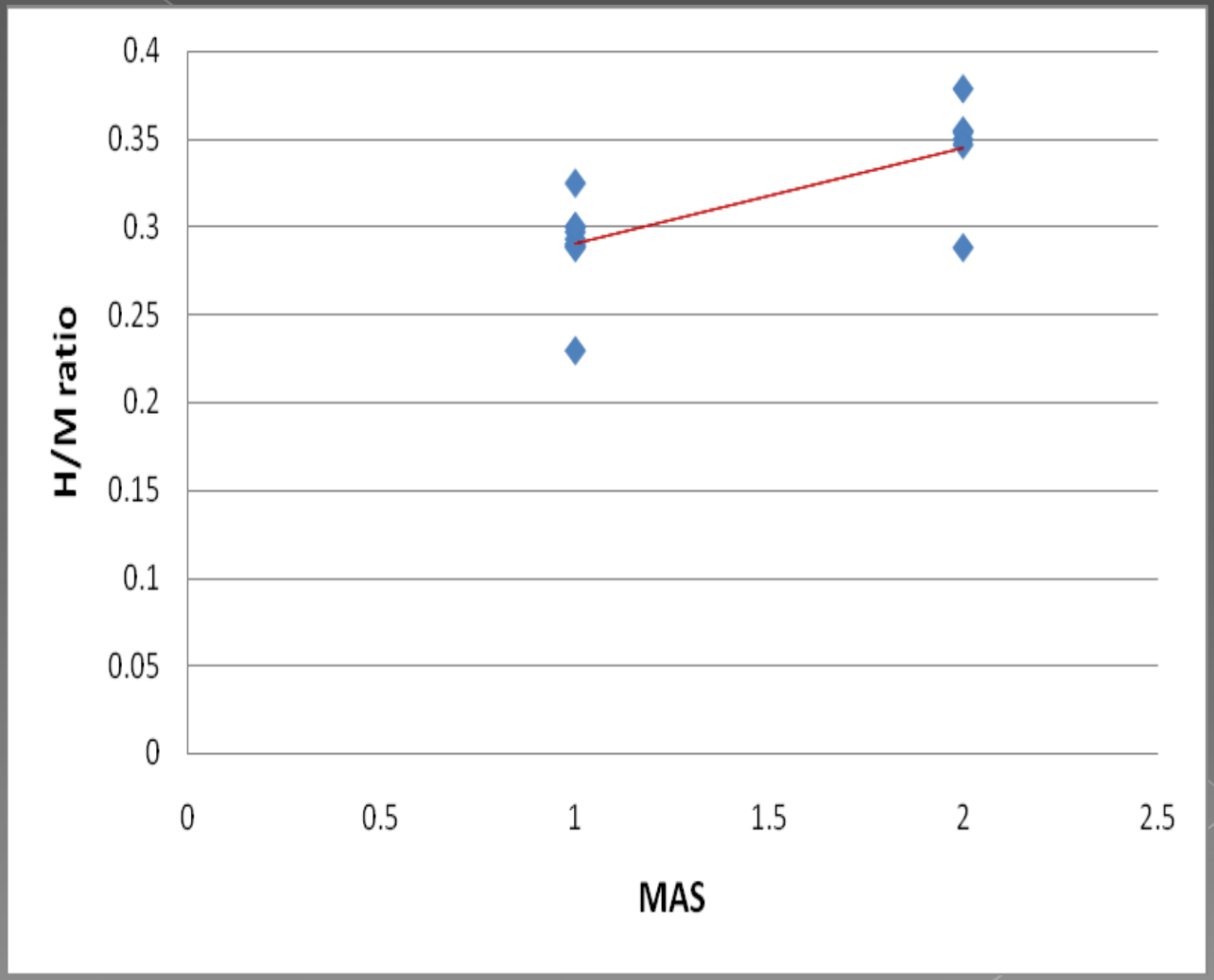

0.335
0.33
0.325
0.32
0.315
0.31
0.305
0.3
0.312
0.334
G 1
G 2

Mean values of ankle dorsiflexion ROM before and after treatment in both groups.

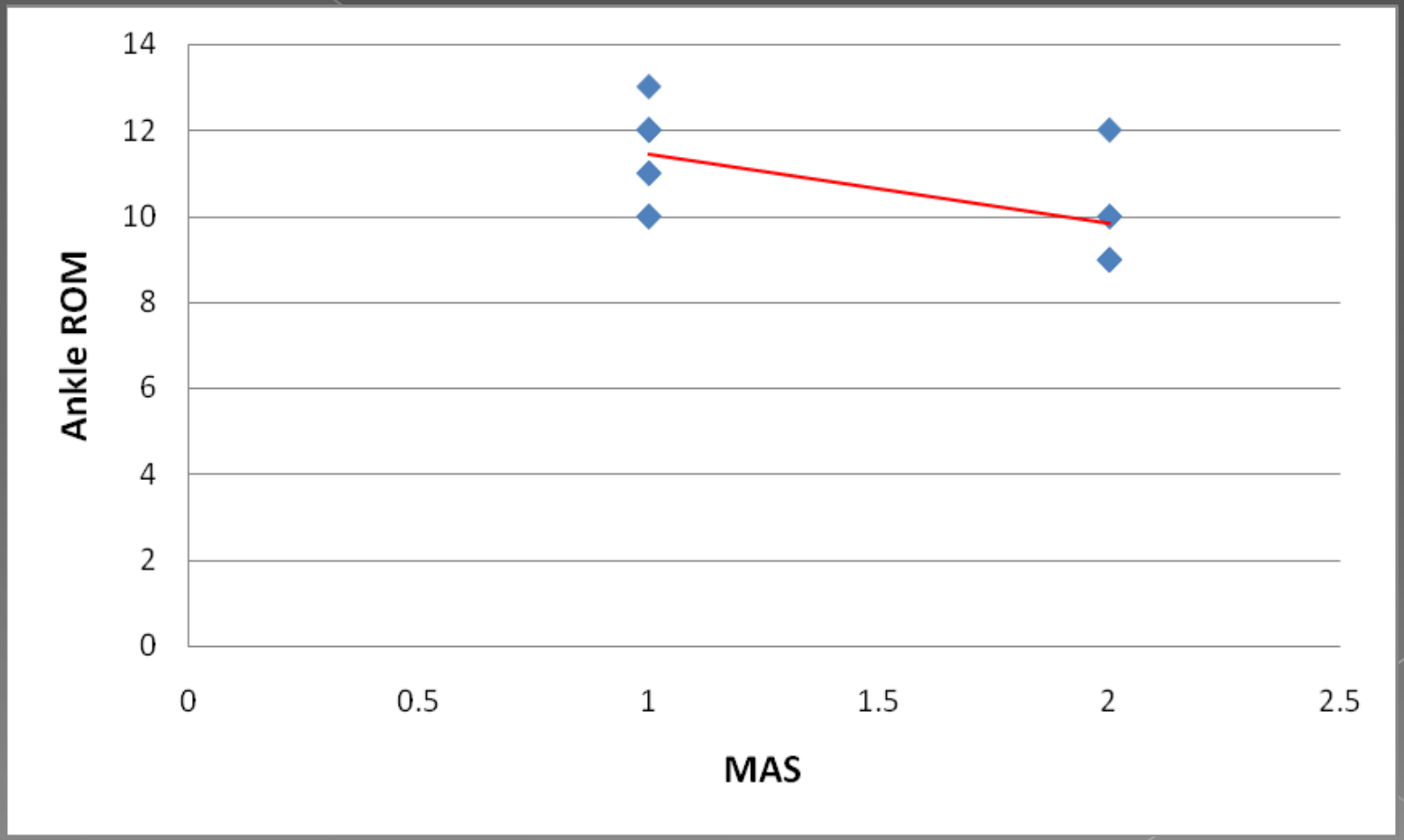



10.7
9.4
10.8
10.6
10.4
10.2
10
9.8
9.6
9.4
9.2
9
8.8
8.6
G 1
G 2

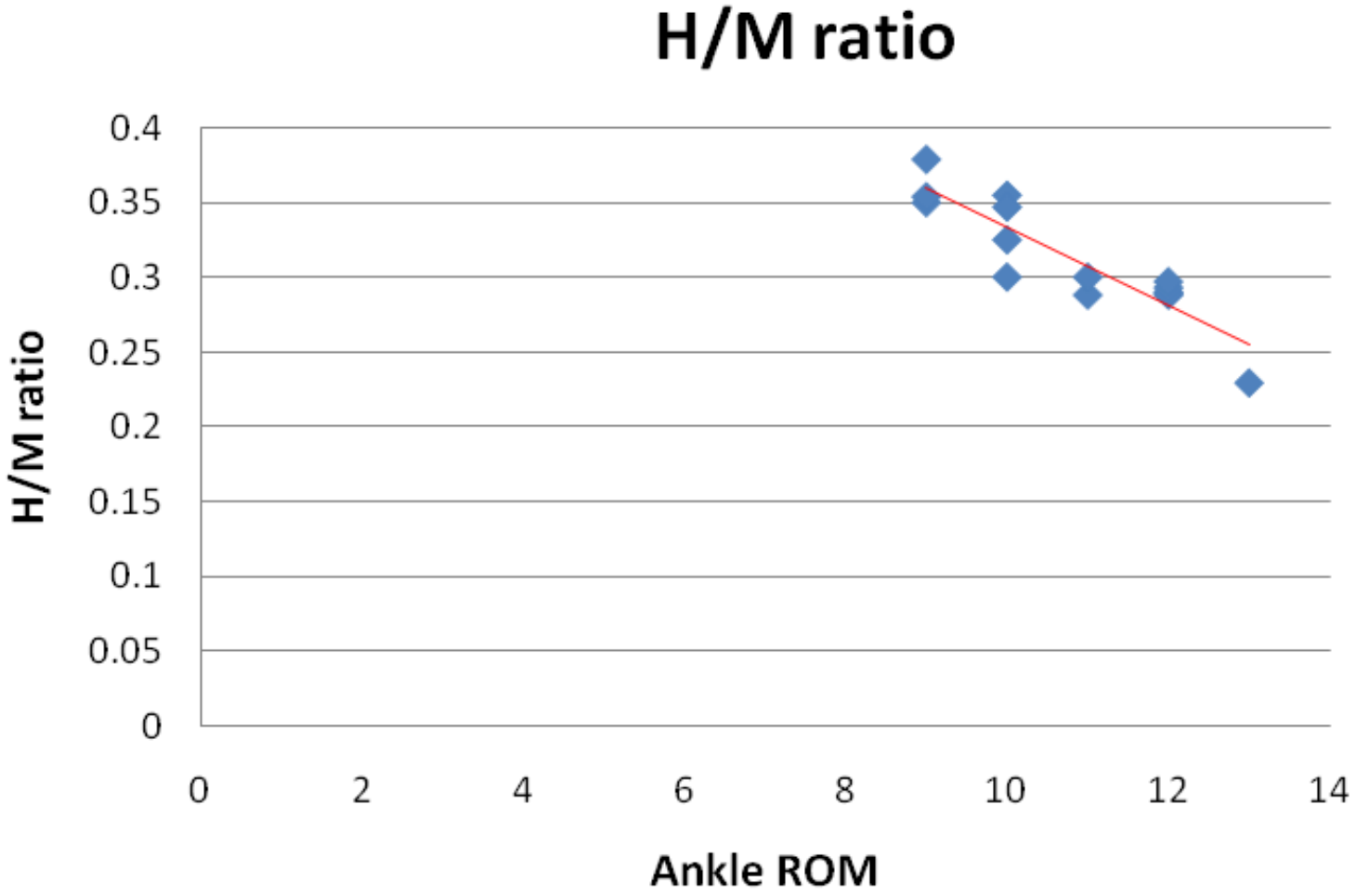
Correlation between H/M values and spasticity grades of MAS.



Correlation between ankle dorsiflexion ROMs and spasticity grades of MAS.



Correlation between H/M values and ankle dorsiflexion ROM



Discussion

According to MAS

There was highly sig. ↓ in MAS grades in G1 compared to G2 post ttt, and sig. ↓in them in G1 post treatment compared to pre treatment.

These results support *(Allison S and Abraham L, 2001)(Devi S and Kumari S, 2015)* whose found cooling:

- ↓Gamma motor neuron (GMN)(MS spindles) firing and sensory nerve endings discharge
- ↓MS. Spasm , ↑MS. Contraction and↑ functional output

But, There was no Sig. deference in G2 post ttt compared to pre ttt

(Danubia et al, 2015)(Yvette L et al, 2015) found that AFO and up and down stairs ex. In spasticity ttt showed poor convincing result

According to H/M ratio

- Althogh there was no sig. deference post ttt in G1 compared to G2, *(Mayer N, 2010)* found that, some patients spasticity may be a polished without change in H/M ratio. This occurs as lower Tem. Affects cell membrane by ↓K+ concentration and ↑Na+ causing membrane hyperpolarization and ↓firing rates.

- But, G1 had a highly sig. ↓in H/M ratio post ttt. *(Krause A et al, 2000)* found that, cooling of calf muscle ↓H/M ratio and ↑ambulation activity as cooling ↓nerve conduction velocity and modulate firing.

- But, G2 had no sig. deference. *(Trompetto C et al., 2013)* found that, exe. Program cased partial ↓in spasticity without H/M ratio change.

According to ankle dorsiflexion ROM

- Ankle dorsiflexion ROM showed a highly sig. ↑ post ttt in G1 compared to G2 and in G1post ttt compared to pre ttt. It also showed sig. ↑ in G2 post ttt compared to pre ttt.

- *(Draper and Knight, 2007)* found that, cooling pain receptors ↓its sensitivity and ↓monosynaptic extensor reflex (efferent Gamma fibers)

- *(Boudarham J et al., 2014)* found that, both G1, G2 those recived cooling + AFO and only AFO had spasticity improvement as AFO put ankle into functional position and facilitate dorsiflexion.

According to correlation coefficient

- On the same line with *(Bakheit et al., 2004)* there was a very strong significant correlation between the H/M ratio and MAS grade.

- Also, as in the study of *(Ghotbi et al., 2007),* a very strong significant correlation between H/M ratio and ROM degrees.

- As *(Roche N et al., 2015)* interrupted that strong significant correlation between MAS and ROM.

Conclusion and recommendations

Conclusion

- NBC appears to be an effective new modality in controlling spasticity of calf muscle in stroke patients.
- Traditional physical therapy with AFO can improve ROM of ankle dorsiflexion for stroke patients.

Recommendations

1. To investigate the effect on NBC on spasticity in chronic stroke patients.

2. To investigate the effect of NBC on spasticity in other brain disorders.

3. To investigate the effect of NBC on spasticity in other spastic muscles of stroke patients.

THANK YOU