

The Choice of Tooth Form for Removable Dentures

Lejla Ibrahimagić¹
Vjekoslav Jerolimov²
Asja Čelebić²

¹Health Centre Zenica, BiH
²Department of Prosthodontics
School of Dental Medicine
University of Zagreb

Summary

Different methods for the choice of artificial teeth for complete dentures are described in this study. The first known theory, based upon Hippocrates division of human temperaments into neurotic, sanguinic, bilial and asthenic types dates from the last century and says that the teeth form should be chosen according to a person's temperament. The temperament theory was replaced by Leon Williams geometric theory (at the beginning of this century) which correlates tooth form and face shape. According to Williams the shape of upper central incisor is in accordance with the shape of the face, i.e., central upper incisor is reduced and rotated facial form. The Williams theory is the most famous theory in the world, which is mentioned in almost all of the textbooks. The first theory after Williams on the choice of artificial teeth for removable dentures was the dentogenic theory of Frush and Fisher, i.e. SPA theory (sex, personality, age). The choice of artificial teeth relied on sex, personality and age, as women have smaller second upper incisors than men, stronger personalities have more pronounced canines and older populations have darker and more abrasive teeth than younger populations, which should be considered during the teeth choice. Other theories are as follows: the theory of aesthetic triangle which correlates tooth shape, face form and residual ridge form; the theory of individual preferences; the theory which recommends the use of old photographs, teeth which are extracted or plaster casts made before extraction, the theory which calculates the width and the length of the central upper incisors from old photographs, etc. However, the importance of the tooth setting and the possibility of reshaping the teeth during setting and contouring of artificial gingiva is also mentioned in the paper.

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Address for correspondence:

Prof. dr. sc. Vjekoslav
Jerolimov
Department for Prosthodontics
School of Dental Medicine
Gundulićeva 5, 10000 Zagreb
Croatia

For a long time the choice of artificial teeth was left to chance. It was dependent on the sets available in dental stores and upon the subjective judgement of the dentist. In the past few centuries, dentists con-

tinually tried to reconstruct and recover the function of chewing, while aesthetics were neglected.

Probably the oldest theory for the choice of frontal artificial teeth is the temperamental theory

(1), which was used in the last century, before the theory of Leon William. Patients were divided into sanguinic, lymphatic, neurotic and bilial types, depending on their temperament (2,3). It was believed that certain types of personality could be described by certain physical characteristics. However, problems arose in deciding on whether behaviour is typical or atypical for any of the temperaments. Artificial teeth for a certain temperament were produced in different shapes from different dental factories. The teeth were of varying forms, so that this method had to be characterised as unreliable. Before the temperamental theory was established, the choice of artificial teeth was left to the subjective judgement of each therapist. The dental industry produced a small range of different tooth forms and therefore aesthetic success was always questionable. The temperamental theory was not based upon scientific facts, it was based on Hippocrates philosophy from the 5th century BC, who divided humans into the above mentioned types. The temperamental theory has great historical significance in dentistry, as it was the first theory on the choice of artificial teeth.

The use of the temperamental theory in the past has been mentioned in studies by White in 1884 (4), Flagg in 1986 (5) and Stamoulis in 1966 (6).

The temperamental theory was replaced by William's theory of harmony, i.e. geometric theory, which determines the tooth form according to the face shape. Fenn (7) mentioned that the new chapter in the field of aesthetics in prosthodontics has been inaugurated by Leon Williams. Williams had a great influence in the development of aesthetics in removable prosthodontics with his theory about the harmony between the tooth and the facial form. Leon William's classification, although not scientifically correct in all details, is undoubtedly the simplest and most useful guide in the selection of artificial teeth, especially as it was accepted by the majority of dental companies which manufacture artificial teeth.

Fenn explains that, according to Williams, the shape of the upper central incisor is in accordance with the form of the face. If one central upper incisor is increased in size and rotated upside down and superimposed to the face in such a way that the incisal edge is parallel to the eyebrows and the cervical part of the tooth is parallel to the lower part of the face, then the forms of the tooth and the face

would be identical. For simplicity, Williams classified all forms in three basic forms: tapering form, ovoid form and square form. To find out which form is suitable for each individual, it is necessary to imagine a line on each side of the face, which runs downward 2.5 cm anterior to the tragus of the ear and through the angle of the lower jaw. If the lines are parallel, then the face form is square, if the lines converge toward the chin, then the face form is tapering, and if the lines diverge towards the chin then the face shape is ovoid. The theory of Leon Williams was adopted by almost all the prosthodontic textbooks in the whole world (7,8).

It was in 1914 that Williams (9) proposed his theory, which became famous under the name of geometrical theory. The theory connected the shape of the tooth and the face. Williams believed that the contour line of the upper central incisors has to be of opposite direction from the contour line of the face.

Williams was a famous dentist in England, well known for his contributions in the field of histology and bacteriology, he was a member of many associations in more than twenty different countries, and also a honorary member in some associations.

At the end of the last century, in 1895, Williams (10-13) was really disappointed with the aesthetics of his full dentures, as well as the dentures manufactured by other dentists. He was also disappointed with the appearance of artificial teeth and therefore he undertook some research on anatomical specimens, available at the Universities of that time. His honourable reputation and memberships of many associations allowed him access to the specimens.

William's theory (10-13) is based on an anthropometric study, performed on more than one thousand skulls at the University of the "Royal College of Georgia". Williams apostrophised that many face shapes exist, depending on the race, and all the shapes in all the races, even in apes, can be categorised into three basic types: ovoid, square and tapering, which are in accordance with reversed and increased tooth contour.

He suggested to the companies manufacturing artificial teeth that they produce 3 to 4 sizes of each basic form of the teeth. One of the biggest manufactures of artificial teeth was located in London

at that time. However, after Williams had presented his theory, he was rejected. As no dental industry was interested in William's theory it was forgotten for a short while.

Although the theory of three basic facial shapes is attributed to Leon Williams, the first researcher who published it was actually Hall in 1887 (14). Williams only took over Hall's theory and joined the theory of the same, but reversed tooth forms.

After having been rejected many times by different dental companies, in 1909 Williams travelled to America as an active member of the Dental Association and presented his study to the Conference, where he was again rejected.

The system of William's tooth forms was later finally accepted by one, at that time, small company in the USA (Dentsply Inc.), and TBS teeth were fabricated (15).

William's theory was finally accepted and it remained absolutely accepted for a period which lasted longer than 50 years (16).

The first theory after Williams on the choice of artificial teeth for removable dentures, was the theory of Frush and Fisher (17), who introduced SPA theory (sex, personality, age). The choice of artificial teeth relied on sex, personality and age and was also known as the dentogenic theory (17-23). This theory had something in common with the rejected temperamental theory (personality of the patient, which is one of SPA factors), but it also introduced gender (females have relatively bigger central upper incisors than males) and age (tooth colour, abrasion).

This theory was the biggest addition to Williams' comprehension of aesthetics (19,20), i.e. it harmonised tooth selection with the patient's gender, personality and age (SPA factors). Age, sex and personality are very important, as they offer subjective unity, which is an indivisible influence of a specific life and specific gender on a specific place in a specific period and thus it is impossible to make a mistake toward a natural appearance during the prosthodontic reconstruction. SPA factors are helpful to reconstruct dynamic unity. The teeth reflect sex characteristics, age characteristics and personality characteristics. To keep holding on to the mentioned theory, the authors proposed, a so - called

"one, two, three guide". One is the central upper incisor, which represents age, two is the lateral upper incisor, which represents gender characteristics and three is the upper canine, which represents personality characteristics (powerful, determined, strong, or delicate, soft and plain).

Frush and Fisher (21), introduced also the expression "dentogenic" to dentistry, which is comparable to the expression "photogenic". The origin of the "genic" means that something is suitable for reproduction.

Authors (19,20) state that in women lateral upper incisors are smaller than in men and that the teeth seem to be tighter in older patients due to the interproximal abrasion. Their opinion is that square teeth are adequate in aged people with many wrinkles, while tapered and rounded teeth are suitable for young women.

Frush was inspired with the work of Zech when he had the idea for the dentogenic theory. Zech was a sculptor and he was helpful to his father, who was a dentist. He experimented with different moulds and constructed teeth in such a way to fit to a certain person. He made soft, rounded teeth for women, and bigger, more irregular teeth for men. In this way he changed the standards of the dental industry, adding artistic irregularities, unusual proximal deformations or tender teeth for tender bodies. Zech inspired Frush in such a way that he changed his view on dentures and introduced aesthetics as an important factor, divided into three dimensions. The denture wearer has his/her own sensibility and someone who observes a dentogenic denture must understand the patient's personality during his/her smile.

According to Sears (25) the lateral upper incisors, which are nearly as wide as the central incisors provide a strong male appearance, while tighter and rounded lateral incisors provide a childish appearance.

According to Frush and Fisher (19-24) orthodontic irregularities have to be reduced and smoothed, but a natural appearance has to remain, as it is a part of the personality, and the patient must not completely change his/her appearance with a new denture. Dentogenic dentures lead to a change, improving aesthetics and the patient's and the therapist's reactions should be: "You look the same, but more attractive".

In spite of the existence of the dentogenic theory, Williams geometric theory is still the most common choice for the therapist choosing artificial frontal teeth.

According to Clapp (16), if we stick to Williams' principles, it will always result in perfect harmony.

Many authors have even invented different devices for face form determination. House and Loop (26) recommend to the dentists to outline the patient's face on paper and then to cut it out and visualise if their outline and the actual face form are the same, in order to choose the correct tooth form.

Dentists Supply Company according to the studies of Young (27, 28), constructed a special instrument, a so called "indicator" for determination of face form. The instrument was made from transparent plastic and the medial line, as well as other vertical lines, were denoted, while holes were cut out for the eyes and nose. The instrument was described by Buchman (29) in the year 1970 in the book: "Atlas of complete denture". By comparing angles between a patient's face and vertical lines denoted on the "indicator", the patient's face type could be determined.

Relying on Young's studies (27,28), the Austenal Company constructed another instrument: "Automatic Instant Selector Guide", which was used to put into relation the shape, size and appearance of a face.

Lowery (30) and Nelson (31) agree with Williams' theory, but they relate not only to face shape and tooth form, but also to the form of the upper residual alveolar ridge. This theory became popular under the name: aesthetic triangle.

The above mentioned geometric theory was supported by many authors: House (26), Shlosser (32), Pound (33), Richey (34). Also many alternatives as a help for upper central incisor choice were proposed, with the face contours in different projections.

Tanzer (35) describes similarity in face shape and upper teeth form in certain types of body constitution according to Kretschmer.

Kretschmer (cit. Vojinović) (36) described a correlation between the upper central incisor shape and the body constitution. He divided the body constitution into: athletic constitution, asthenic con-

stitution, picnic and leptosomic constitution, each having a correlation with a certain upper tooth form. Kretschmer's division of the body constitution into the above types: asthenic, athletic and picnic is connected with different inclination towards different illness in medicine and consequent different reaction to the proposed therapy.

Heartwell (37) describes four types of face shapes and analogue types of frontal upper teeth, which is de facto modification of the Williams classification.

Devin describes well known theories about the connection between the shape of the female body and women's upper teeth, i.e. smaller teeth, more of a triangle and rounded form and the male body shape and men's upper teeth, where bigger and square teeth are prevalent. He also describes correlation of the upper incisive form and face form in some animals.

Some authors rely only on the individual preference of a patient for tooth form choice and setting, which is known as the theory of individual preferences (20,38-40). In any case, the patient's preferences on the shape, size and composition of artificial upper frontal teeth are often different from the professional's perception, which indicated some aspects of aesthetics, which were not considered earlier. To satisfy a patient and his/her demands, different sizes, colours and forms of artificial teeth are placed onto a waxed arch, set in different ways, the arch is inserted into the patient's mouth and the procedure is repeated until the patient is satisfied with his/her appearance.

Wright (41) recommends the use of old photographs for choice of artificial teeth.

Krajicek (42,43) recommends duplication of the patient's teeth before extraction in a hard stone.

Klein (44), Hayward (45), Kafandaris and Theodorou (46) recommend setting extracted natural teeth into a denture and they describe a technique for fixing a natural tooth with the acrylic resin of a denture.

Lee (47) and Neill et al. (48) based full denture aesthetics on the Williams theory, with modification which meant that tooth incisal edges were correlated with the forehead and cervical dimensions with the mandible.

Many of the above mentioned theories for the choice of artificial teeth have been combined and used by many authors, who agree that success was better when different theories were combined than by relying on a single theory (49-54).

Powell and Hamphries in 1984 (55) described different proportions of the human face, which were studied for the purpose of reconstructive surgery. They described oval, triangle and square face forms, i.e. the same face forms as Williams.

Lee (47) reports a method for artificial teeth choice which is more simple than the method described by Williams. He measures the patient's face in 3 horizontal levels: the forehead level, level of zygomatic bones and the width of the most distal points of the face on the level of the lips. Correspondent to the mentioned measures are the horizontal dimensions of the central upper incisor at the gingival level, incisal level and the level where a tooth is the widest. In that way, a patient whose face is of equal size at the level of the forehead, zygomatic bone and lips needs central upper incisors that are of equal size at the gingival and incisal level, i.e. square teeth. If the dimensions of the forehead and the face at the level of the lips are smaller than dimensions at the level of the zygomatic bone, than ovoid teeth should be chosen. According to Lee, four basic shapes of the face and central upper incisor can be recognised.

Boucher (56) states that the shape of the residual alveolar ridge has an influence on artificial teeth arrangement, and he recommends flatter frontal teeth in older patients because of the abrasive changes at that age, while he prefers more rounded frontal teeth for younger patients. Tooth shape can be determined upon the shape of the residual alveolar ridge. In the square alveolar ridge there is no compression between teeth, sometimes there is diastema, canines are at the same level as central incisors. Tapering form of the residual alveolar ridge is usually in accordance with teeth compression because of the less space available on the alveolar ridge. The vestibular surfaces of incisors are usually less visible as they are rotated. In the oval shaped alveolar ridges there is no rotation and compression between teeth and incisors are usually in front of the canines. Therefore, artificial teeth arrangement should be in accordance with the shape

of residual alveolar ridges and should be set in a harmony with the curvature of the lower lip during smiling in the frontal plane. Artificial incisor teeth arrangement in the frontal plane should not be plane or curved in a wrong direction with the occlusal plane being inclined too low posteriorly.

Douvitsas et al. (57) consider that the shape of the residual alveolar ridge is in correlation with gender.

In our population some studies have been carried out on artificial teeth choice (58-60). Nikšić and Jerolimov (61) studied Williams' principles and found that a certain correlation exists between the face and the central upper incisor's shape. The most frequent combination was oval face and oval central incisors (76% in men and 61% in women. Square face and square incisors were present in 11% of men and 14% of women, while tapering face and tapering incisors were present in 6% of males and 12% of females. Ibrahimagić found in 2000 patients that the most common combination was an oval face and square central upper incisors, i.e. tapering-square incisors, as they are narrower in the cervical third of the tooth (62).

Cholia et al. in 1999. (63) studied the shape and dimensions of upper central incisors in 25 white individuals, 25 individuals from Asia and 25 black individuals from the Caribbean. White population (76%) and black population (64%) had the biggest frequency of square upper central incisors, while the Asian population (56%) had the highest frequency of oval shaped incisors.

Brisman (38) states that the Williams' rules for choosing tooth forms corresponding to facial form has been used for more than 60 years, which is really surprising, as face contour and upper central incisor's contour correspond only in a small percentage of cases, even then it cannot result in an ideal aesthetic appearance.

Brisman (38) studied photographs of 65 white individuals, 8 black individuals, 5 Asians and 2 Hispanics, who had intact frontal teeth. Photographs are made using a special mirror system, a method introduced by Brodbelt (64), so that the individual is photographed full face together with the left and the right profile at the moment the photograph is taken. Patients keep the mandible in the rest position during photographing. For the teeth other photo-

graphs are taken. Each photograph is increased in size (enlarged) and 11 anatomical points determined on the face and 9 on the upper central incisor. Referent points are digitised and scanned. By the use of Trubyte guide, faces and teeth are classified by referent points according to the Williams theory. Each shape is then divided into the upper and lower part. Analysis of the shape was made by a comparison of ratios between face width and tooth width. No correspondence of facial to upper central incisor's form was found, or completely tapering or completely square form. According to this analysis a new tapering-square form is introduced.

Brissman (38) also found that the concept of what is beautiful differs between the patient and dentist, because aesthetics are associated with social and physiologic state. Patients prefer symmetric teeth arrangement and shorter teeth than the dentist.

Brodbelt et al. (65) claim that many dentists still use Williams' theory for the choice of artificial teeth (9-13), which replaced the oldest temperamental theory. In 1984, they compared tooth and facial forms (66), in 81 of patients. Patients were photographed by the use of a mirror system (according to Brodbelt, which enables a photograph of full face and both profiles at the same time), and tooth and facial shapes were determined according to the digitised photographs on a computer. Results indicated that the tooth shape and facial form did not correspond.

Seluk, Brodbelt and Walker (66) compared facial form and tooth shape in 3 male and 3 female patients. The patients were chosen if they met the criteria of having typical facial forms according to Williams classification. Each of the patients received 3 pairs of full dentures, each pair with different tooth forms: tapering, square or oval tooth form.

Patients and their dentures were photographed (Brodbelt mirror system, full face and both profiles at the same time) (64-66), as well as "typical" artificial teeth forms before setting. Photographs were scanned and facial forms digitised on a computer, as well as teeth shapes in each of the 3 pairs of full dentures. The aim of the study was to compare the shape of each face and corresponding tooth forms, and to determine whether patients prefer a certain tooth form and whether the chosen form of artificial teeth is changed during teeth setting and contouring artificial gingiva. The results indicated a significant

difference was between the forms of artificial teeth before and after setting, i.e. the shape of the artificial teeth was changed by gingival contours and the way the teeth had been set, so that in the final denture the teeth had a completely different shape from the original one. There was also a significant difference between the tooth shape and facial form, which had been calculated according to bitemporal, bizygomatic and bigonial face width and gingival, contact point and incisal tooth width. The patients' preferences for a certain tooth form were not the same as postulated by Williams.

In 1951, French (67) pointed out that the tooth contour could be changed during setting in wax of trial dentures, depending on the contours of the artificial gingiva and grinding of the upper part of the artificial central incisor to fulfil the interocclusal space demands. Swenson (68), Sears (69), Hughes (70) and Krajicek (71) experimented with different methods of the same forms of artificial teeth arrangements and they also established a different appearance of the same teeth, set in a different way. They concluded that the way the artificial teeth are being set and arranged is more important than the teeth form.

Bell (72), also considers Williams' theory not valuable. In his research he found no correspondence between the tooth shape and facial form. Bell considers that artificial tooth form choice depends mainly on the dentist's subjective judgement, the result of which is that the choice of artificial teeth is the least scientific discipline in dentistry. The choice of the central upper incisor's shape, dimensions and position has been described by many authors, none of them entirely satisfactory, as claimed by Bell. In his own research, Bell analysed only 36 males with natural dentition. He made impressions, made casts, as well as producing intraoral photographs and retroalveolar radiograms. Face contour was determined on a computer by plotting the lines of each patient's photograph from the hair line towards both temporal bones and continuing through the temporal process of the zygomatic bone towards the gonion. In a similar way tooth contours were made, zoomed in, turned upside-down and superimposed over the facial contour. Analysis of the results showed that no correlation between tooth shape and facial form exists. Bell states that the size and arrangement of the central upper incisor in the upper arch is more important than the form. He

considers that the tooth shape is best determined from an old photograph, and during teeth setting it is possible to change the tooth shape due to the arrangement, arch shape and contours of the artificial gingiva.

Wright (41) decided to re-check Williams' theory and he found that in 60-70% of subjects the form of the upper central incisor was different from the shape of the face. Only 30% of subjects had a similar form, and an identical form was found in only 13% of subjects.

Mavroskoufis and Ritchie (73), based on subjective judgement, compared tooth and facial form, projecting enlarged and reversed tooth contour over facial contour. The authors found no correlation which would support Williams' theory. They stated that Williams (9-13) and Clapp (16,74) described so-called "apparent face" in their studies (73), i.e. the face together with the forehead and the hairline.

In "actual" face, (Face together with the eyebrows, without the forehead) contours were determined by plotting the upper line which connected the most superior points on the eyebrows, and from the end of the eyebrows the line ran downwards to the most lateral point on the zygomatic bone, and along the outer part of the cheek to the chin, where it was connected with the line from the other side. In "apparent" face, the upper line followed the hairline (including the forehead), in contrast to the "actual" face. After the "actual" and the "apparent" face were plotted, tooth contour was also plotted, enlarged, reversed and projected over the face form. Slides of the "actual" and "apparent" faces were made. To compare the face and the central upper incisor form, the formula was derived by the authors: $D = (Lf - Lt) \times 100 / Lf$. Lf is the length of the face, Lt is the length of the projected tooth (zoom in varied from 13 to 15 times). If the calculated D was not more than 1%, the forms were supposed identical. If the D was 1 - 7%, the forms were supposed as similar, and if the difference was bigger than 7%, the forms were supposed as different. The results of the comparison of 70 "apparent" faces with the form of 140 central upper incisors (70 on the left side and 70 on the right side) revealed only 5.3% identical tooth and facial forms, 25.6% similar forms, and 68.7% completely different forms. The results of the comparison of 70

"actual" faces, (without forehead) with the form of 140 central upper incisors (70 on the left side and 70 on the right side) revealed only 1.45% identical tooth and face forms, 15.75% similar forms, and 82.8% completely different forms. The results of comparison of actual face (upper lines within eyebrows) with the tooth shape revealed even more difference with the form of upper central incisor than the "apparent" face (upper line along the hairline). The authors concluded that the choice of artificial teeth based on Williams' rules is worthless.

Nevertheless, they suppose that it is better to consider "actual face". Actual face was for the first time defined by Sears (25,69,75) as the face from glabella to gnation, and was divided into two halves, the upper and the lower half, with subnasion as the point separating the two parts. The "actual face" is less influenced by the changes than the "apparent" face and is considered as a more constant face, while the apparent face is considered more valuable as the more aesthetic face. DeVan (76), however thinks that the best results are with the "apparent" face.

In 1998. Sellen et al. (77) compared tooth form, face shape, palatal form and the residual alveolar ridge shape by the use of a personal computer. For the purpose of the research, casts poured in the hard stone were made, as well as photographs of each individual and their central incisors. Fifty individuals participated (30 women, 20 men). The computer program made for that purpose allowed enlargement (zoom-in) and superpositioning of the contours. Authors zoomed in the central upper incisor until it fitted to the most prominent points of the zygomatic bones.

Upon the results of that study, the authors concluded that women had the most frequent oval face form together with the square tooth form, and men had the most frequent triangular tooth form. The forms of the central upper incisor and the face were identical in 22%, which is the smallest matching of the four variables. In more than a half of the individuals, the tooth form and the face form were completely different, and the rest of the sample showed some similarity, but not complete matching. Palatal form and the residual alveolar ridge form were identical in 44% of the cases, which is the biggest matching. The residual alveolar ridge form and the face form were identical in only 28% of the

cases. In only 24% of the cases, the tooth form was identical to the residual alveolar ridge form.

Sellen et al. (78) also investigated whether the therapists and students are capable of choosing adequate artificial teeth, which are good for a certain age and gender (they re-checked the dentogenic theory proposed by Frush and Fisher). Five specialist prosthodontics and one hundred students were interviewed. They assessed all 6 adequately set frontal teeth, which reflected the age in 3 age groups (young, medium and old) in males and in females. However, the participants had no idea for whom the dentures were constructed and their task was to attribute the dentures to the male or female of a certain age group. All the specialist prosthodontics gave the correct answers, while the students were not sure and often attributed the set teeth incorrectly for a certain gender or age group.

Lombardi (79) is contra Williams for 2 reasons: 1. It is difficult to find patients with typical facial forms, as most people have mixed facial contours, and 2. The form of a single tooth is not very important; the most important is the whole composition, and the form of one element (central upper incisor) is secondary compared to the forms of the sequence of the other elements, which together with the new elements become a composed and organised entity. Lombardi thinks it is impossible to view the teeth and the facial form at the same time. The author says that the system of the tooth choice according to the facial form is better than no system, but it is definitely not a precise method.

In 1999. Bindra et al. (80) introduced a new method for calculating the actual width or the length of the central upper incisor from a pre-extraction photograph. Interpupilar width is measured on the patient ($ippac$) and the proportion is made by the same distance measured on the photograph (ip_{fot}). The proportion represents the number which says how many times the actual distance is larger than the distance measured on the photograph. If the width of the upper central incisor, measured on the photograph ($\dot{s}i_{fot}$) is multiplied by that number, one calculates the width of the actual incisor ($\dot{s}i_{pac}$). The formula is derived from the ratio: $ip_{pac} / ip_{fot} = \dot{s}i_{pac} / \dot{s}i_{fot}$, i.e. the width of the actual incisor ($\dot{s}i_{pac}$) = $ip_{pac} / ip_{fot} * \dot{s}i_{fot}$ (patient interpupilar width divided by the interpupilar width on the photograph is multiplied by the incisor width on the photo-

graph). The author rechecked this method on the photographs of individuals with their own teeth, which were measured and then compared with the values calculated from the photographs. T-test revealed no significant differences between the measured and the calculated distances by the mentioned formula from the full face photographs, and the authors concluded that the method is reliable.

Discussion and conclusions

None of the mentioned theories for the choice of artificial teeth is completely reliable and accurate. The majority of well-known theories are: the temperamental theory, Williams' geometric theory, dentogenic theory according to Frush and Fisher, the theory of the aesthetic triangle according to Lowery and Nelson, the theory of individual preferences of the patients or the choice according to the form of the extracted teeth, or calculated dimensions from old photographs.

Brodbelt (64,65), Walker in 1967. (81), Lagree in 1976. (82), Bell in 1978. (72) and Mavroskoufis & Ritchie (73,83-85), Seluk and Brodbelt (66), Garn et al. (86) in their studies found no connection or similarity between the face shape and the tooth form, as stated by Williams. They consider that the tooth form, neither with regard to dimensions, nor shape is recommendable for a certain gender or facial form.

For correct tooth choice, even computer simulations have been made, to determine the exact correlation between the mentioned factors. Such methods comprised the digitising of the image, plotting the contours and calculation of the correlation (66, 72, 73, 87). The results showed that there is still not one certain factor responsible for the choice of tooth dimensions and the form.

The Williams' theory has been interpreted differently by different authors, some of whom use the apparent face, some the actual face or the face below the eyes.

No matter which tooth form is chosen, has been confirmed that the form of the tooth form may be completely changed during the teeth setting and artificial gingiva contouring. Controversial theories are described in the article.