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Technical Note

The weight of spectacle frames and the area of their nose pads

Glyn Walsh

Department of Vision Sciences, Glasgow Caledonian University, Cowcaddens Road, Glasgow G4 0BA, UK

Abstract

The current international standard for spectacle frames recommends that frames weighing up to 25 g should have a minimum nose-pad contact area of 200 mm^2 and that those weighing over 25 g should have a minimum contact area of 250 mm^2. 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 little difference in weight between stainless steel frames and those from unnamed materials.

Keywords: discomfort, eyeglasses, nose-pads, spectacles, weight

Introduction

BS EN ISO 12870 (BSI, 2004) is the principal International Standard that defines the mechanical and chemical properties of spectacle frames and mounts. This standard includes many formal requirements relating principally to their safety, durability and stability. However, at the end of the document is an 'informative' section, Annex A, which gives several non-binding recommendations for spectacle frame designs. The standard indicates that frames weighing up to 25 g should have a minimum nose-pad contact area of 200 mm^2 and that those weighing over 25 g should have a minimum contact area of 250 mm^2 but, as is the case for most such standards, does not indicate the sources of this advice.

A red patch on the nose where the nose-pads sit is a common clinical observation, and considerable associated discomfort is not uncommon. It could therefore be argued that if a frame does not follow even the minimum recommendations in the Standards, that fashion may be outweighing practicality, comfort and safety at the frame design stage. On many frame, and more particularly mount (rimless, supra etc.) designs, small round pads are becoming the norm, and these are clearly smaller than the minimum advised. However, for a high proportion of frames it is less clear if the pads are smaller than the ISO recommendation. There are no published, quantitative data available on either the bearing area or the weight of spectacle frames published to date. The aim of this study was therefore to fill this gap and also to determine both how much information is readily available on the materials from which frames are made, and if there is any real difference in weight between typical ophthalmic practice selections of frames from different metals.

Materials and methods

All the adult metal frame stock of the Glasgow Caledonian University Eye Clinic (GCU) displayed on a single day was measured (155 frames). Rimless and supra mounts were excluded. Of these, six were 'safety' frames with side-shields. Only a single size of each frame was measured, this being the first encountered when working sequentially through the displays. Display lenses were removed and the frames and display lenses weighed using an electronic scale, ± 0.01 g. The display lens thickness was also recorded using vernier lens

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Correspondence and reprint requests to: Glyn Walsh.
Tel.: 0141 331 3375; Fax: 0141 331 3387.
E-mail address: gwa@gcal.ac.uk

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thickness callipers ±0.1 mm. Moulds were then taken of one pad of each frame using flexible modelling material (Newplast®, Newclay Products Ltd., Newton Abbot, Devon). The frames included both budget and 'designer labels'. Where the information was available from the importers' catalogues and websites, or was marked on the frame, the type of metal from which it was claimed the frame was made was also recorded.

The moulds were placed on a digital scanner and scanned at 400 dpi. They were then turned through 180° and a second scan made. This proved necessary because of the shadowing effects from the depressed mould. The scans were then imported into Adobe Illustrator and the pad outline copied, using the clearer part of each original image, and filled in black. These images were in turn imported into Adobe Photoshop and the black area highlighted with the magic wand tool. From this the number of pixels can be obtained directly using the histogram function. A sheet of graph paper (180 × 280 mm) was treated similarly, enabling the pixel figure to be converted to mm^2. This process was reproducible ±5% for the pads, ±0.01% for the, much larger, paper scale.

Results

Nine frames (5.8%) had a total pad area of 200 mm^2 or greater. Of the five frames weighing over 25 g, only two safety frames achieved 250 mm^2.

Both the weight of the frames and the pad areas were normally distributed. The mean weight was 16.09 g (S.D. 4.49 g; range 7.01–29.66 g) and mean pad area was 80.94 mm^2 (S.D. 12.77 mm^2; range 56.2–129.5 mm^2) for single pads. There was no correlation between frame weight and pad area (*Figure 1*).

Manufacturers' display lenses (which were present in 145 of the frames) had thicknesses which were found to vary between 0.8 and 1.5 mm. These were not consistent for a single importer, or even within a single frame range from that importer. Display lens weight was normally distributed with a mean of 3.23 g (S.D. 0.60; range 1.77–4.97).

Very little information was available on any of the materials from which the frames were made. Twenty-three were indicated to be of 'stainless steel', two of 'memory metal', and there was no indication for the remaining 130 (83.9%). There was no information on the plastic components of any of the frames or on any metals present other that what was deemed the principal (marketable?) one. The mean weight for stainless steel frames was very similar (15.35 g) to that of the ones for which no indication of material was obtained (16.03 g). This difference was lower (mean weight 15.89 g) when safety spectacles, all of which were made from unnamed materials, were excluded. Ten of the frames in the sample could not be found in current on-line or paper/cd-rom catalogues from within the last year. Of these four were from a company that has neither on-line nor hard copy catalogues, and the remaining six were known to have been in stock for over a year.

Discussion

The method used here overestimates the pad area, as an impressed mould includes the side profile in the measured area. Other methods such as inking the pad surface and making a print from it would have given a smaller area. However, as the frames used were the stock of a working clinic, this was not an option. The impression method should give a fair estimate of the

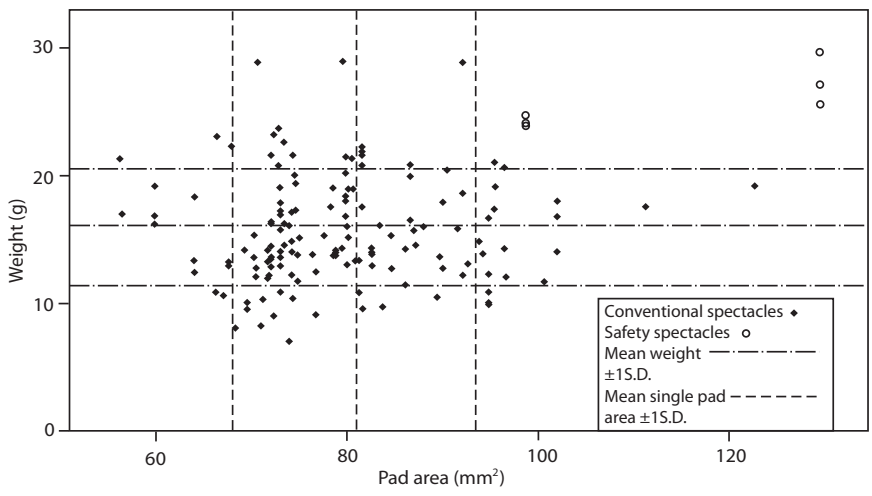

Figure 1. The relationship between the pad area of a metal frame and its weight. Mean pad area and weight are indicated. There is no relationship between these parameters.

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pad area in contact on a relatively fleshy nose or with heavy lenses. A direct comparison with the stock of other practices was not possible, but GCU does not have a high proportion of very expensive designer label frames. The majority of adult patients are elderly, from the less affluent parts of Glasgow, or students and staff of the University itself. However, the designer label-type frames (approximately 15% of the stock) included varied almost as widely as the lower priced models in both weight and pad area.

Very few frames achieved the pad area recommended by BS EN ISO 12870 (BSI, 2004). It is possible that the large pad areas recommended in the Standard would not be accepted cosmetically, although there is no published evidence to support such a belief. However if the assumption is made that the standard has some underlying evidence to support it and is not a typographical error, it is alarming that the pads on commercially produced frames are so small. If there is no data to support the advice of BS EN ISO 12870 (BSI, 2004), then steps should be taken by the industry to determine how the area of the pad affects user satisfaction and frame safety, and the results of this work made public. Given the historical track record of the spectacle industry in generating such data (Walsh, 2009), this is an unlikely scenario without concerns being raised by the professions, public and – ideally – the Medicine and Healthcare Products Regulatory Agency.

As there was no information on the material for some 84% of the frames, a similar result to an earlier and more detailed investigation (Walsh *et al.*, 1991), and stylistic factors are very significant, no firm conclusions could be drawn about the relative weights. However, a mean difference of 0.64 g (4.03%) between stainless steel and unnamed materials is strongly suggestive that frames made from stainless steel are not significantly lighter than the more frequently used copper-nickel alloys and is almost the same as the standard deviation of the dummy lens weight (0.60 g). The densities of the two classes of materials are very similar, with that of copper-nickel alloys being typically about 12% higher, suggesting that the stainless steel frames may have had thicker components or that titanium or other light metals may have been included in the unnamed category. The latter scenario is unlikely, as such alloys are a saleable parameter and can command a higher price.

There were no frames in stock indicated as being from titanium or titanium alloy. This was rather unexpected and could have been a result of the time the sample was taken, which was just before both Christmas and an annual stock-take and more expensive stock frames are purchased singly and are likely not to have been replaced in the preceding few weeks.

There is no simple 'rule of thumb' for estimating lens weight (e.g. Spiegler, 1982; Obstfeld, 1991; Tang, 1990; 1995). However, volumetric calculations are often carried out on practice computer systems to give an accurate answer so far as available data permits. No similar predictions have been previously made for spectacle frames and the data presented here show that no prediction of frame weight can be made from the information available to the practitioner, other than weighing or making a direct comparison of empty frames. As rimless and supra mounts were excluded, there is no obvious reason for the variation in display lens thickness, and standardisation of this would make the practitioner's life easier.

Conclusions

The advice on pad size in the current International Standard is being widely ignored. Data on acceptable pad size for both comfort and safety are needed.

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