



# Study of Accommodative & Convergence Status and Effect of Accommodative & Convergence Exercises in Diamond Workers

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**Abstract:** *In modern civilization when near work has assumed so much of importance, it is but natural that convergence and accommodation has great significance. Constant use of one eye in diamond cutting and polishing causes dissociation between the eyes leading to accommodation failure. This accommodation failure causes relative convergence insufficiency. The establishment of efficient accommodation and convergence in diamond workers presenting with decrease amplitude of accommodation and convergence insufficiency is challenging field of vision care. It is the author's observation that concern over cosmesis too frequently outweighs considerations of establishing effective visual functioning, efficiency, and comfort. One reason for this attitude appears to stem from misconceptions that symptoms related to insufficiency of accommodation and convergence in premature presbyopic age is relieved by giving near addition. Second reason seems to relate to the limited resources available that describe the practical management aspects of designing and administering successful therapy programs. The goal of present study is to analyze the prevalence of insufficiency accommodation & convergence in diamond workers as well as facilitated accommodative and convergence exercises in diamond workers. The purpose of study is also to assess the effect of Exercises on work profile of diamond workers. So it will give the impact of exercise on diamond workers. This is prospective based study. 70 diamond workers were selected. Initial examination was conducted to rule out exclusion criteria followed by refraction and we measure Near point of convergence & Amplitude of Accommodation with RAF rule & MINUS lens technique. Decrease in Accommodation and convergence demand were given proper exercise on synaptophore and with RAF rule was given up to 2 weeks and after 2 weeks again assessment was conducted on accommodation and convergence demand. Out of 70 workers 49(70%) given exercise. 39(79.59%) were cured totally and reached to normal range after two weeks. 7(14.28%) were improved and 3(6.12%) were totally failed and didn't improve with exercise. In Diamond workers there are high prevalence of accommodation and convergence dysfunction. Study shows good result of accommodation and convergence after exercise and even it is maintain for longer period with proper exercise.*

**Keywords:** *Diamond workers, Amplitude of accommodation, near point of convergence.*

## I. INTRODUCTION

In contemporary culture when near work has whispered to so much of magnitude, it is but natural that convergence has great significance. Phylogenetically it is very young faculty and hence it is prone to great disorders, where near work are highly exaggerated.

Diamond cutting and polishing is done in most part of Gujarat predominantly in Surat and Navsari districts of south Gujarat. As diamond worker's wages depends upon quantity of work done which give more temptation for strenuous near work which is 8 to 10 hours daily. Youngsters are more attracted due to high wages paid in this diamond industry.

Unvarying utilizes of solitary eye in diamond cutting and polishing causes dissociation between the eyes leading to accommodation malfunction. This accommodational failure causes virtual convergence insufficiency.

Due to these accommodation failure and relative convergence insufficiency diamond workers develops symptoms like blurring of vision for near, headache, eyestrain, eye ache, watering, and e.t.c. Due to these conditions it is difficult to work for long time.

Even some diamond workers develop sever blurring of vision in evening time, this condition is may due to either lag of accommodation or tonic accommodation which is partly responsible for "Night myopia"; in which the refractive state of most people is more myopic in dim illumination than in bright surroundings.<sup>1</sup>

For all above symptomatic condition in general weakest convex lens is given for near in non presbyopic age for temporary relief which may not be give satisfactory results in long term bases. To overcome this condition this study was done to evaluate that whether exercises would give long term benefit or not.



## II. BRIEF REVIEW OF LITERATURE

1. Study done on Treatment of convergence insufficiency in diamond cutters by Dr O.P.Bilore, Dr A.P.Shroff, and Mr. Paresh Antani which is published in I.J.O.(vole 15,1979) 2present a study of 200 diamond cutters who attended Rotary eye institute Navsari with complain of image blur &/or eye strain.

Each case was subjected to complete ocular and orthoptic check up including Maddox road, Maddox wing, synaptophore examination, determination of near point of convergence and Accommodation.

In observation 28% diamond cutters had NPA between 6to10cm; 42% had range between 11to 15 cm; 19.5% had range of accommodation between 16to 21 cm and 10.5% had range beyond 21 cm. Convergence insufficiency was high among Emmetropes (61.5%) followed by Myopes (20%) and Hyperopes (11.52%).

Out of all above Diamond Cutters Subjective improvement was seen in 70% and objective improvement seen in 58% cases. Subjective failure was in 2% cases.

2. One another comparative study of measurement of Near point of convergence, sustenance of convergence, Amplitude of Convergence & Latent/Manifest Strabismus between Diamond Workers, Embroidery Workers & Normal population by Dr. Kamini L Audich (MS,DO ;professor & Chief ,ocular motility clinic, M & J Western Regional Institute of ophthalmology) 3

In this study 70 cases of Embroidery Workers (performing Binocular near Work), 150 Cases of Diamond Workers (performing Uniocular near Work), and 55 cases of Normal Population were taken.

This study`s result shows that 71% of Diamond Workers, 23% of embroidery workers, and 0% of normal population having latent/Manifest strabismus .They also conclude that both Binocular & Uniocular constant Near Work decreases Amplitude of Motor Fusion and Sustenance of convergence and increase Near Point of Convergence ( $p<0.05$ ) and both are Strabismogenic( $p<0.01$ ).

3. Characterize accommodation facility problems and related symptoms among otherwise healthy young pre-presbyopic showing accommodative dysfunction.

The purpose is also to evaluate an Accommodative facility training technique by studying the effect of the training on relative Accommodation. (By: Bertil Sterner from Institute of Ophthalmology university of Goteborg 2001). 4

In this study children aged 9-13years, referred by School Health Care for near work-related problems and complaining of Headaches, blurred vision, Asthenopia, loss of concentration, and Avoidance of near acuity, were selected Result of this study shows that in all Children, the symptoms gradually decreased and finally disappeared during the training period.

Result of study also indicate that accommodative facility training is an effective method resulting in loss of symptoms and that it also has a real effect on the amplitude of relative accommodation in patients with impaired relative accommodation. Because accommodative infacility may result in asthenopic symptoms, it is of great importance to identify the dysfunction to prevent unnecessary near vision problems.

## III. METHODOLOGY

### Research Design:

This prospective clinical study enrolled Consecutive patients, who were aged up to 35 years and engaged with diamond work and who also diagnosed with poor Near point of accommodation and poor Amplitude of Accommodation.

**Study Location:** The present study was conducted at Rotary Eye Institute, Navsari.

**Selection of Study Population:** A purposive sample of 70 Diamond workers was chosen for the study, those who were attending the O.P.D.

## IV. OBJECTIVES

The aim of study was to facilitated accommodative and convergence exercises to diamond workers and also observe accommodative and convergence status after exercises.

The substitute objectives of study were as follows,

1. To analyze the prevalence of insufficiency accommodation & convergence in diamond workers.



2. Comparison of amplitude of accommodation with RAF & MINUS lens technique.
3. Comparison of Near point of convergence with RAF & PUSH UP technique.

## V. INCLUSION & EXCLUSION CRITERIA

### ➤ Inclusion Criteria

1. Occupation: - Diamond worker.
2. Age Group: - Up To 35 years.
3. Patients with Insufficiency of Accommodation & Convergence.
4. Best corrected v/a: -  $\geq 6/9$ .

### ➤ Exclusion Criteria

1. Age Group: - Above than 35 years
2. Patients with ocular & systemic disease

In the present study 70 Diamond Workers who attended Rotary Eye Institute for Complaint of blurred vision, Eye Strain and other associated symptoms were selected for study. Each case was subjected to complete ocular check up including History taking, Distance & near Visual Acuity, Subjective Test, measurement of Near Point of Convergence & Amplitude of Accommodation, etc.

In this Study the NPC was measured by two different techniques.

#### 1. Push Up Technique:-

- Begun with the target 50 cm directly in front of patient. Patients were instructed to look at the tip of pen with both eyes.
- Then target was slowly moved towards the bridge of the patient's nose. It should take approximately 10 seconds.
- Patients were asked to report when target was sustained double & patients were also looked objectively when they loses the fixation
- At last the Distance between target and bridge of patient's nose was measured.
- Procedure was repeated for 3 times and average of it mentioned in Performa.<sup>1</sup>

#### 2. RAF (Royal Air Force Ruler) Technique:-

- The arm of R.A.F. ruler was supported at patient's nasal bridge.
- Then direct additional lighting over the patient's shoulder to illuminate reading card without shadows.
- Patient was asked to focus at target of dot which was in between two lines.
- It was advanced towards patient slightly below the eye level.
- Patient was asked to know where line become sustains double & eye was also monitored objectively for Divergence.
- The centimeter value at endpoint of sliding target was taken as patients Near Point of Convergence.<sup>5</sup>

The Amplitude of Accommodation was also measured by two Techniques.

#### 1. RAF (Royal Air Force Ruler) Technique:-

- The arm of R.A.F. ruler was supported at patient's nasal bridge.
- Then direct additional lighting over the patient's shoulder to illuminate reading card without shadows.
- Patient was indicated to the one line above to the smallest size text that they can see on near chart when positioned at about 40 cm .
- Target was slowly Moved towards the patient and asked him to know where fine print become sustain blurred.
- This point on Diopter bar was equivalent to patient's Amplitude of Accommodation.

#### 2. Minus Lens to Blur Technique:-

- Patient was asked to concentrate at 6/60 letter on Snellen's chart.
- Started with -0.50Dspherical.
- Then increase power in successive manner of -0.50 D spherical.
- Patient was instructed that as lens was change the vision would become blurred.
- The point at when patients vision become sustain blurred & he/she cannot read letter of 6/60 that power of minus lens was equivalent to patients Amplitude of Accommodation.<sup>5</sup>

Out of 70 patients only 49 patients were agreeable to come for Accommodative and Convergence Exercises, rest were given home Exercise and Medical Treatment.



### Synaptophore Exercises for fusional Convergence

- Patient was seated comfortably.
- First of all patient's IPD was adjusted.
- Then foveal Fusion slide was selected.
- Asked patient to fused image.
- Then asked patient to hold the handle and moved it slowly convergent side.
- At one point the image was appear doubled at that point asked patient to re fused the image.
- Same procedure was done for 5 minutes on each day of exercise for 2 weeks.
- After that NPC was measured on each day and progress is recorded<sup>5</sup>.

### R.A.F. rule exercises for increase Amplitude of Accommodation

- Hold R.A.F. ruler at patient's nasal bridge.
- Patient was instructed to read letters on card.
- Patient was then directed to move card slowly towards his or her open eye until letters begin to blur.
- When letters become blurred patient was instructed to stop moving drum and make letters clear.
- When print clears, patient resumes moving drum closer until blur is noted again.
- Patient was continues in this manner until he or she can no longer make letters clear.<sup>6</sup>

### LOOSE MINUS LENS ROCK

- A loose minus lens was interposed directly in front of patient's open eye, and patient was instructed read the print.
- If print was blurred, the patient was directed to make it clear.
- As soon as it clears, the minus lens was removed and patient was directed again to make print clear.
- As soon as target clears, minus lens was interposed in front of eye again.
- The lens power was increase in -0.50D Spherical in each successive manner.
- Test was done for five minutes each day.
- At end of each day of exercise progress was noted.<sup>7</sup>

Two weeks after end of exercise session patients were recalled and accommodative & Convergence status were noted.

## VI. RESULTS

TABLE 1- COMPAIRING OF NPC WITH PUSH UP & R.A.F. METHODS AT EACH TIME OF EXAMINATION (P VALUE: 0.00174).

NPC WITH PUSH UP METHOD			
NPC (cm)	1 <sup>st</sup> visit	After exercises	2 week of exercise
6 -10	53(75.71%)	46(93.87%)	45(91.83%)
11 -15	10(14.28%)	03(06.12%)	04(08.16%)
16 -21	06(08.50%)	00	00
Beyond 21	01(01.42%)	00	00
<b>Total</b>	<b>70</b>	<b>49</b>	<b>49</b>

NPC WITH R.A.F. RULER			
NPC (cm)	1 <sup>st</sup> visit	After exercises	2 week of exercise
6 -10	40(57.14%)	44(89.79%)	44(89.79%)
11 -15	23(32.85%)	05(10.29%)	05(10.29%)
16 -21	05(07.14%)	00	00
Beyond 21	02(02.85%)	00	00
<b>Total</b>	<b>70</b>	<b>49</b>	<b>49</b>

COMPARISON OF AVERAGE NPC (P VALUE: 0.00174)		
EXAMINATION	PUSH UP(cm)	R.A.F. (cm)
1 <sup>ST</sup> TIME	10.071	10.878
AFTER EXE	07.297	08.010
2 WEEKS AFTER EXERCISE	07.570	08.230

In this prospective, comparative study, NPC with push up shows that there were 93.87% patient gain normal range of NPC after exercise and from them 91.83% patient's maintain their NPC even in second follow up which was 2 weeks after exercise. While comparing NPC with R.A.F. ruler shows that 89.79% patients gain their normal range of NPC.



TABLE 2 – COMPAIRING VALUES OF AOA BY R.A.F. AND MINUS LENS METHOD AT EACH TIME OF EXAMINATION (P VALUE: 0.00896)

**AOA WITH R.A.F. RULER**

Diopter	1 <sup>st</sup> visit	After exercises	2 week of exercise
1-3	00	00	00
4-6	37(53.85%)	04(8.16%)	06(12.24%)
7-9	29(41.42%)	42(85.71%)	40(81.63%)
10-12	04(05.71%)	03(06.12%)	03(06.12%)
<b>Total</b>	<b>70</b>	<b>49</b>	<b>49</b>

**AOA WITH MINUS LENS METHOD**

Diopter	1 <sup>st</sup> visit	After exercises	2 week of exercise
1-3	17(24.28%)	00	01(02.04%)
4-6	48(68.57%)	21(42.85%)	23(46.93%)
7-9	05(07.14%)	28(57.14%)	25(51.02%)
10-12	00	00	00
<b>Total</b>	<b>70</b>	<b>49</b>	<b>49</b>

COMPARISON OF AVERAGE AOA (P VALUE: 0.00896).

EXAMINATION	R.A.F.(D)	MINUS LENS METHOD (D)
1 <sup>ST</sup> TIME	6.446	4.485
AFTER EXE	8.053	6.680
2 WEEKS AFTER EXERCISE	7.851	6.553

AOA was also measured by 2 Different Techniques, one is R.A.F. Ruler another was minus lens to Blur Method .By R.A.F. method before exercise 41.42% patient were come under ample kind of AOA and after exercise 85.71% patient were draw closer beneath plentiful manner of AOA.

TABLE 3 – COMPAIRING NEAR VISUAL ACUITY (Reduce Snellen’s Chart)

Near V/A	1 <sup>st</sup> visit	After exercises	2 week of exercise
N12p – N12	03(04.28%)	00	00
N10p – N10	08(11.42%)	00	00
N8p – N8	12(17.14%)	02(04.08%)	03(06.12%)
N6p – N6	47(67.14%)	47(95.91%)	46(93.87%)
<b>Total</b>	<b>70</b>	<b>49</b>	<b>49</b>

The percentage of N6 visual acuity at first visit was 67.14% at second follow up it was 95.91% which was 93.87% even after 2 week of end of exercise session.

TABLE 4 – RESULT OF TREATMENT (BASED ON DONDERS, DUANE & SHEARD’S STUDY ON AOA V/S AGE)<sup>1</sup>

CURED	IMPROVED	FAILED	TOTAL
39(79.59%)	07(14.28%)	03(06.12%)	49

After exercise 79.59% patients were cured, 14.28% was improved from their preceding status and 06.12% was non respondent to therapy.

## VII. CONCLUSION

This study has characterized a group of Diamond workers with impaired relative accommodation. In Diamond workers there is high prevalence of accommodation and convergence dysfunction. They were relieved of symptoms and as a result of work up; they improved both their NPC and their NPA.

In present study high incidence of convergence insufficiency in Emmetropes is difficult to explain but most probably it may be due to delayed development of convergence reflex in otherwise normal individual and which give rise to symptoms in those concerned with excessive close work. Convergence is phylogenetically young and it is late to develop hence suffers anomalies. Even this condition was also matched with previous study of Dr. Billore & Dr. Shroff 1980.

There is a minimal difference in push up and R.A.F. ruler method for measuring NPC but there is a about 1-3 D difference of readings in R.A.F. ruler and Minus lens to blur method.

Results also indicate that maintaining a constant size target when using the R.A.F. of determining amplitude of accommodation will overestimate the amplitude in subjects with higher amplitudes relative to those with lower amplitudes.



Out of 70 diamond workers only 49 were able to come for 2 weeks of exercise session. Other patients were given home exercise and medical treatment. 21 patients were given refractive correction for distance.

It was observed that home exercise and medical treatment was not effective at all in Diamond workers. [2] Accommodative and convergent exercises were very effective and relieve subjective or objective symptoms or both in diamond workers.

From all diamond workers 79.59% cases were cure, 14.28% were improved and 06.12% cases were failure. According Davies (1946) refractive error plays no part in causation of convergence insufficiency nor do they affect the cure rate of these cases

#### REFERENCES

1. The International Centre for Eye care Education --- Second Edition 2003 (Module 5 Binocular Vision).
2. Treatment of convergence insufficiency in diamond cutters by Dr O.P.Bilore, Dr A.P.Shroff, and Mr. Paresh Antani which is printed in I.J.O.(vole 15,1979)
3. 63rd Proceedings of all INDIA Ophthalmological Society Conference 2005(AIOS).
4. Characterize accommodation facility problems and related symptoms among otherwise healthy young pre-presbyopes showing accommodative dysfunction. The purpose is also to evaluate an Accommodative facility training technique by studying the effect of the training on relative Accommodation. (By: Bertil Sterner from Institute of Ophthalmology university of Goteborg 2001).
5. Von Noorden GK. (2002) the near vision complex. Burian-Von Noorden's binocular vision and ocular motility, theory and management of strabismus. 6th ed. Chapter 5, pg 85–100.
6. A.K.Khurana (1999) theory & practice of squint & orthoptic 1st edition chapter 7 Anomalies of Convergence, Divergence, & accommodation.pg 151-169.
7. Elizabeth & Michael (1993) clinical management of strabismus. Chapter 17 vision therapy techniques, pg 295-345.