

28

CORRELATION BETWEEN WEIGHT OF SPECTACLE AND THE CONTACT AREA OF NOSE PADS WITH RESPECT TO STANDARD ALIGNMENT

Hardee Punjabi¹ Usman Memon¹ Kinnari Kalaria¹

¹Nagar School of Optometry, Ahmedabad

ABSTRACT

Aim:

To understand the co-relation between the weight of spectacle and the contact area of nose pads with respect to standard alignment.

Study Design: A cross-sectional study.

Method: Parameters such as weight of spectacle, frontal angle of nose and nose pads, splay angle of nose and nose pads and pantoscopic angle, area of nose pads and contact area of nose pads were measured using simple tools such as portable weighing machine and a handmade gauge similar to Fairbanks facial gauge and the correlation between all the parameters was found out.

Results: Out of total 75 frames, 42 frames (56%) had no change in contact area with the corresponding area of nose pads with respect to the parameters including weight of spectacle frontal angle, splay angle and pantoscopic angle in standard alignment of spectacle, while other 33 frames (44%) had a noticeable change in the contact area of nose pads with respect to the corresponding parameters.

Conclusion: Difference of 50mm² of area between contact area and area of nose pads is acceptable with current trend of frames. Current trend of light weight frames and lenses has given ease to alignment as even misalignment does not result into marks. Contact area corresponding with the area of nose pad play a significant role in distribution of spectacle weight on nose. Mismatch between contact area and area of nose pads will result into skin marks. Ideally, a wearer is happy when standard alignment is achieved with respect to facial measurements.

Key words: **WEIGHT OF SPECTACLE , CONTACT AREA OF NOSE PADS ,STANDARD ALIGNMENT**

INTRODUCTION

The art of successful spectacle frame design is to cater for the various different markets in radically different ways. According to a recent report by one of the leading market research companies on current eyewear market, the **global eyewear market** was worth US\$ 120 Billion in 2018, registering a CAGR of 3.4% during 2011-2018. The market is further projected to cross US\$ 141 Billion by 2024, at a CAGR of 2.6% during 2019-2024. Currently, the global demand for good-quality eyewear products is being augmented by increasing prevalence of hypermetropia and myopia at young ages. In developing nations, improving lifestyles, urbanisation and availability of advanced eyewear products are positively impacting the market growth. ^[3]

Dispensing an aligned spectacle is an important part in optometry practice. Not only shape but also correct measurements of face as well as frame are necessary for a spectacle to fit properly on wearer's face without leaving facial marks. All the parameters of standard alignment either individually or together have a great impact on wearer's final spectacle design. Hence, it is the foremost duty of a dispenser to take proper measurements of all the necessary parameters such as angles, weight and areas.

With the increasing demand of fashion and comfort, the spectacle industry has been advancing and introducing newer and lighter frame designs in the market. Also, people now tend to choose plastic frames over metals as plastic frames have proven to provide better comfort and fit to wearers as compared to metal ones.

Spectacles represent the most commonly owned eyewear product, accounting for around three-fourths of the total market share. Technological advancements and increasing dependence upon gadgets and electronic devices have led to a rise in eyesight disorders, thereby resulting in an increased demand for spectacles. Definitions of facial features to be measured with existing systems of facial measurement are often not specific enough for frame design and manufacturing. Currently, for individual frame design, experienced personnel collect data with facial rules or instruments. ^[6]

Now what is a spectacle?

A spectacle is frame holding a pair of lenses containing ophthalmic prescription in proper position in front of the eyes.

How can the increased demand for a good quality eye product be fulfilled?

The spectacle wearing public has not always embraced the latest designs with alacrity but those that provide a safe, durable, stable and comfortable means of holding corrective lenses in place. Hence, a dispenser or a practitioner must make sure that a frame received from an optical laboratory should meet the basic requirement of standard alignment so that it can properly fit the wearer. ^[3]

A general rule for standard alignment is to begin with the bridge, then work with the end pieces, and handle the temples at last. Apparently, the changes made in one part of frame may influence the alignment in another part. Handling the bridge first, and the other parts in order, helps to eliminate having to go back and realign parts. ^[2]

This study is aimed at finding out how the parameters are related to each other in case of plastic frames, and how they affect the final alignment of spectacle on face. ^[2]

Some of the important parameters to be taken care of during the standard alignment of a spectacle are as follows. ^[2]

Pantoscopic angle:

It is the angle the frame front deviates from true vertical when the glasses are held with the temples horizontal. This angle ensures the temple parallelism.

Range: 4-18 degrees. ^[2]

Standard Alignment of nose pads:

As with the frame front and the temples, there is a specific standard alignment for the nose pads that should be used during the preliminary adjustment of the frame. ^[2]

Frontal angle:

The *frontal angle* of the nose pads refers to the vertical position of the pads in relation to each other when viewed from the front. ^[2]

The tops of pads should be closer together than the bottoms, angling in toward each other approximately 20 degrees from true vertical. ^[2]

Splay angle:

The difference between back and front edges of each pad, viewing from top or bottom, is the *splay angle*. For initial alignment, a splay angle of 25-30 degrees is satisfactory. ^[2]

AIM

To understand the co-relation between the weight of spectacle and the contact area of nose pads with respect to standard alignment.

REVIEW OF LITERATURE

The current international standard for spectacle frames recommends that frames weighing up to 20 g should have a minimum nose-pad contact area of 200mm² and those weighing over 25 g should have a contact area of 250mm². It is shown that these recommendations are being almost universally ignored for frames with separate pads on arms. The information on frame materials in manufacturers' literature is woefully inadequate but, from the information available, there was a little difference in weight between stainless steel frames and those from unnamed materials. ^[1]

-Walsh G. Ophthalmic Physiol Opt.2010

INCLUSION AND EXCLUSION CRITERIA

Inclusion Criteria:

- Plastic frames having inbuilt nose pads.

Exclusion Criteria:

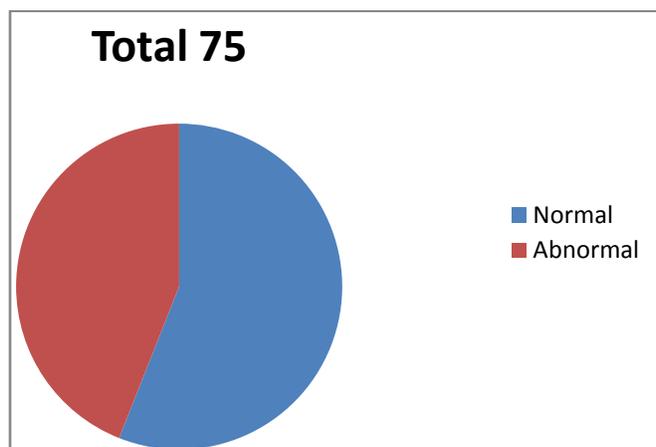
- Metal, Supra, Combination, Rimless frames that have nose pads attached to pad arms.

MATERIALS AND METHOD

75 random plastic frames currently being used were studied. The spectacle wearers were informed about the study and the process was explained before taking all the frame measurements and imprinting the nose pads on wearer's nose with the help of removable paint. Weight of spectacle frames with prescription lenses intact was measured in grams using a handheld digital weighing machine. Frontal angle of the nose and nose pads, Splay angle of the nose and nose pads, and pantoscopic angle of the frames were measured in degrees using a handmade gauge similar to *Fairbanks Facial Gauge*^[5]. The length and breadth of nose pads was measured in mm scale and the Length x Breadth formula was used to find out the area of nose pads (mm²). The contact area of nose pads (mm²) was measured by getting an impression of nose pads using washable paint color on the nose where the pads would rest and measuring area with the same Length x Breadth formula.

RESULTS

Out of the total 75 frames, 42 frames (56%) were found to have contact area similar to the corresponding area of nose pads with respect to the weight of spectacle and the frontal, splay and pantoscopic angles. 33 frames (44%) had a noticeable change in contact area against the pad area with respect to other parameters.

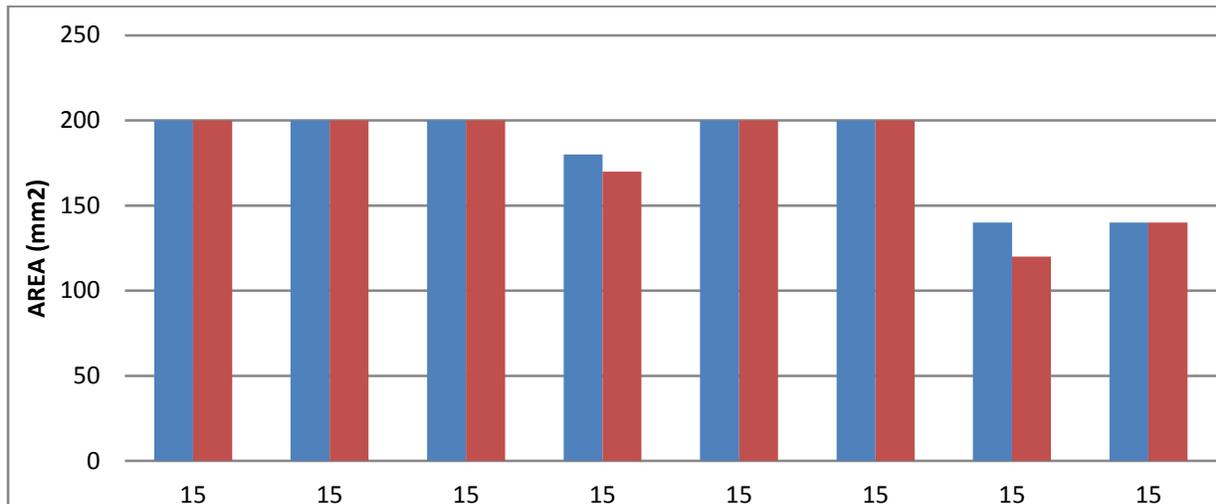


The average values of all the parameters with the standard deviation are as follows:

PARAMETERS	AVERAGE	STANDARD DEVIATION
Weight of spectacle (in grams)	22.6	5.62
Frontal Angle (in degree) Face Frame	R= 20.72 L= 21.02 R= 20.90 L= 20.90	3.13 3.57 3.23 3.44
Splay Angle (in degree) Face Frame	R= 31.45 L= 31.24 R= 31.45 L= 31.08	4.82 4.61 4.51 4.62
Pantoscopic Angle (in degree)	11.62	2.84
Area of Nose Pads (in mm ²)	175.73	39.34
Contact Area of Nose Pads (in mm ²)	163.26	40.31

Since the spectacles were not the stock products but the ones already in use, information on the materials from which the frames were made was not available for all the frames. 20 frames out of 75 were made from TR material, 22 were acetate frames and there was no indication on the remaining frames.

This entire data of 75 spectacles was divided into 5 groups according to the weight of frame and the area of nose pads and contact area were compared using graphs.

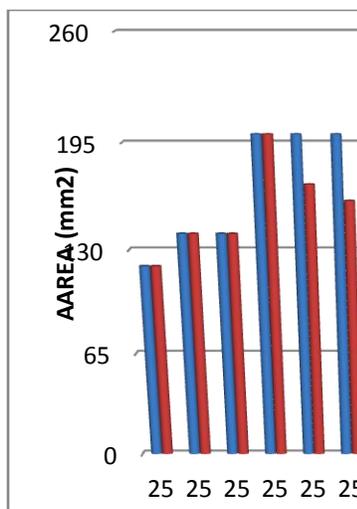
GRAPH 1: ANALYSIS FOR SPECTACLES HAVING 15 g WEIGHT

As shown in the above graph, there were total 8 spectacles having 15 g weight. Out of these, in 5 spectacles the pad area and the contact area were found to be same and were found to be as per the recommendations by the international standard i.e. 200 mm². 3 spectacles were found to have variable results i.e. variable pad area and contact area, 1 of the 3 spectacles had contact area and pad area of 140 mm². However, the 3 spectacles did not meet the standard requirements.

GRAPH 2: ANALYSIS FOR SPECTACLES HAVING 20 g WEIGHT

In the above graph, inner circle indicates the area of nose pads and the outer circle indicates corresponding contact area of nose pads. The results here show that out of total 35 frames, only 12 frames met the international standard of 200 mm² area (both AONP and CA) while the remaining 23 frames gave variable results. Out of 23, 8 spectacles, although not according to the international standard, but achieved contact area similar to the corresponding pad area (3 spectacles with 150mm², 2 with 180mm², 2 with 140mm² and 1 spectacle having pad area and contact area of 140mm²).

GRAPH 3: ANALYSIS FOR SPECTACLES HAVING 25 g WEIGHT

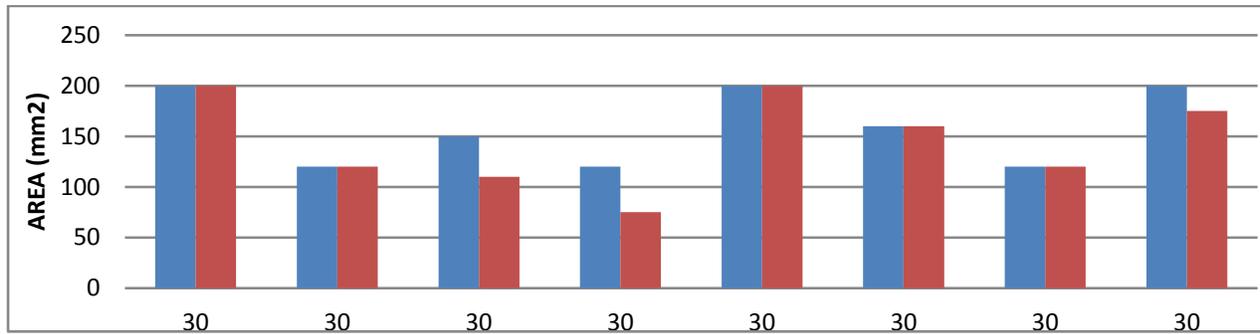


There were total 21 spectacles having 25 g weight. Only 1 spectacle among them had pad area of 250 mm² as per the standard



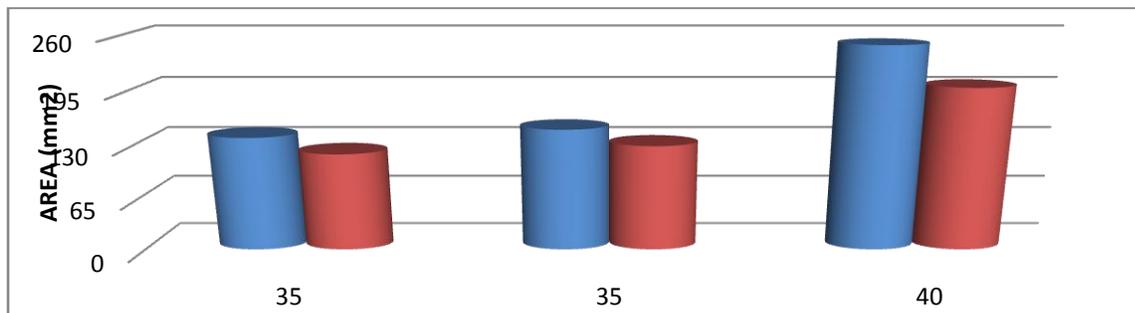
but the corresponding contact area was only 200 mm². 7 spectacles had pad area and the corresponding contact area of 200 mm². 13 frames had variable results which did not meet the requirements of the international standard. However, out of these 13, 5 spectacles were found to have pad area and corresponding contact area to be same (3 spectacles having 120 mm² area and 2 spectacles with 140 mm² area).

GRAPH 4: ANALYSIS FOR SPECTACLES HAVING 30 g WEIGHT



As shown in the above graph, of total 8 frames, only 2 spectacles had pad area as well as contact area of 200 mm², 2 spectacles had pad area and the corresponding contact area of 120 mm², 1 spectacle had pad area and contact area of 160 mm² and the remaining 3 with variable results.

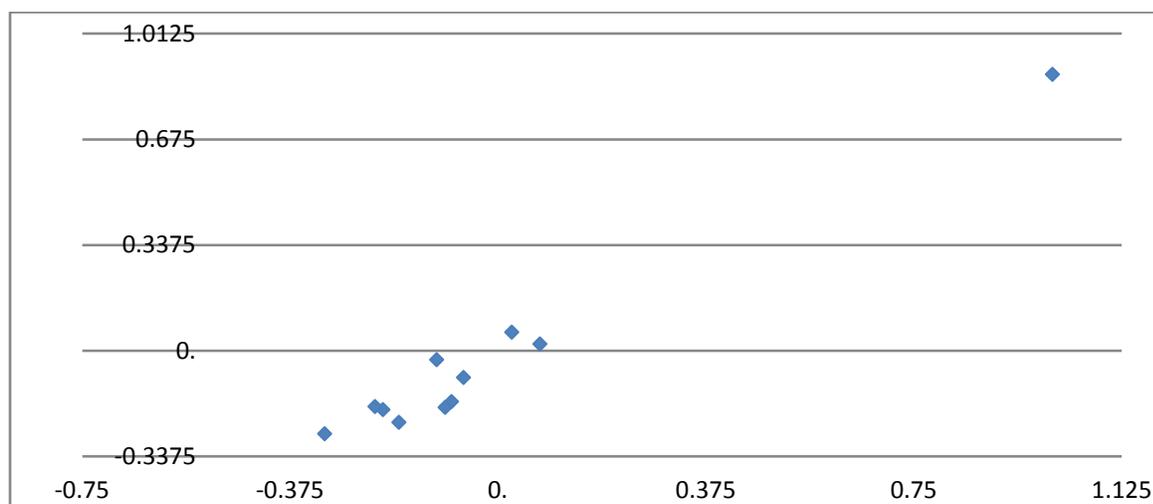
GRAPH 5: ANALYSIS FOR SPECTACLES HAVING WEIGHT > 30 g



The graph clearly shows that none of the 3 spectacles weighing above 30 g met any requirement of international standard. 1 spectacle had pad area of 250 mm² but the corresponding contact area was found to be 200mm² which shows no significance. Also, it can be seen that

out of 75 people, there were only 3 who had spectacles weighing above 30 g, which is only 4% of the total study subjects.

The statistical analysis was done and the correlation between the weight of spectacle and the contact area of nose pads with respect to the standard alignment was found out using the Correlation function in excel. The results showed that there is a negative correlation between the pad areas and the other parameters. The graph is shown below.



DISCUSSION

In this study, the method of inking the pad surface and getting impression of it on nose overcomes the drawback of overestimating the pad area in previous study where the technique of mould impression was used. However, the frames used in previous study were metal frames while the frames used in this study were plastic. Choosing correct measurements for parameters becomes a crucial task while dispensing plastic frames because unlike metal frames where the nose pads are adjustable, the bridge and the nose pads in plastic frames are fixed and cannot be adjusted as and when required. Apparently, different methods may generate different results for different frame materials. Hence, indisputable comparison between the results generated for the two different categories of frames would be inapt.

The results in this study showed that with the increasing weight, the chances of misalignment of spectacle on the wearer's face also increase. The two main reasons for the misalignment leading to variable results in area of nose pads and their corresponding contact area were the direct impact of any of the parameter that was outside the normal limits and/or the other rea-

son being the combination of parameters which were under normal limits individually but had a difference of more than 3 degrees on corresponding sides of nose and nose pads (for example: difference of more than 3 degrees between the frontal angle of right side of nose and nose pad). Although, some abnormality was also observed in parameter/s of the spectacles that met the international standard but it was of no clinical significance as the final fit of spectacle wasn't hampered i.e. the standard alignment of the spectacle was achieved.

Only a few frames achieved the pad area recommended by BS EN ISO 12870(BSI 2004, Revised 2016). However, none of the 33 (44%) abnormal subjects had any complains of misalignment of spectacle on their face but an objective finding of red marks of nose pads were found in few of them.^[1]

As per recent article on dispensing in an international magazine, 72% of the lab returns were frame related and 7% were due to incorrect measurements. The suggestions given for right frame selection included non-metal frames that tend to hide edge thickness better, pantoscopic tilt and the sweep of the eye lashes in relation to lens back surface. Furthermore, frame size should be appropriate to the prescription they will be used for, taking likely appearance and weight into consideration.^[4]

Guidelines need to be followed for a spectacle to achieve comfort and bearable weight and proper fit on a wearer's face.

Steps in Standard Alignment and fitting of Frames.^[2]

STEP 1: Horizontal alignment

- a. Check for a rotated lens.
- b. Check for a skewed bridge.

STEP 2: Four-point touch(vertical alignment)

- a. Check for X-ing.
- b. Check for variant planes.

STEP 3: Open temple alignment

- a. Check the temples for the straightness of shaft.
- b. Check for angles of the temples when fully opened for symmetry.

STEP 4: Temple parallelism

- a. Check for bent endpiece.
- b. Check for loose or broken rivets or loose hidden hinge.
- c. Check for bend in the temple shaft.
- d. If none of the above is at fault, the hinge is to be bent.

STEP 5: Alignment for the bent-down portion of the temple

- a. Check for equality of downward bend.
- b. Check for equality of inward bend.

STEP 6: Temple-fold angle

- a. Check for the central crossing of the temple shafts when folded.
- b. Check for a fold that permits the insertion of the spectacles into a standard case.

STEP 7: Pantoscopic angle

- a. Check tilt of lenses from a side view.
- b. Check for straightness of the frame on the face from front view.

STEP 8: Nose pads or bridge area

- a. Adjust the frame for proper height when necessary.
- b. Adjust the frame for proper vertex distance when necessary.
- c. Adjust the nose pads for maximum surface contact.

Limitations of the study:

Frames studied were taken randomly.

The weight was measured with the lens intact.

No individual lens measurements such as thickness, density, weight, etc. were taken into consideration but overall weight of the spectacle was measured.

CONCLUSION

Difference of 50mm² of area between contact area and area of nose pads is acceptable with current trend of frames.

Current trend of light weight frames and lenses has given ease to alignment as even misalignment does not result into marks.

Contact area corresponding with the area of nose pad play a significant role in distribution of spectacle weight on nose.

Mismatch between contact area and area of nose pads will result into skin marks.

Ideally, a wearer is happy when standard alignment is achieved with respect to facial measurements.

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Conflict of interest: NIL