The influence of maxillary central incisor height-to-width ratio on perceived smile aesthetics

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VERIFIABLE CPD PAPER

IN BRIEF

- Highlights differences in perception of dental aesthetics between dentists, technicians and patients.
- Stresses that patients are generally less concerned about dental appearance than dentists or technicians.
- Suggests 82% is the most attractive width-to-height ratio for normal central incisors for the majority of patients.

RESEARCH

Objective To determine the influence of varying the width-to-height ratio of maxillary central incisors on perceived smile aesthetics. **Design** Cross-sectional study. **Setting** Postgraduate dental teaching hospital. **Methods** A posed female smile was digitally modified using Adobe Photoshop®. Three images were created; central incisors with normal form, tooth wear and delayed apical migration. For each image the length of the teeth was altered to create a set of nine images with normal form (66% to 96% width-to-height ratios), and sets of five images with tooth wear and with delayed apical migration (78% to 96% ratios). The images in each set were ranked in order of most to least attractive by 32 dentists, 32 technicians and 32 patients. **Results** An 82% width-to-height ratio was perceived as the most attractive for normal central incisors although there is variability in the responses. There is a definite trend towards the extremes of very long or very short teeth being less attractive. The very long central incisors, and those with tooth wear were perceived as unattractive. The patients rated fewer images from the tooth wear and delayed apical migration sets as unattractive compared to the dentists and technicians. **Conclusion** The width-to-height ratios perceived as most attractive correspond with the higher end of ideal ratios proposed in the dental literature (75-80% width-to-height ratio). Significant differences exist between the aesthetic perceptions of dentists, technicians and patients and there is lack of agreement within each group, in particular within the patient group. The individual variability in patient response should be taken into account during treatment planning.

INTRODUCTION

The maxillary central incisors are the most dominant teeth in the smile and are commonly the most visible on smiling. Patients are becoming increasingly aware of their dental appearance and, for many, aesthetic concerns have become one of the primary reasons for seeking dental treatment. Treatment that restores masticatory function and treats active disease, without the achievement of aesthetic ideals, is often not considered to be a complete success and can give rise to dissatisfaction with treatment.[1]

Shaw *et al.* found that the social attractiveness of young adults could be influenced by their dento-facial appearance.[2] The perception of 800 young people towards photographs of standardised faces with the exception of different versions of dento-facial arrangements, such as normal, prominent or severely crowded incisors, or cleft lip, were assessed and the attractiveness recorded on a visual analogue scale. For the majority of characteristics examined, the normal incisor relationship gained the most favourable ratings for perceived friendliness, social class, popularity and intelligence.[2]

Understanding aesthetic perception of altered central incisor ratio is important for treatment planning, and knowledge of the ideal width-to-height ratio can facilitate decision making and provide guidance for achieving an aesthetic result. For example, when central incisors are missing, the width available can be measured and the most appropriate height calculated for optimal aesthetics. Also the central incisors may be affected by tooth wear with loss of vertical height and knowledge of ideal height for a given width would help with restorative, and sometimes orthodontic, planning.

Central incisor width-to-height ratios of 0.76,[3] 0.78[4] and 0.86[5] have been found in studies of clinical crowns of human teeth. The last figure is calculated from clinical crown measurements using dental casts and is therefore not comparable with the first two ratios which are calculated from anatomical crown measurements.

Little is known or has been scientifically proven about the ideal aesthetic width-to-height ratio of central incisors.[6,7,8] How the aesthetic perception of the central incisor ratio varies between dentists, dental technicians and patients is also unknown.

The aim of this study was to assess central incisor width-to-height ratios perceived

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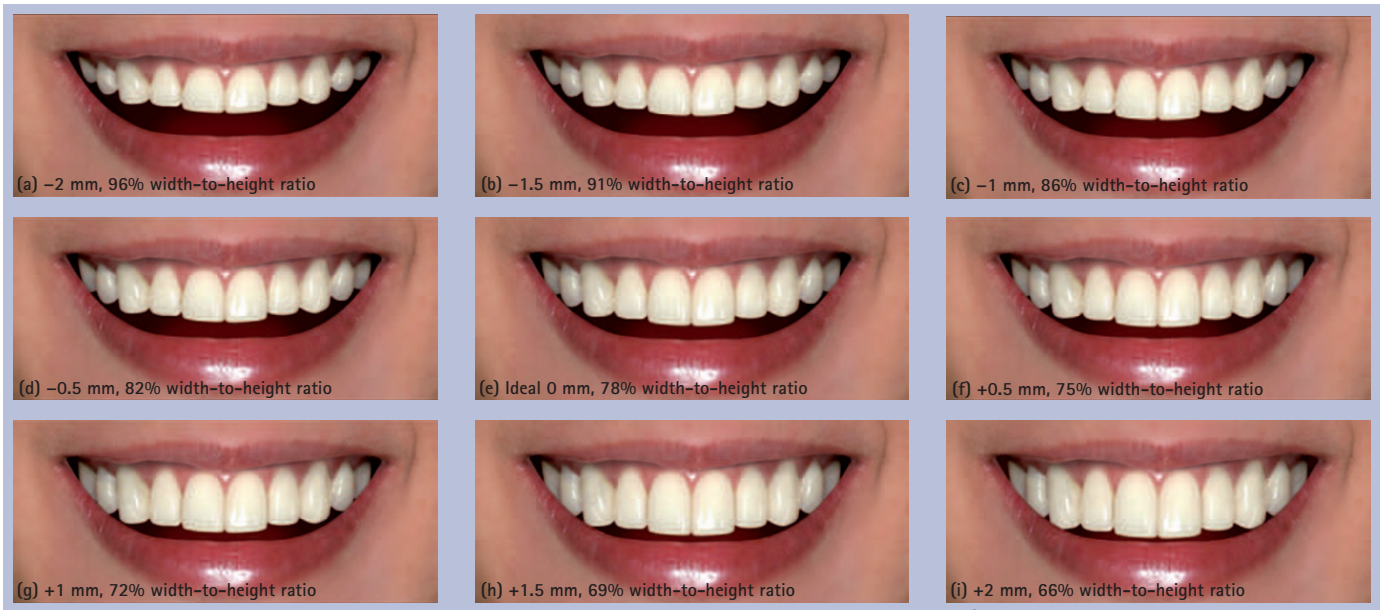
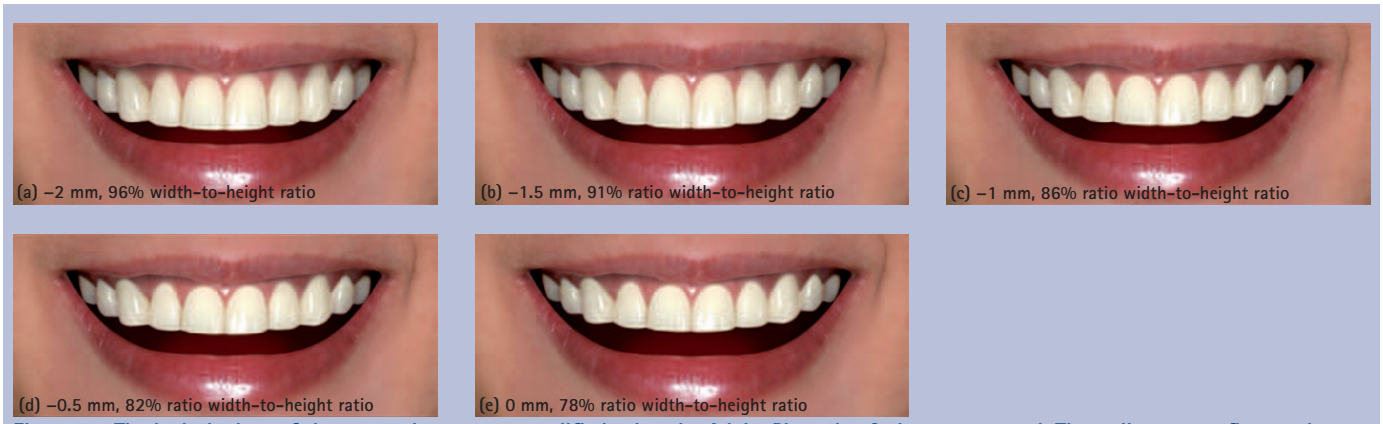
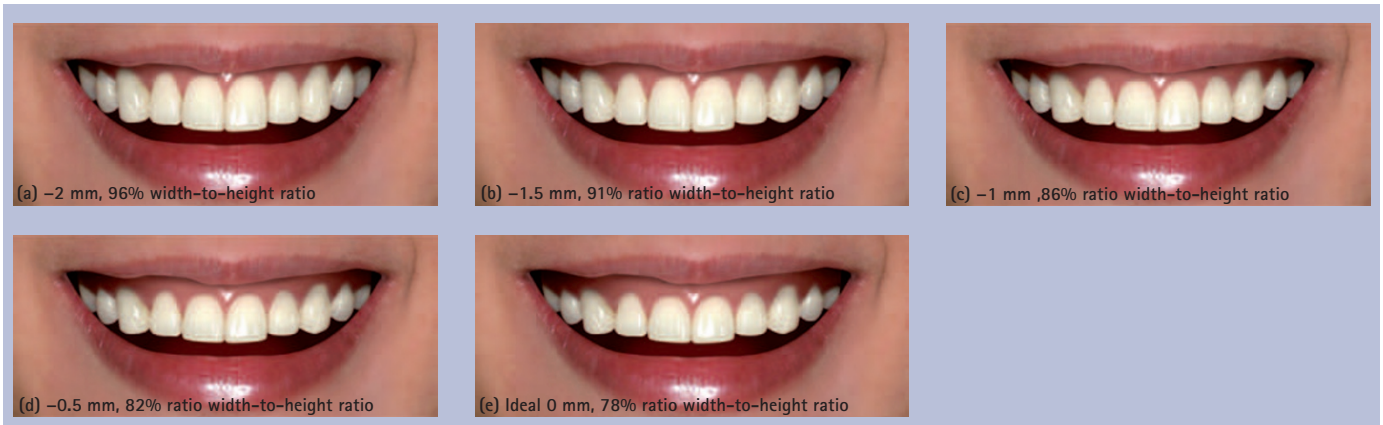


Figs 1a–i The first set of images were created by using the Adobe Photoshop® measuring tool to increase/decrease the teeth to the planned length. Nine variations of the master image with the height of the central incisors adjusted in 0.5 mm increments. The 'ideal width-to-height ratio' master image is (e)



Figs 2a–e The incisal edges of the master image were modified using the Adobe Photoshop® clone stamp tool. The smile arc was flattened, the interincisal difference was reduced by making the level of all the anterior teeth similar, and the embrasures were filled in. This image was modified to the range of width-to-height ratios with the same method as for set 1. Five variations of the master image were created with the height of the central incisors adjusted in 0.5 mm increments. The central incisor height was only reduced from 11 mm in 0.5 mm increments and not increased in height



Figs 3a–e The gingivae were cut out using the Adobe Photoshop® lasoo tool. This created an additional layer which could be moved independently over the master image to create a series of images. The gingival coverage of the crowns was increased to the required amount that maintained the planned width-to-height ratios of the central incisors. The incisal edges were not altered. Five variations of the master image were created with the height of the central incisors adjusted in 0.5 mm increments. The central incisor height was only reduced from 11 mm in 0.5 mm increments and not increased in height

as attractive and unattractive by dentists, technicians and patients in order to provide guidance on creation of tooth proportion for upper incisors where treatment is indicated.

MATERIALS AND METHOD

Computer software (Adobe Photoshop® 9.0 CS2 software; Adobe Systems Inc, San Jose, CA) was used to digitally manipulate a photograph of a female posed smile that was voluntary and unstrained. The image showed only the smiling lips and was digitally modified to remove the mandibular teeth and create aesthetic 'ideals' as previously proposed within the dental literature. The master image was used for all further digital modifications used in the study. This methodology of manipulating a photograph of the same female posed smile was previously reported by Foulger *et al.*[9]

To create the images used in the study, all aspects, including the central incisor width, were kept constant, and only the height was varied and manipulated to produce three sets of photographs with 0.5 mm height alterations (Figs 1-3). The images produced ranged from height alterations of –2 to +2 mm, creating width to height ratios of 96 to 66%.

The three sets of 7 × 5 inch gloss photographs were presented to the participants with black superior and inferior borders. A unique symbol on the reverse prevented interpretation or recognition of an order if a participant inadvertently saw this and was used with its corresponding code for data collection.

Ninety-six participants, each aged 26 years or older were enrolled into the study. Overall 51 females and 45 males were recruited. Thirty-two patients that were attending the prosthodontic department for a new patient clinic or scheduled treatment (11 males, 21 females) took part voluntarily and were unpaid, along with 32 dentists who were prosthodontic department staff or postgraduate students (equal number of males and females) and 32 prosthodontic technicians who were staff or students (18 males, 14 females). Ethical approval for the study was obtained from the joint UCL/UCLH committees on the ethics of human research (Committee Alpha).

Participants were presented with each of the three sets of randomly shuffled photographs and ranked them in order of least to most attractive. For each set, it was asked whether there were any images that were felt unattractive. Throughout the interview, the specific dental features that were under investigation were not revealed to the participants, nor was there a time limit.

To test reliability of the data collected, participants were asked to repeat the order of attractiveness ranking for the same three sets of images. This was performed after a minimum wash out period of ten minutes. Cohen's kappa values were calculated to assess the level of agreement between the participant's first ranking and repeat ranking for the most attractive and least attractive image in each set.

Data was analysed using SPSS software for Windows (version 14.0; SPSS Inc,

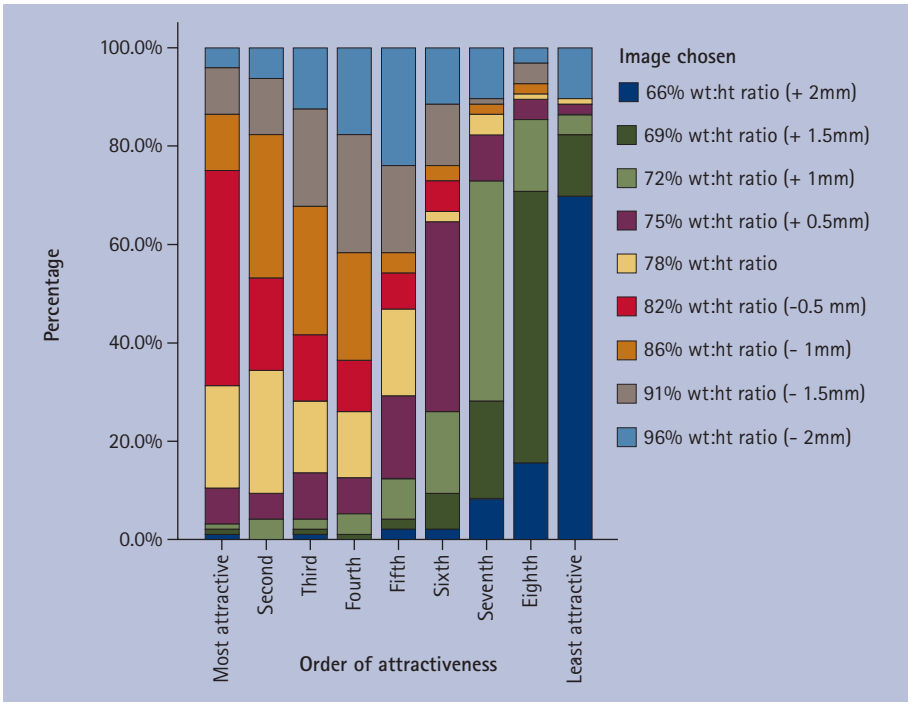


Fig. 4 Order of attractiveness of modified width-to-height ratio of central incisors (normal form) – all groups combined

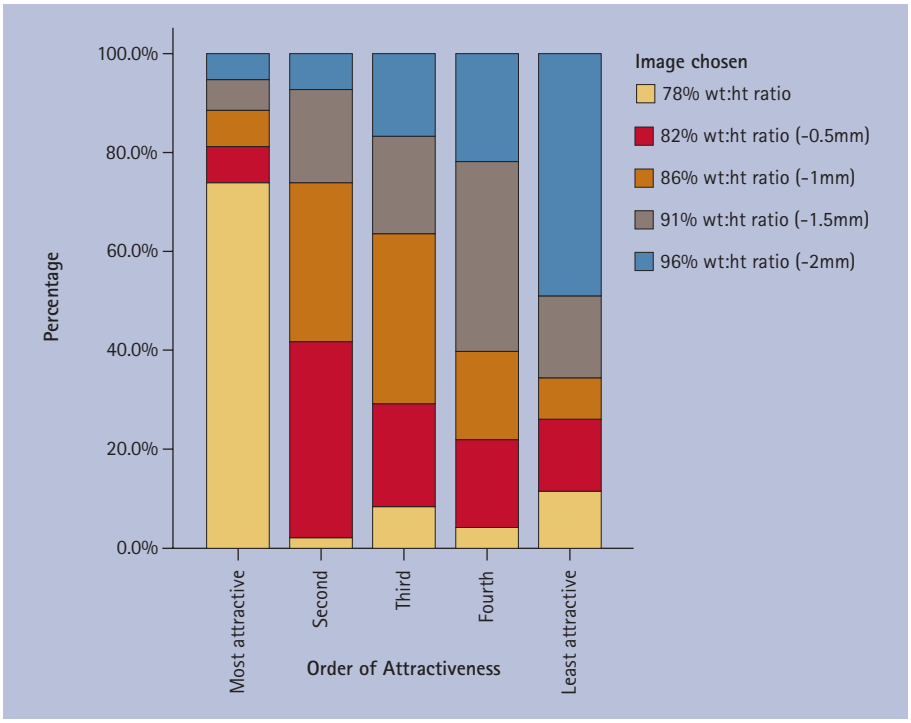


Fig. 5 Order of attractiveness of modified width-to-height ratio of central incisors (tooth wear) – all groups combined

Chicago, Illinois, USA). The level of significance was set at 5%. Fisher's exact test for independent samples was used to identify if a statistically significant difference existed collectively between participants' choice from each set, and if significant, it was used to determine between which groups this difference occurred. Pearson's chi-squared test was used to determine if there was a statistically significant difference in the gender distribution between the participant groups, and a Kruskal-Wallis test to determine if there was a statistically significant difference between the median ages.

RESULTS

Level of agreement between participants' selection/reliability

The Cohen's kappa agreement of all participants for the most attractive image and for the least attractive image was reasonable agreement (Cohen's kappa = 0.503 and 0.592 respectively).

For the dentist group, Cohen's kappa agreement was reasonable (0.592) for the most attractive selection and dentists were more similar in their repeat ordering of their least attractive choice, with Cohen's kappa indicating substantial agreement (0.722).

Technicians exhibited reasonable Cohen's kappa agreement for their most and least attractive selections (0.582 and 0.584 respectively). The patient group had moderate agreement (0.328) for their most attractive choice and reasonable agreement for their least attractive choice (0.475).

Order of attractiveness and most and least attractive selection

For each of the sets of images, the majority of participants perceived the 82% or 78% central incisor width-to-height ratios as the most attractive. The 82% width-to-height ratio for the central incisors with normal form was chosen by 43.8% of participants (Fig. 4), and the 78% ratio for both the central incisors with tooth wear, chosen by 74% of participants (Fig. 5), and for the central incisors with delayed apical migration, chosen by 31.3% of participants (Fig. 6).

The longest central incisors, 66% width-to-height ratio, were perceived as the least attractive by the majority of participants (69.8% of participants), the image with the most tooth wear, 96% ratio, was considered least attractive by the majority of participants, (49% of participants) and the image with the most delayed apical migration, 96% ratio, was considered least attractive by the majority of participants, (64.6% of participants).

Within each set of images, there was more agreement in the choices for the least attractive, than in the agreement for the most attractive images.

In the set of central incisors with normal form, there was a definite trend in ordering as less attractive, as the two extremes of longer central incisors and shorter central incisors were approached. Participants overwhelmingly ranked the longest central incisors as less attractive than the shorter extremes. For the sets representing tooth wear and delayed apical migration, as the central incisors became shorter, the images were progressively perceived as less attractive, and those that displayed the greatest tooth wear or the most gingival coverage

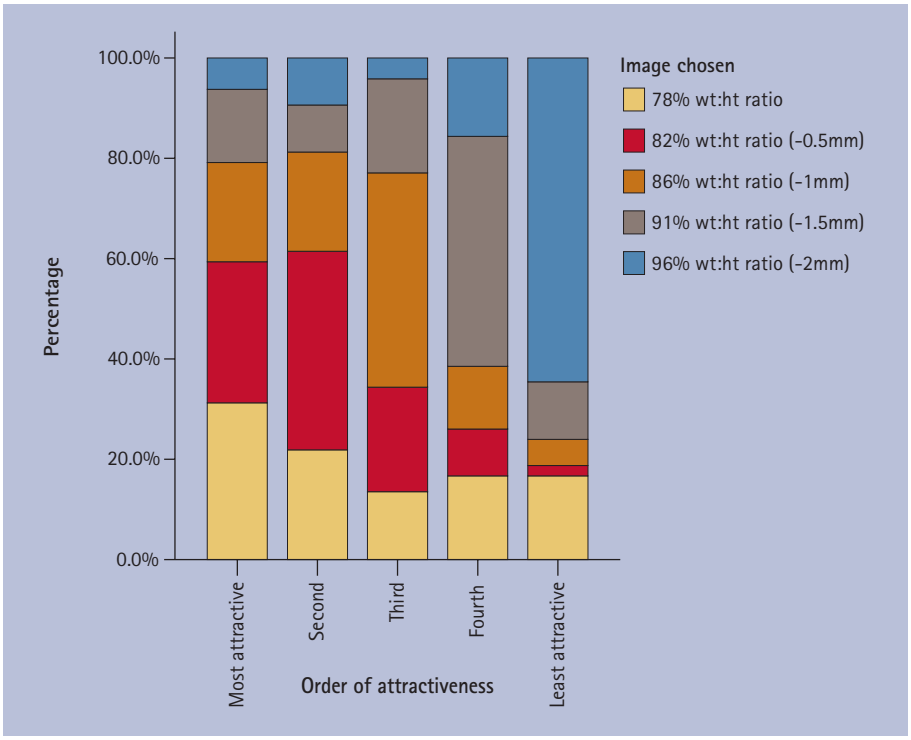
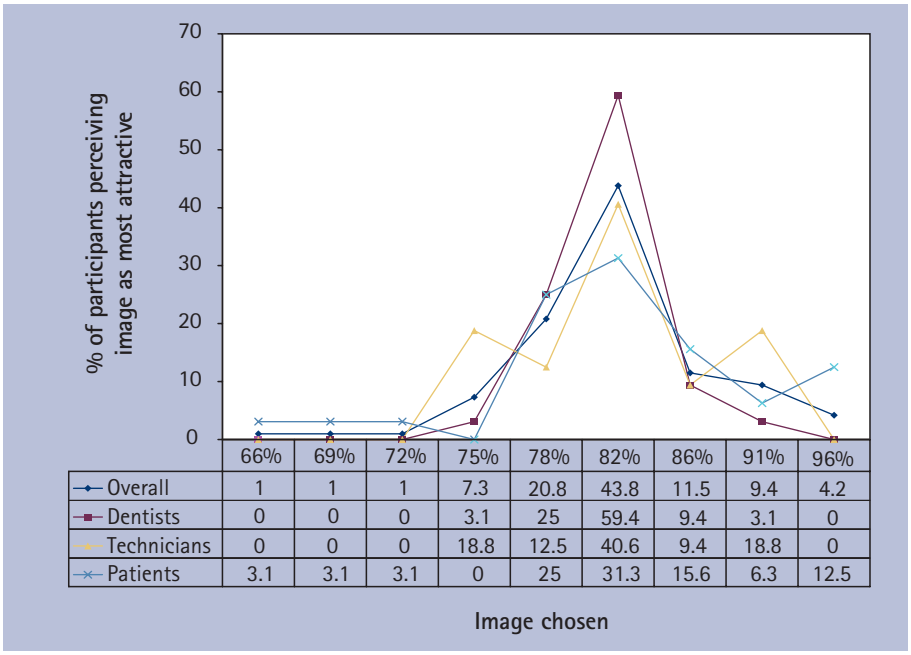


Fig. 6 Order of attractiveness of modified width-to-height ratio of central incisors (delayed apical migration) – all groups combined



	66%	69%	72%	75%	78%	82%	86%	91%	96%
Overall	1	1	1	7.3	20.8	43.8	11.5	9.4	4.2
Dentists	0	0	0	3.1	25	59.4	9.4	3.1	0
Technicians	0	0	0	18.8	12.5	40.6	9.4	18.8	0
Patients	3.1	3.1	3.1	0	25	31.3	15.6	6.3	12.5

Fig. 7 Perception of most attractive width-to-height ratio of central incisors (normal form)

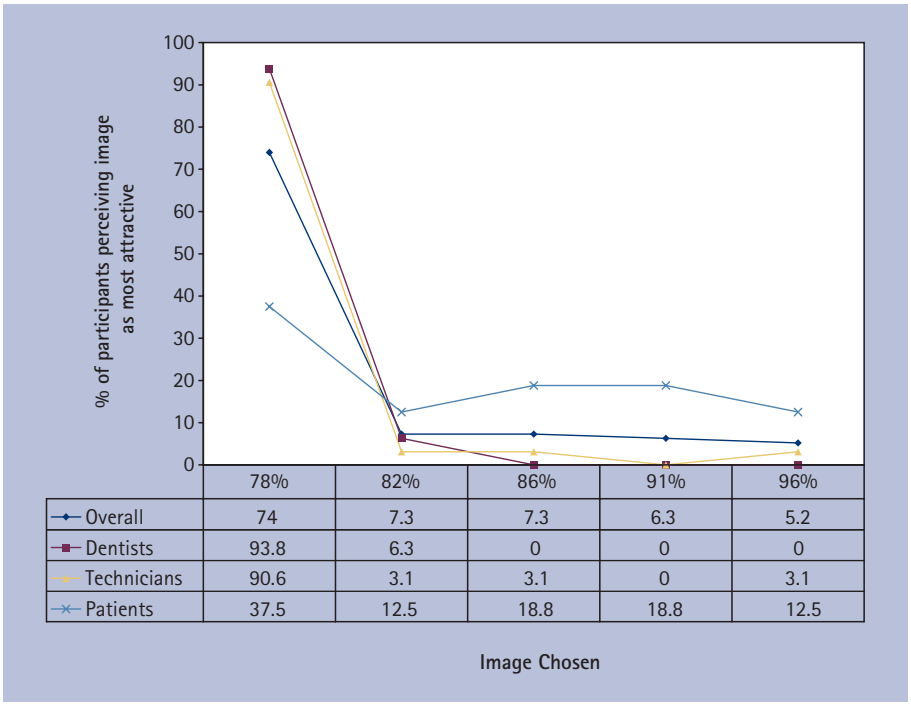


Fig. 8 Perception of most attractive width-to-height ratio of central incisors (tooth wear)

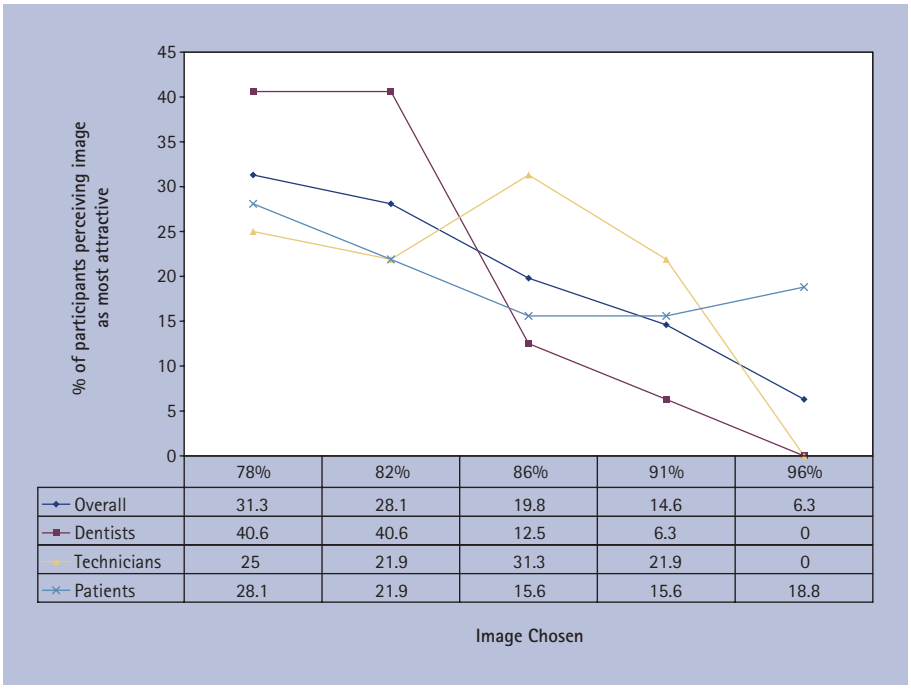


Fig. 9 Perception of most attractive width-to-height ratio of central incisors (delayed apical migration)

were perceived as the least attractive by the majority of participants.

Differences in perception between participant groups

Statistical analysis using Pearson's chi-squared test showed that gender distribution between the groups did not differ significantly. A Pearson's chi-squared value of 3.26 with 2 degrees of freedom gave p = 0.233. A Kruskal-Wallis test was used to compare the ages between the groups and gave a value of 9.65 and p = 0.08, showing that the difference in median ages was statistically significant at the 1% level.

For each set of images, there was more similarity in the ordering of attractiveness by dentists, with more dentists choosing the same images. Patients had the least similarity, generally choosing the greatest range of ratios for each of their rankings (Figs 7-12).

For the ratio chosen as the most attractive, there was a statistically significant difference between the technicians and the patients' selection from the normal central incisors set (p = 0.03) and from the central incisors with tooth wear (p = 0.01). There was a statistically significant difference between the dentists and patients' selection of the most attractive ratio of central incisors with tooth wear (p = 0.01) and with delayed apical migration (p = 0.04). The difference between the dentists and the technicians' most attractive choice was not statistically significant for any of the sets: normal central incisors (p = 0.16), tooth wear (p = 0.29) and delayed apical migration (p = 0.12).

For the ratio chosen as the least attractive, there was a statistically significant difference between the dentists and the technicians' selection from the central incisors with normal form (p = 0.02), and between the dentists and the patients for the tooth wear set (p = 0.04). For the ratio chosen as least attractive, the difference was not statistically significant between the technicians and patients (p = 0.87), and between the dentists and patients' (p = 0.26) selection for the central incisors with normal form, or between the technicians and patients (p = 0.14), and between the dentists and technicians (p = 0.11) for the central incisors with tooth wear or between any of the groups for the least attractive ratio chosen for the central incisors with delayed apical migration (p = 0.09).

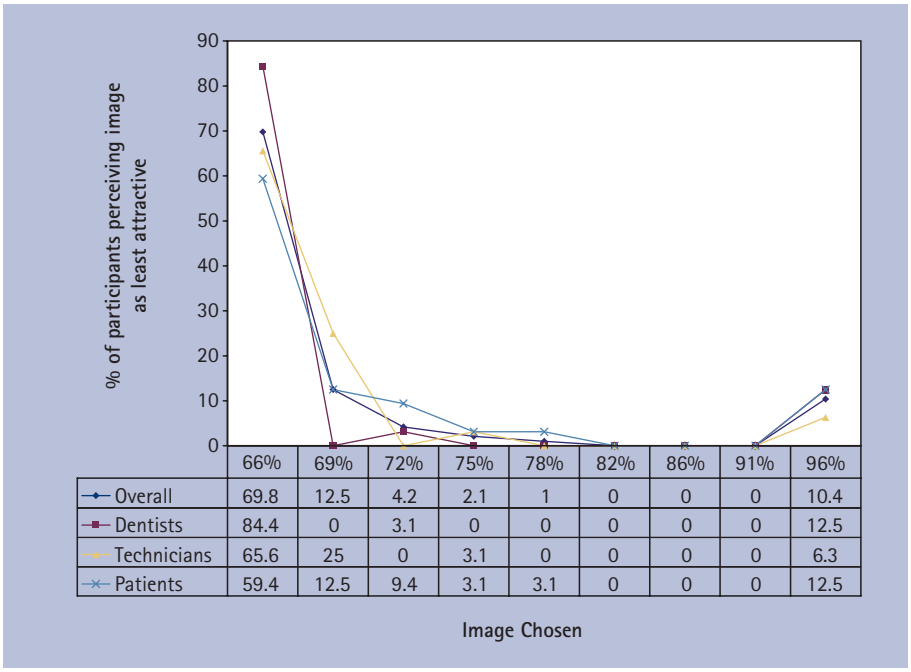
Images perceived as unattractive by different participant groups and differences between the sets

For the central incisors with normal form, as the extremes of length were approached, the images were perceived as unattractive by increasing numbers of participants from each group (Fig. 13). For the sets representing tooth wear and delayed apical migration, as the central incisors became shorter, the images were considered as unattractive by increasing numbers of participants (Figs 14 and 15). An exception was that none of the patients found the delayed apical migration image with 96% width-to-height ratio unattractive (Fig. 15).

Although higher percentages of the dentists and technicians than patients perceived images of the normal central incisors as unattractive, the differences

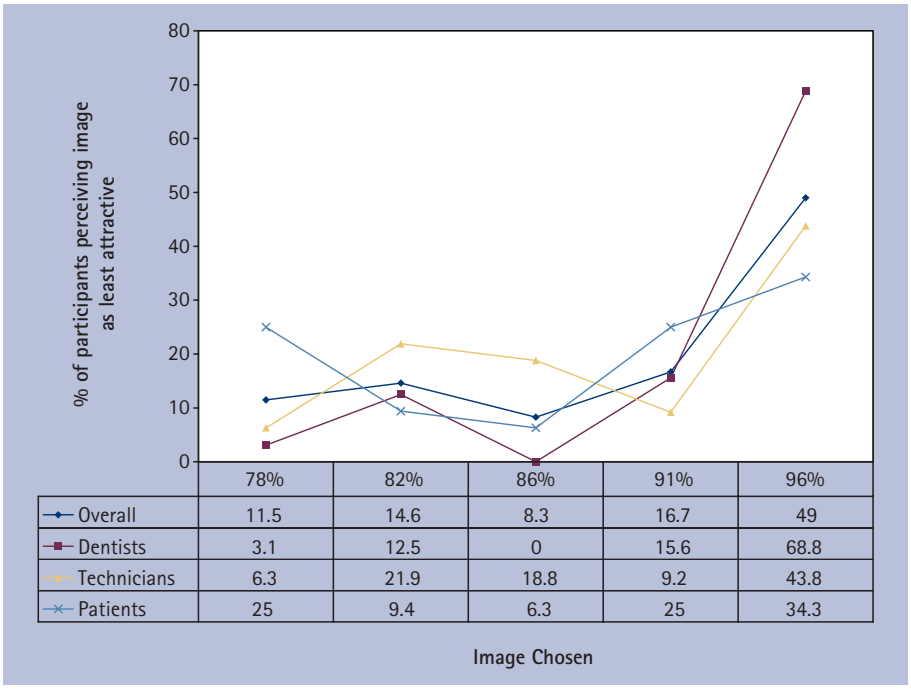
between the groups were not statistically significant (p = 0.17). In the sets representing tooth wear and delayed apical migration, higher percentages of dentists and technicians than of patients judged the images as unattractive. This was a statistically significant difference for the tooth wear images that were perceived as unattractive between the dentists and patients (p = 0.01), and between the technicians and patients (p = 0.02), and in the delayed apical migration images between the dentists and patients (p = 0.04), and between the technicians and patients (p = 0.02). In contrast the difference in perception of images as unattractive between the dentists and technicians was not statistically significant for tooth wear (p = 1.67) nor for delayed apical migration (p = 0.25).

At each width-to-height ratio, 96%, 91%, 86%, and 82%, the images representing tooth wear were perceived as unattractive by a greater percentage of participants than the central incisors with normal form, or with delayed apical migration (Figs 16-19). Similar percentages of participants perceived the central incisors with normal form and the central incisors with delayed apical migration as unattractive. The comparison was not made for 78% ratios because it was exactly the same image in each set. The differences between the 3 sets at each ratio was statistically significant between tooth wear and normal central incisors (p = 0.01) and between tooth wear and delayed apical migration (p = 0.03). The difference was not statistically significant between normal form and delayed apical migration images at each ratio (p = 0.29).



	66%	69%	72%	75%	78%	82%	86%	91%	96%
Overall	69.8	12.5	4.2	2.1	1	0	0	0	10.4
Dentists	84.4	0	3.1	0	0	0	0	0	12.5
Technicians	65.6	25	0	3.1	0	0	0	0	6.3
Patients	59.4	12.5	9.4	3.1	3.1	0	0	0	12.5

Fig. 10 Perception of least attractive width-to-height ratio of central incisors (normal form)



	78%	82%	86%	91%	96%
Overall	11.5	14.6	8.3	16.7	49
Dentists	3.1	12.5	0	15.6	68.8
Technicians	6.3	21.9	18.8	9.2	43.8
Patients	25	9.4	6.3	25	34.3

Fig. 11 Perception of least attractive width-to-height ratio of central incisors (tooth wear)

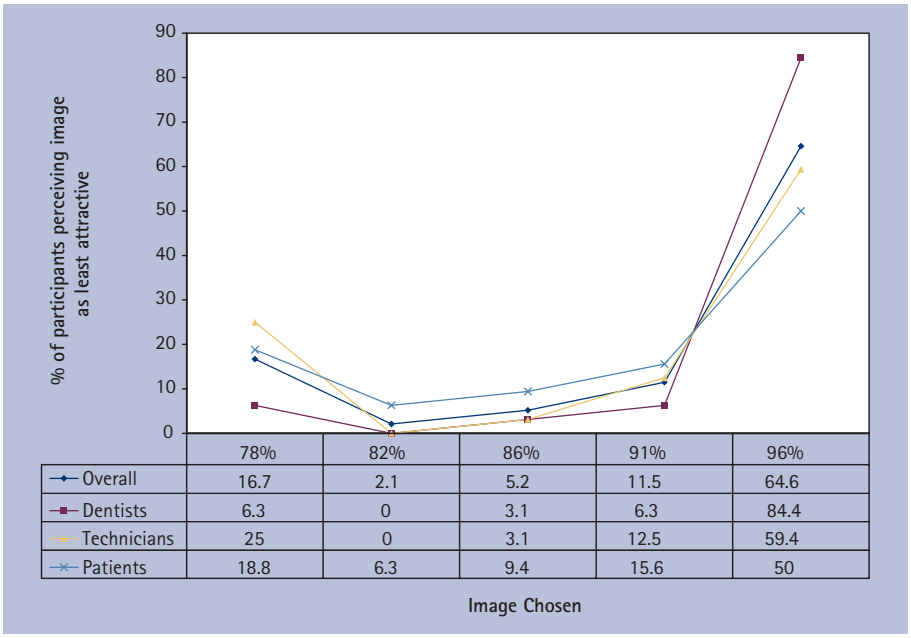
DISCUSSION

Level of agreement between participants selection/reliability

Cohen's kappa was used to assess the reliability of the results and overall showed that there was reasonable agreement for all participants between their first and repeat selection of their most and least attractive image. To have all the groups displaying at least moderate agreement was very good considering the subtle difference between the images (0.5 mm change in length) and therefore, difficulty of the task. This did not vary greatly between the participant groups. The dentists had substantial agreement for their least attractive choice which showed that dentists were the most consistent in choosing the same image. The patient group had a lower Cohen's kappa agreement, moderate agreement, for their most attractive selection, showing they were not as consistent as the dentists and technicians in this choice.

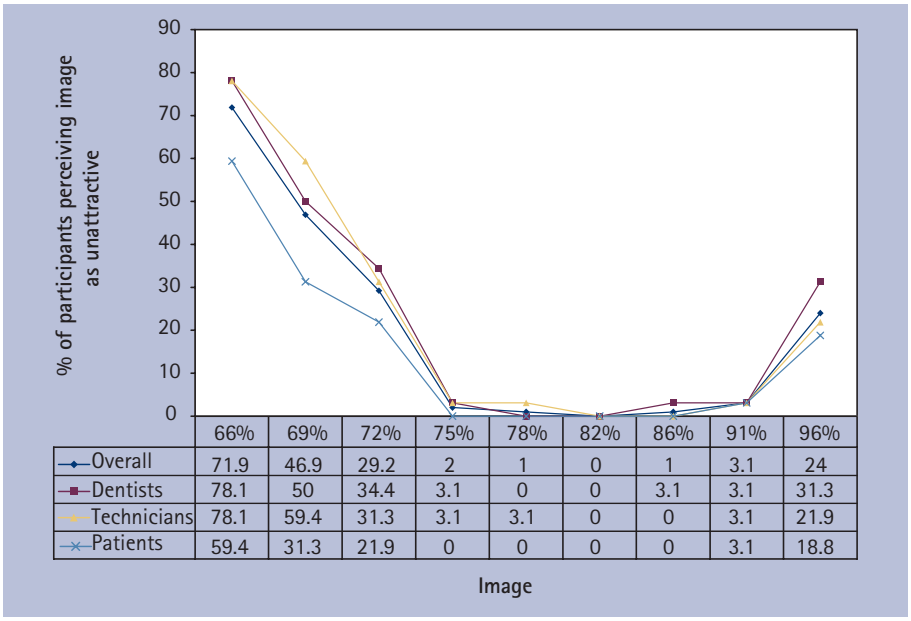
Order of attractiveness and most and least attractive selection

Overall, the normal central incisors with 82% width-to-height ratio were perceived by the majority of participants (43.8%) as more attractive than any other ratio. It is interesting that this image was chosen by over twice as many participants than any other ratio, including the 78% ratio. An 82% width-to-height ratio is higher than the ideal ratios proposed in the dental literature, 80% width-to-height ratio[10,11] and 75-80%[7,12,13,14] width-to-height ratio showing that overall in this study participants favoured shorter teeth relative to the width than has previously been proposed. The results do also show that there



	78%	82%	86%	91%	96%
Overall	16.7	2.1	5.2	11.5	64.6
Dentists	6.3	0	3.1	6.3	84.4
Technicians	25	0	3.1	12.5	59.4
Patients	18.8	6.3	9.4	15.6	50

Fig. 12 Perception of least attractive width-to-height ratio of central incisors (delayed apical migration)



	66%	69%	72%	75%	78%	82%	86%	91%	96%
Overall	71.9	46.9	29.2	2	1	0	1	3.1	24
Dentists	78.1	50	34.4	3.1	0	0	3.1	3.1	31.3
Technicians	78.1	59.4	31.3	3.1	3.1	0	0	3.1	21.9
Patients	59.4	31.3	21.9	0	0	0	0	3.1	18.8

Fig. 13 Percentages of participants that perceived modified width-to-height ratios (66-96%) of central incisors (normal form) as unattractive. Note because each width-to-height ratio was judged as either 'attractive' or 'unattractive', each column is independent and the percentages across each row do not total 100%

was variability in the results with some respondents preferring other ratios. This highlights the important point that one ratio does not necessarily suit all patients and the patients' perception of ideal should always be taken into account. A diagnostic set up is a useful clinical tool for exploring the patients' perception during the treatment planning stages.

For the set representing tooth wear, the 'ideal' 78% ratio was selected as the most attractive by nearly three quarters of all participants; however, this was the only image with unworn incisal edges. It is clear that no tooth wear was considered more attractive than signs of incisal tooth wear. Other than the image displaying no tooth wear, the other images were all chosen by similar numbers of participants (less than 10%) irrespective of the width-to-height ratio. For the delayed apical migration set, similar percentages (approximately one third of participants) chose either the 78% or 82% ratio as most attractive. There was no clear leader, which could be because it was difficult for participants to differentiate between the images in this set.

There was a definite trend in ordering as less attractive, as the two extremes of longer central incisors and shorter central incisors were approached. This shows that participants were overwhelmingly less tolerant of the longest central incisors, tending to rank them as less attractive than the shorter extremes. The very long central incisors were chosen as the least attractive by nearly 70% of all participants. This has interesting implications for patients who have gingival recession due to periodontal disease.

For the tooth wear and delayed apical migration sets, the image sets only had shorter incisors showing more tooth wear/gingival coverage. For these, the shortest teeth, 96% ratio, were chosen as least attractive by at least half of all participants.

These results also show that for each set there was less agreement in the selection of the most attractive images, than for the least attractive images. Participants therefore appeared more certain of what they did not like than what they did like. In all the sets, several different ratios were often judged as the most attractive by high numbers of participants, which suggests that there is not one standard 'ideal' and that individual variability should be taken into account whilst treatment planning.

Differences in perception between participant groups

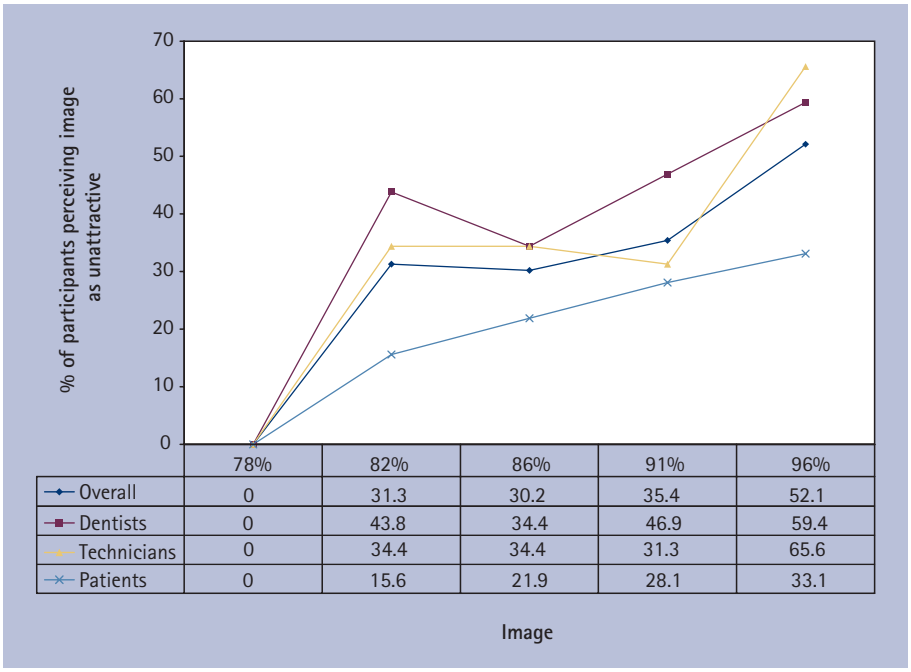
There was more agreement in the ordering of attractiveness by dentists and technicians than patients. A smaller range of width-to-height ratios was chosen by the dentists and technicians for the most and least attractive ranking, which could be explained by their professional dental training, with preconceived ideas of what is normal. The exception to this was the technicians' ordering of the delayed apical migration images where there was considerable variety in rankings. This could have been because the technicians are less used to looking at the gingival tissues and they may have been concentrating on a different aspect in the photographs.

In contrast, there was the least agreement in the patients ordering of attractiveness and the greatest range of images was chosen for each of the ranking positions. In each set the same ratios were often ranked as both the most attractive and the least attractive ratio

by a number of different patients. This was especially noticeable in the sets representing tooth wear and delayed apical migration. The patients had the least agreement in their choices in these sets, perhaps because it was harder to tell the difference between the images, with less difference between the extremes in the five image series, compared to the nine images in the set with central incisors of normal form. For example, in the tooth wear set, the 78% width-to-height ratio was chosen as the most attractive image by nearly three quarters of all participants. This image was the only image with unworn incisal edges. However, although it was chosen as the most attractive by over 90% of both the dentists and the technicians, it was only chosen as the most attractive by 37.5% of the patients. This reinforces that in the tooth wear set, the patients may not have noticed, or were not making their judgements based on the width-to-height ratio, because each of the different ratios were actually perceived as the most attractive by a number of patients.

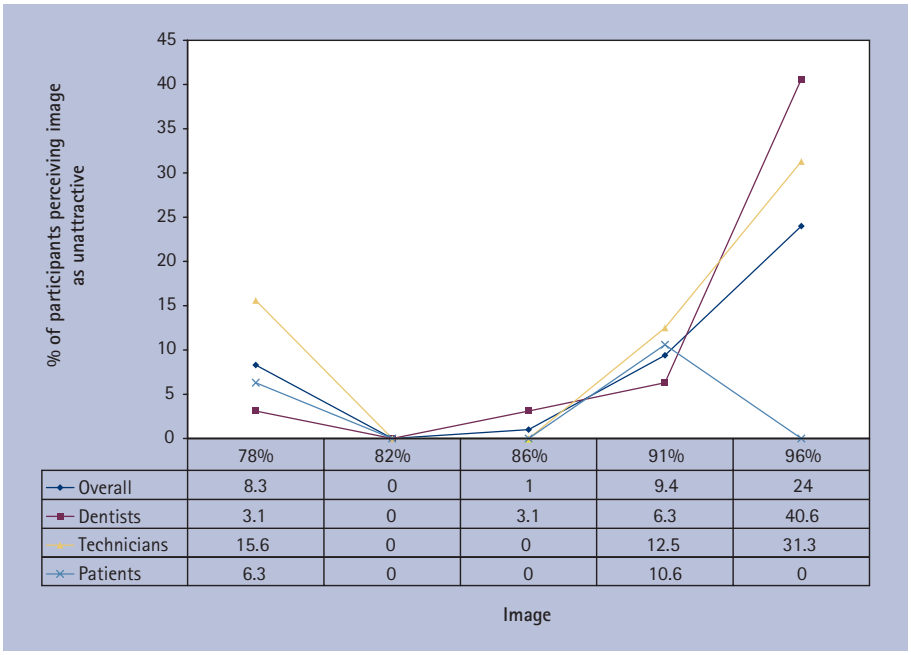
Although remaining very subjective because the ordering of attractiveness is people's opinions, these findings support previous studies[6,8,15,16] showing that dentists are more perceptive than patients to discrete changes in dental appearance. Clinically, dentists should be aware of this and be careful not to heavily impose their own strict criteria of what is aesthetic unless it is a patient concern.

Understanding the difference in perception of dental aesthetics between dentists, technicians and patients will help aid communication between all parties. It will make it more likely that an individual patient has their expectations met, or where unrealistic, that their expectations are addressed from the outset.



	78%	82%	86%	91%	96%
Overall	0	31.3	30.2	35.4	52.1
Dentists	0	43.8	34.4	46.9	59.4
Technicians	0	34.4	34.4	31.3	65.6
Patients	0	15.6	21.9	28.1	33.1

Fig. 14. Percentages of participants that perceived modified width-to-height ratios (78-96%) of central incisor (tooth wear) as unattractive. Note because each width-to-height ratio was judged as either 'attractive' or 'unattractive', each column is independent and the percentages across each row do not total 100%



	78%	82%	86%	91%	96%
Overall	8.3	0	1	9.4	24
Dentists	3.1	0	3.1	6.3	40.6
Technicians	15.6	0	0	12.5	31.3
Patients	6.3	0	0	10.6	0

Fig. 15 Percentages of participants that perceived modified width-to-height ratios (78-96%) of central incisors (delayed apical migration) as unattractive. Note because each width-to-height ratio was judged as either 'attractive' or 'unattractive', each column is independent and the percentages across each row do not total 100%

Images perceived as unattractive by different participant groups and differences between the sets

In general, the images that were ranked as the least attractive were also perceived as unattractive by the greatest number of participants. For the central incisors with normal form, a greater number of participants in each group perceived the images as unattractive as the extremes of length were approached, and for the sets representing tooth wear and delayed apical migration, as the central incisors became shorter, an increasing number of participants in each group tended to consider the images unattractive. In the sets representing tooth wear and delayed apical migration, higher percentages of dentists and technicians than patients were critical of the appearance and judged the images as unattractive.

These findings support those within dental literature,[6,8,15,16] showing dentists are more critical about dental appearance than patients. This study also shows that technicians found more of the images unattractive than patients. If patients are less concerned about dental appearance and have a higher threshold for perceiving images as unattractive, this needs to be appreciated when treatment planning to avoid over treatment.

At each width-to-height ratio (96%, 91%, 86%, 82%), the images representing

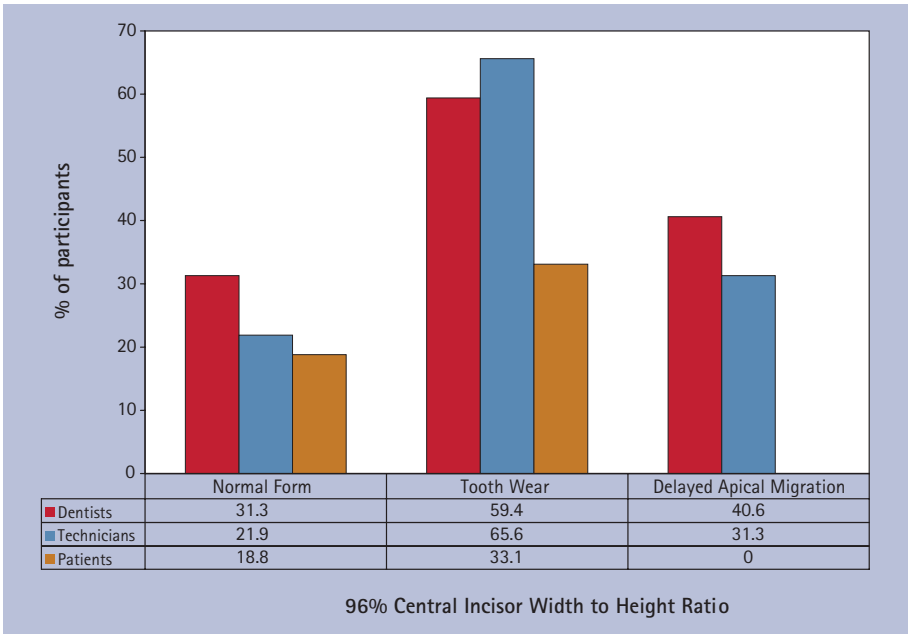


Fig. 16 Percentages of participants by group that perceived 96% central incisors as unattractive. Note because each width-to-height ratio was judged as either 'attractive' or 'unattractive', each column is independent and the percentages across each row do not total 100%

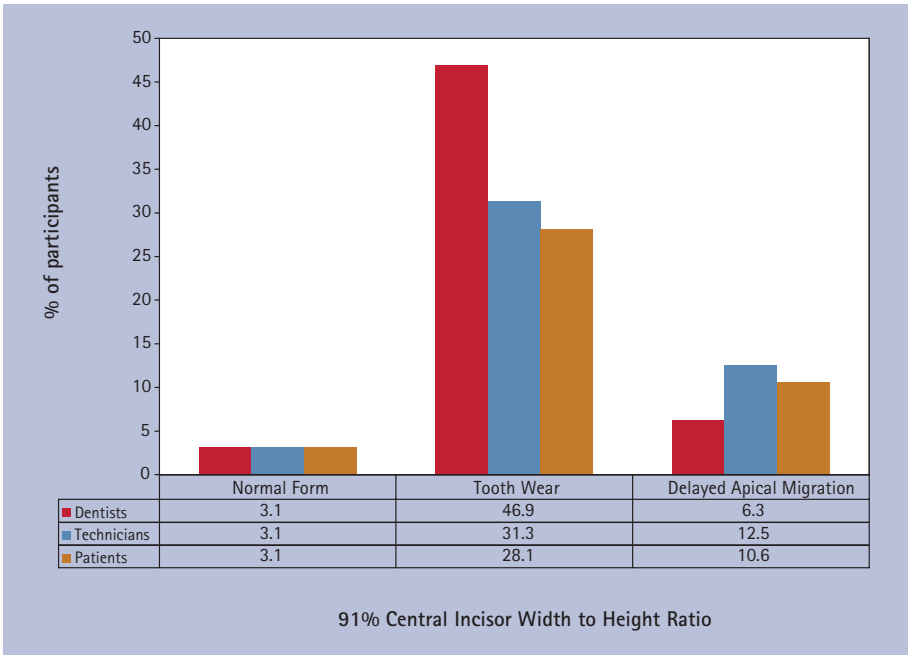


Fig. 17. Percentages of participants by group that perceived 91% central incisors as unattractive. Note because each width-to-height ratio was judged as either 'attractive' or 'unattractive', each column is independent and the percentages across each row do not total 100%

tooth wear were perceived as unattractive by greater numbers of participants than those representing central incisors with normal form or delayed apical migration. The difference in perception of images as unattractive between the sets was statistically significant between normal form and tooth wear ($p = 0.01$) at each ratio, and between tooth wear and delayed apical migration ($p = 0.03$) at each ratio, however, the difference was not statistically significant at any ratio between the normal and delayed apical migration sets. This suggests that tooth wear was more of an aesthetic concern than the same size teeth with normal form, or those appearing shortened as a result of delayed apical migration/altered passive eruption.

Strengths, limitations and suggestions for further research

Pearson's chi squared test showed that the gender distribution between the groups did not differ significantly despite there being six more female than male participants. However, the Kruskall-Wallis test showed that the difference in median ages between the groups was statistically significant ($p = 0.08$), which could have influenced the results, for example in general, younger patients could be more aesthetically driven, critical and therefore perceive more images as unattractive. It is less likely to have influenced the order of attractiveness. In contrast, older people in general may exhibit more tooth wear and have shorter teeth and they could perhaps favour tooth size which is more similar to their own? There are no studies in the literature that look at the influence of age on the perceived width-to-height ratio of central incisors, which could be an interesting area for further research and to ascertain whether or not people prefer images of teeth that are similar in size to their own.

It is useful to see that the extremes of the image sets were perceived as unattractive by a number of participants, confirming that the images presented covered the range in width-to-height ratios, from attractive to unattractive. However, there is no clear threshold between acceptable and unacceptable height-to-width ratio. If a threshold of treatment need could be established, it could be used to determine when corrective procedures are indicated from an aesthetic perspective and used to provide counselling if intervention is not needed when below the threshold. This could perhaps be achieved by asking subjects whether or not they thought the teeth in question required treatment. However, if a threshold did in fact exist, it may be governed by various factors such as facial profile and the age and sex of the patient.

CONCLUSIONS

Readers should now be aware of an ideal width-to-height ratio of 82% when planning direct or indirect restorations for central incisors. The ideal length can be calculated by multiplying the known width by 1/(0.82). However, the results also suggest that there is not one standard 'ideal' and found that dentists and technicians are more critical than patients of the appearance of, and changes to the width-to-height ratio of the central incisors. Therefore individual variability should be

taken into account when planning treatment. Dentists should fully explore the patients' needs often with the aid of diagnostic wax ups, to avoid over treatment and imposing their own views.

Within the limitations of this study, the following conclusions can be drawn:

- An 82% width-to-height ratio for the central incisors with normal form and 78% ratio for the central incisors with tooth wear or with delayed apical migration were perceived as the most attractive
- The very long incisors and those with the most tooth wear or gingival coverage were perceived as the least attractive
- There was less agreement between participants choice for the most attractive than for the least attractive images
- Dentists had the most agreement in their ordering of attractiveness and patients had the least agreement in their choices
- For the most attractive selection from each set of images, there was a statistically significant difference (p = 0.01) between all of the participant groups
- For the least attractive selection from each set of images, there was a statistically significant difference between the participant groups' selection of the normal form (p = 0.02) and tooth wear (p = 0.01) but not of the delayed apical migration set of images
- There was a statistically significant difference in perception of tooth wear images as unattractive between the dentists and patients (p = 0.03) and between the technicians and patients (p = 0.02), but the difference was not statistically significant between the dentist and technicians (p = 016)
- There was a statistically significant difference in perception of delayed apical migration images as unattractive between the dentists and patients (p = 0.04) and between the technicians and patients (p = 0.02), but the difference was not statistically significant between the dentists and the technicians (p = 0.25)
- For the same height central incisors, the images displaying tooth wear were perceived as more unattractive than those of normal form or with delayed apical migration.

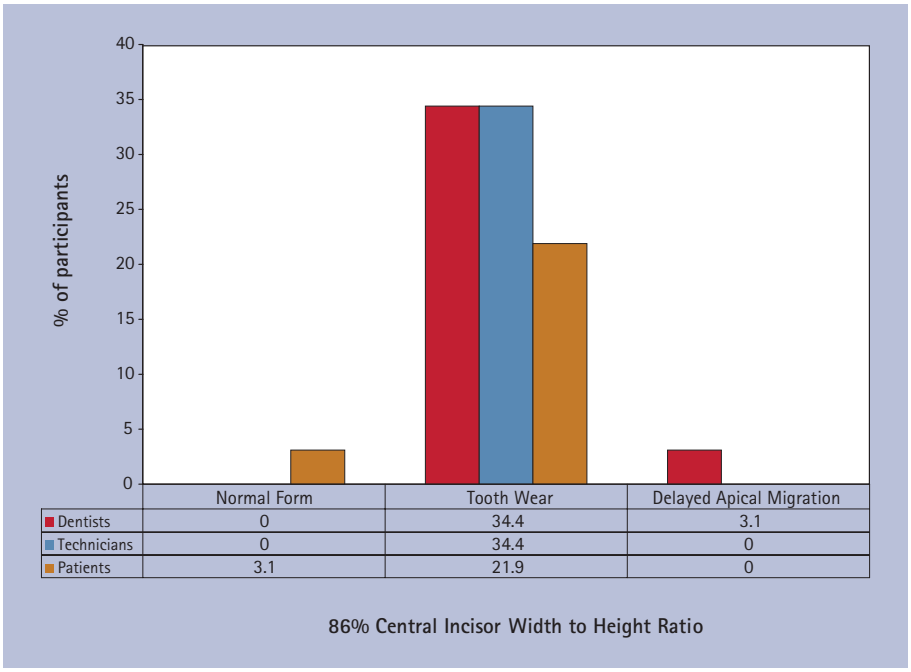


Fig. 18 Percentages of participants by group that perceived 86% central incisors as unattractive. Note because each width-to-height ratio was judged as either 'attractive' or 'unattractive', each column is independent and the percentages across each row do not total 100%

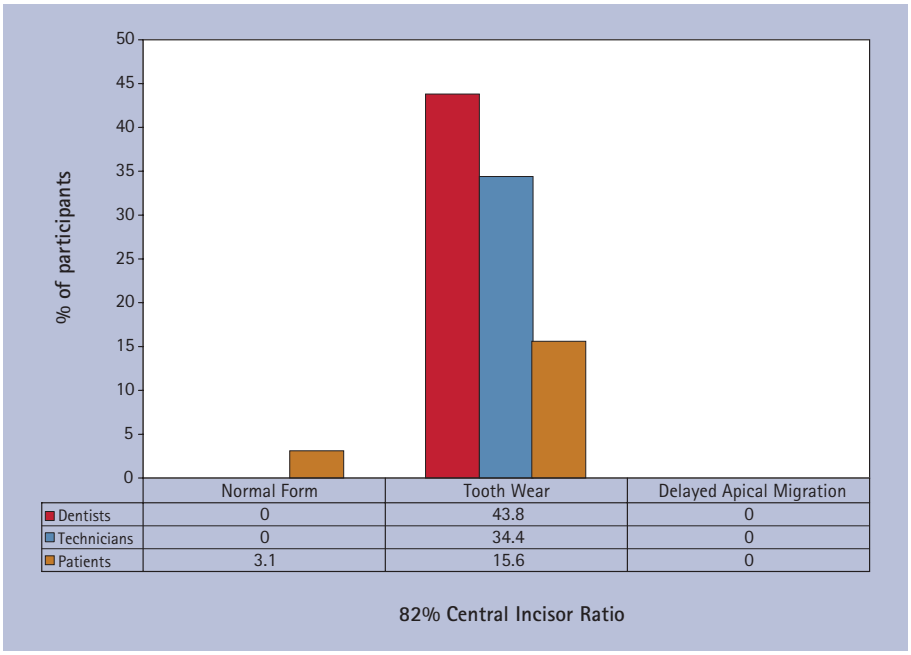


Fig. 19 Percentages of participants by group that perceived 82% central incisors as unattractive. Note because each width-to-height ratio was judged as either 'attractive' or 'unattractive', each column is independent and the percentages across each row do not total 100%

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