

# Smile Design By The Numbers

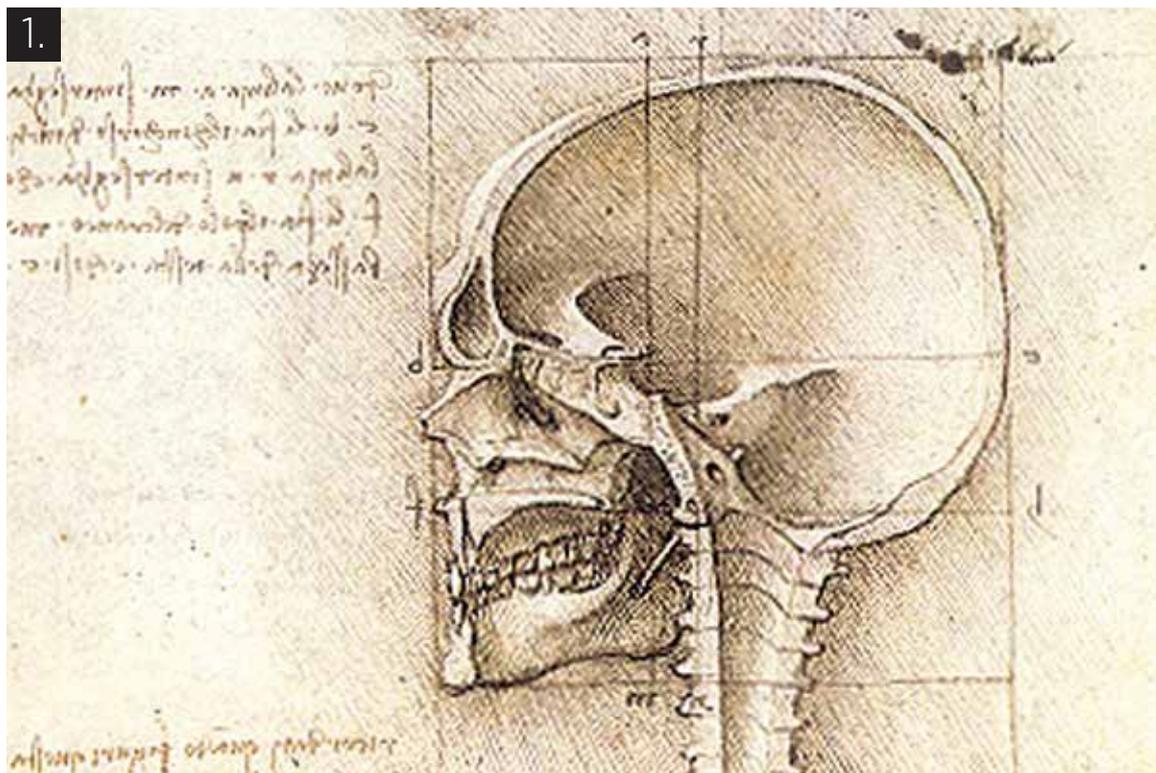
Daniel H. Ward, DDS

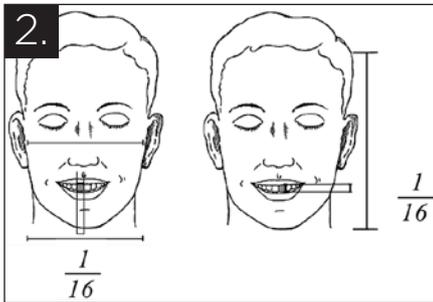
## Introduction

Dentistry and smile design is an art and a science. Subtle variations can make a smile look unique and better match the personality of the patient.<sup>1</sup> Creating smiles that all look the same is undesirable and should match the size and body type of the patient.<sup>2</sup> When you begin to study and analyze smiles deemed to be esthetic, a range of proportions emerge.<sup>3</sup> The preferred proportions do not always coincide exactly with those routinely found in nature. Patients generally do not seek dental treatment to recreate the average smile; they seek an exceptional smile.

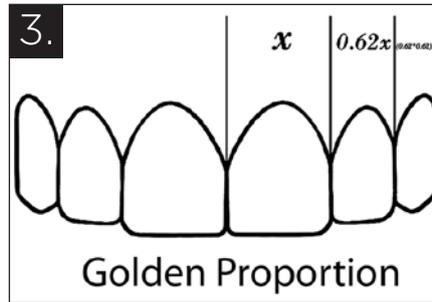
## Proportions

One of the first to analyze and portray body proportions was Leonardo da Vinci. His famous illustrations showed common anatomical proportions<sup>4</sup> (Fig. 1). One of the first to report tooth proportions was House. He stated that the height of the central incisor should be 1/16 the length of the face from trichion to menton.<sup>5</sup> The width of the central incisor should be 1/16 the inter-zygomatic width (Fig. 2). It has been advocated that the facial view width of the maxillary 6 anterior teeth should be in golden proportion to the inter-commissural

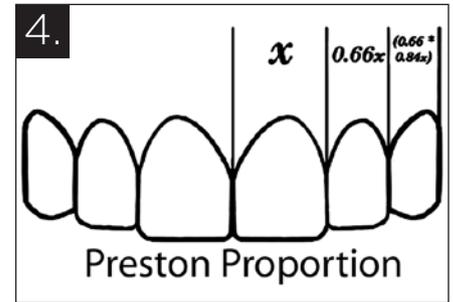




House 1:16 Rule.



Golden Proportion Smile.



Preston Proportions Smile.

width. Lombardi wrote about the repeated ratio whereby the facial view width of each maxillary tooth became smaller by a fixed percentage.<sup>6</sup> Levin limited this repeated ratio to the golden proportion which is defined as 62%.<sup>7</sup> (Fig. 3) Numerous tooth to tooth width proportions have been advocated.<sup>8,9</sup> Most of these are not what is generally found in nature. In one study the average tooth to tooth width proportion observed in North American dental students was 66% for the lateral incisor/central incisor frontal widths and 84% for the canine/lateral incisor frontal widths<sup>10</sup> (Fig. 4). Reported tooth proportions vary according to the geographic location of the smiles being studied.<sup>11-12</sup>

**Width/Length Ratios**

The width/length ratio of the central incisor has also been deemed to be important. The reported natural proportion is 84-87%<sup>13-14</sup> (Fig. 5). According to one study the width/length ratio of the central incisor was the primary deciding factor for dentists surveyed deciding the preferred proportions of the smile and the preferred proportion was 75-78%.<sup>15</sup>

**Red Proportion**

A method of relating the size of the teeth to body size, tooth length and inter-commissural width has been advocated. The Recurring Esthetic Dental (RED) Proportion states that the facial view tooth to tooth width of the maxillary anterior teeth remains constant as you move distally<sup>16</sup> (Fig. 6). Each tooth becomes narrower by a fixed percentage which can be different with each patient. Research has shown that dentists prefer smiles with normal length teeth that have a 70% RED Proportion. Dentists prefer patients with tall teeth to show a 62% RED Proportion, which is the same as the Golden Proportion. Dentists prefer patients with short teeth to exhibit an 80% RED Proportion<sup>15</sup> (Fig. 7) This occurs because the 78% w/l ratio of the central incisor is preferred. If a patient has tall teeth the central incisor needs to be wider to maintain the 78% w/l ratio. Less space is available for the remaining an-

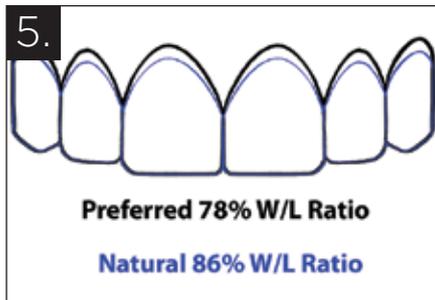
terior teeth so the teeth have to become narrower. The reverse is true for short teeth.

Though not observed in nature, one study showed that the RED Proportion was preferred to naturally occurring proportions by a majority of dentists surveyed.<sup>17</sup> Formulas have been developed that calculate the ideal widths of the maxillary anterior 6 teeth with different height teeth using the RED Proportion with a 78% w/l ratio of the maxillary central incisor.

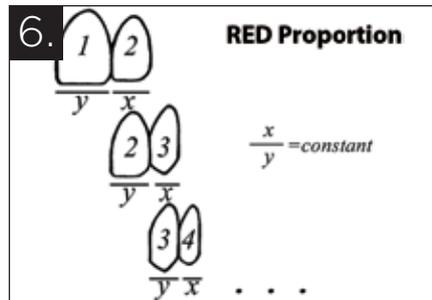
**Using Red Proportion Charts To Calculate Anterior Tooth Widths**

Using the information learned from studies that dentists prefer smiles in which the w/l ratio of the central incisor to be 78%, you can first determine the relative overall height of the patient and the relative tooth height for the patient. The inter-canine width is divided by the corresponding divisor to determine the central incisor width. The resulting central incisor width is multiplied times the appropriate RED proportion to determine the width of the lateral incisor. The lateral incisor is

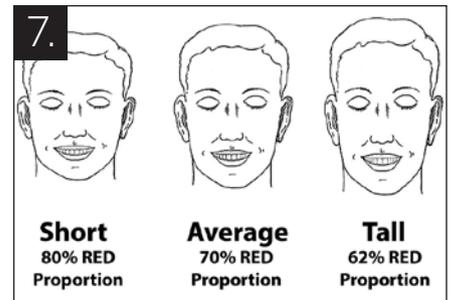
Desired RED proportion		Inter-canine Divisors (rounded): Inter-canine width/(n)=tooth width		
Tooth Height	RED Proportion	Central Incisor Width (CIW)	Lateral Incisor Width (LIW)	Canine Width
Very Tall	62% RED	ICW/4.0	CIW *0.62	LIW *0.62
Tall	66% RED	ICW/4.2	CIW *0.66	LIW *0.66
Normal	70% RED	ICW/4.4	CIW *0.7	LIW *0.7
Short	75% RED	ICW/4.6	CIW *0.75	LIW *0.75
Very Short	80% RED	ICW/4.8	CIW *0.8	LIW *0.8



Preferred vs Natural W/L ratios



RED Proportion Definition



Body types with preferred RED Proportion

multiplied times the same RED Proportion to determine the facial view width of the canine. Figure 8 demonstrates using Table 1 and the ICW to calculate the widths of the anterior teeth for a normal tooth height.

**Simplified Method To Use Red Proportion Charts To Calculate Anterior Tooth Widths**

Determining the sizes of the teeth can be simplified by using the inter-canine width and the existing or desired length of the central incisor. The Inter-canine width is divided by the desired central incisor length to produce a number which should be between 3.1 and 3.8. The chart is used to look up the corresponding divisors for the inter-canine width to determine the widths of the central incisor, lateral incisor and canine. Figure 9 demonstrates using Table 2 and the ICW/ CIH to calculate the widths of the anterior teeth which was determined to have a normal tooth height.

**Table 2:** Calculating the Anterior total widths from Inter-Canine Width (ICW) and Central Incisor Height (CIH) maintaining 78% w/l ratio

Inter-Canine Width/ Central Incisor Height	RED Proportion	Central Incisor Width	Lateral Incisor Width	Canine Width
3.1	62% RED	ICW/4.0	ICW/6.47	ICW/10.43
3.2	65% RED	ICW/4.15	ICW/6.38	ICW/9.81
3.3	67% RED	ICW/4.24	ICW/6.33	ICW/9.44
3.4	70% RED	ICW/4.38	ICW/6.26	ICW/8.94
3.5	73% RED	ICW/4.53	ICW/6.20	ICW/8.49
3.6	75% RED	ICW/4.63	ICW/6.17	ICW/8.22
3.7	75% RED	ICW/4.78	ICW/6.12	ICW/7.85
3.8	80% RED	ICW/4.88	ICW/6.10	ICW/7.63

**Using Red Proportion Charts To Calculate Central Incisor Width And Height**

Some dentists prefer to use the concepts of the RED Proportion to determine the ideal size of the central incisor and to make the lateral incisor 0.5 mm narrower and the canine 0.5mm wider than the calculated widths to coincide more with the naturally occurring width proportions. In this case you could measure the inter-canine width, determine the desired relative tooth height and calculate the width and length of the central incisor. Figure 10 demonstrates using Table 3 and ICW to determine the width and height of the central incisor.

**Clinical Case**

A 17-year-old female presented to our office following orthodontic treatment for restorative treatment to replace her missing lateral incisors. Photographs were taken and frontal view measurements made and recorded (Fig. 11). It was determined that there was inadequate space to place dental implants in the lateral incisor area. The occlusal plane on the left side was higher than on the right side. The canine teeth were not angled properly. Occlusion was not consistent. It was determined that orthodontic retreatment was necessary to stabilize the occlusion and provide the desired esthetic outcome.

The inter-canine width was measured and determined to be

**Table 3:** Calculating Central Incisor Length (CIL) and Central Incisor Width (CIW) from Inter-Canine Width (ICW) with different tooth heights maintaining 78% w/l ratio

Tooth Height	RED Proportion	Central Incisor Width	Central Incisor Length
Very Tall	62% RED	ICW/4	ICW/3.1
Tall	66% RED	ICW/4.2	ICW/3.25
Normal	70% RED	ICW/4.4	ICW/3.4
Short	75% RED	ICW/4.6	ICW/3.6
Very Short	80% RED	ICW/4.8	ICW/3.8

# Mark your calendars for the 78th Annual Winter Clinic

Friday,  
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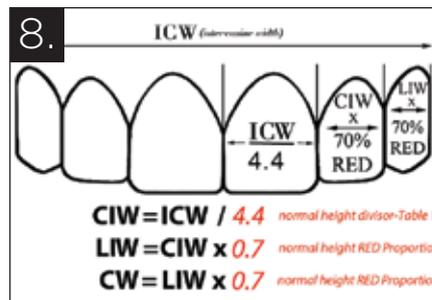
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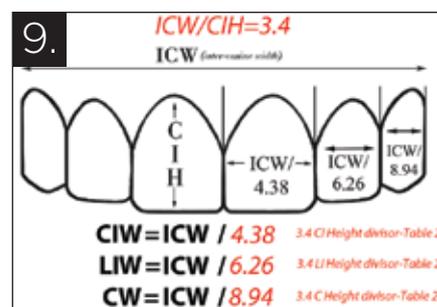
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Using ICW and Relative Tooth Height to calculate Tooth Widths



Using ICW/CIH to calculate Tooth Widths

36.2mm. The central incisor height was measured as 9.4mm. Dividing these two numbers and looking up the quotient which was 3.8 it was determined that the 80% RED Proportion would be appropriate (Fig. 12). An 80% template was placed over the photo to observe the desired position of the teeth (Fig. 13).

Orthodontic appliances were placed and the progress was monitored in our office. Measurements were made to determine if the teeth were in the proper position (Fig. 14). Once the teeth were deemed to be in the proper position the appliances were removed and removable retainers fabricated. The patient was then referred to the periodontist who placed implants in the area of the missing lateral incisors. The implants were allowed to integrate, were uncovered and healing screws were placed (Fig. 15).

After stabilization, the desired size of the central incisors was calculated using Table 3. The ICW was 36.2 and the very short tooth height used. The ICW was divided by 4.8 to determine the width of the central incisor would be 7.5. The ICW was divided by 3.8 to determine the tooth length of the central incisor to be 9.5 (Fig. 16). The bicuspid and canines were prepared for porcelain laminate veneers, the central incisors for crowns and the lateral incisors implant crowns. Photographs of the prepared teeth and the stump shade were sent to the laboratory (Fig. 17). Impressions were made and provisional restorations placed. The patient returned in three weeks and the prostheses were tried in and seated. The patient

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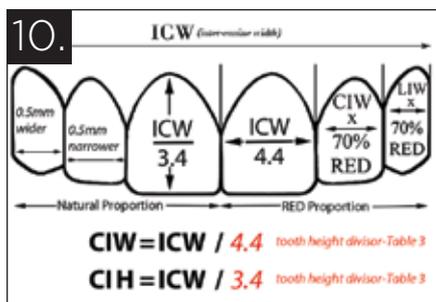
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Using ICW to calculate CIW and CIH



11. Pre-Operative smile

returned in several weeks for evaluation and minor adjustments (Fig. 18). She was very pleased with her new smile and happy that we had coordinated the orthodontic treatment.

### Summary

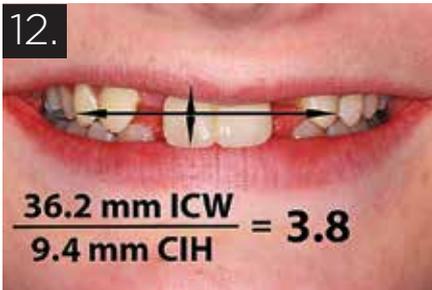
Proportional smile design is a convenient tool to calculate the sizes of the anterior teeth which complement the face and body. Proportional smile design is not designed to detract from the creativity of the dentist and the laboratory, but to enhance their ability to create smiles that better match the unique characteristics of the patient. With careful smile analysis, smile design, thorough planning, and attention to detail, predictable results can be achieved. **OH**

Dr. Ward is in private practice in Columbus, Ohio. He is a Diplomate of the American Board of Aesthetic Dentistry, a Fellow of the American Society for Dental Aesthetics, Fellow in the Academy of General Dentistry and Fellow in the American and International College of Dentists. He has lectured internationally and authored numerous articles in the field of proportional smile design. Email:dward@columbus.rr.com

Oral Health welcomes this original article.

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Measuring ICW-CIH to determine factor



Smile with 80% RED Template



Measuring orthodontic widths



Post Ortho and Implant Placement



Calculating Central Incisor Height and Length for short teeth using ICW



Photo of stump shade with prepared teeth



Post-Operative Smile

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