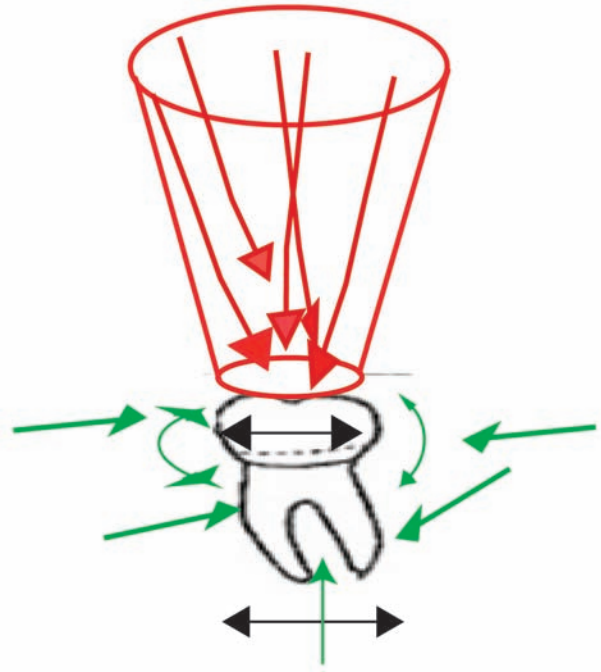
QUALITATIVE AND QUANTITATIVE ORTHODONTIC VECTOR FORCES

by V. C. "Bud" White DDS, MS



KEY TO VECTOR FORCES:

QUALITATIVE VECTOR FORCES-RED

QUANTITATIVE VECTOR FORCES-GREEN

RESULTANT TOOTH MOVEMENTS CROWN/ROOT-BLACK

A vector force is a resolution of all the forces in one plane in space. An example of horizontal vector forces may be the net result of all the forces acting at a point. This vector force is expressed with an arrow with 2 parts being direction and magnitude.

VECTOR III® is derived from vectors in 3 planes in space they are: horizontal, vertical and transverse.

One may address qualitative orthodontics as vector forces within nature's functional design or it's Living Functional Factor (LLF)™, vector forces being the resultant forces in 3 planes in space; vertical, horizontal and transverse and having a direction and a magnitude.

Orthodontic vector forces applied within the LLF™ and not exceeding the design limitations do not result in orthodontic tooth movements. On the contrary they result in maintenance of the supportive structures via function. When this function is negated disuse atrophy results in structural modifications.

Appropriately Wolff's Law can be paraphrased to state;
Altered function alters structure and altered structure alters function.

Qualitative orthodontic vector forces would include the functions of mastication and occlusion. Applied forces within the range of the LLF™ of the human dentition are physiologic or free from structural insult or pain. The resultant force/structure environment of its' systems being an integral part of the total structure/function. Examples such as the tongue and the buxinator system with its' structure and functions as described by Brody and others. Qualitative orthodontic vector forces, when within natures design of the LLF™, only have to not exceed these function/structure design limitations and no orthodontic tooth movement would be the norm. Qualitative physiologic forces in general exhibit maintenance rather than orthodontic movement or structural changes. This is an example of Wolff's Law where structure and function are in a "non-altered state".

It should be noted that forces of mastication have been expressed in pounds per square inch PSI not grams per mm as expressed in orthodontic bio-mechanics. Mastication forces can function and have been evaluated and noted in the range of 250 PSI (±)on molars in the human dentition although they are intermittent forces they are non-traumatic and pain free.

Vector environmental forces when applied outside the LLF™ or natures functional design have demonstrated their effect of altered structure and function.Thumb sucking and tongue thrusting being some examples. The awareness of normal physiologic function and altered physiologic function is of importance in relation to maintain structure or alteration of structure.

Qualitative orthodontic vector forces and quantitative orthodontic vector forces both being significant require awareness and judgment. Quantitative orthodontic vector forces have historically been the substance of bio-mechanics and its application in orthodontic diagnosis, case management and treatment. The art and science of orthodontics has been described as 50% treatment application and 50% control or management of the side effects of the treatment The didactic education and clinical skills are developed and honed as it were in graduate programs and continuing education post graduate courses.

Qualitative orthodontic vector forces when prudently addressed and implemented have the potential to significantly negate side effects of clinical bio-mechanics in orthodontic treatment. Newton's Law III of equal and opposite forces being true in a non-living environment are found to be not true in a living environment. Qualitative orthodontic bio\analytic™ added to the traditional quantitative bio-mechanics has the potential to reduce side effects and treatment times of 50% or more and result in the the advancement of the orthodontic standard of care. An orthodontic treatment with fixed appliances and nominal side effects or significantly reduced negative side effects requires a different finishing and detailing of active orthodontic treatment. Without side effects or with nominal side effects being present a finishing or detailing treatment phase may require a re-evaluation of the traditional choices of bands and brackets and their multiple configurations.

Many of the contemporary brackets and bands have features to address and augment the correction of side effects while treating the case and aid in the esthetic positioning and detailing of the roots and crowns of the teeth. Not only would many of these contemporary configurations and features be unnecessary but they may be counter-indicated. In a revolution vs. an evolution the use of awareness and judgment are imperative. The evaluation of why we use these configurations is prudent added to what they are for and what is usual and customary.

An example of re-evaluating the traditional or contemporary techniques with various fixed appliance features and configurations would be the following:

As per Reed A. Holdaway, D.D.S. October, 1952
"Bracket angulation as applied to the edgewise appliance"

The problem of bracket angulation is better understood if approached from the following clinical aspects:

A. As an aid in paralleling roots adjacent to extraction sites.
B. As one method of setting up posterior anchorage units tipped back or anchorage prepared positions.
C. As a means of artistically positioning teeth.

AWARENESS AND JUDGMENT

AWARENESS

Example: If one were to have a normal Class I patient with no indications of a malocclusion, no alignment problem, good vertical overbite, good overjet, correct midline and an ideal facial profile this would NOT be a good candidate for orthodontic intervention.

Awareness Questions

If you were to place straight wire brackets or the brackets you use for your patients on this example patient and place the finishing wires you use for detailing on your cases what would be the desired action or result?

Would there be no changes in the patient? Would there be be changes in the root positions and dentition as a result of the angulations in the brackets you presently use?

JUDGMENT

When one reevaluates the bracket angulations as applied to the edgewise appliance as described by Dr. Reed A. Holdaway October 1952 with attention to A, B & C are they what you are doing in your office with contemporary orthodontic treatment?

Judgment Questions

A. In the cases you treat non-extraction are you using the same brackets as extraction cases?
B. Do you set up posterior anchorage units tipped back or anchorage prepared positions in your contemporary orthodontic treatment?
C. When you artistically position teeth do you need to over-correct the side effects of treatment or would angulations of the normal patient as described in the awareness example be more appropriate and desirable?

JUDGMENT COMMENTARY

It may be prudent for us all to reevaluate our diagnosis and treatment appliances in relation to the contemporary orthodontics we are now practicing. The evolution of orthodontics from 1952 has been significant. Using a cephalometric analysis such as the Steiner analysis that loses 1/3 of the 15MM in an extraction of 4 bicuspids per arch, or 5MM, due to anchorage loss may not be a good "fit" for many of the contemporary orthodontic treatments. There are angulations of upper cuspids ranging from 13°, 11°, 8° or 5° of various straight wire brackets. The normal angulation of the upper cuspid in a non-malocclusion is expected to be 0° angulation. The slot size of brackets in relation to the wire sizes used is an area that calls for judgment as well.

SUMMARY

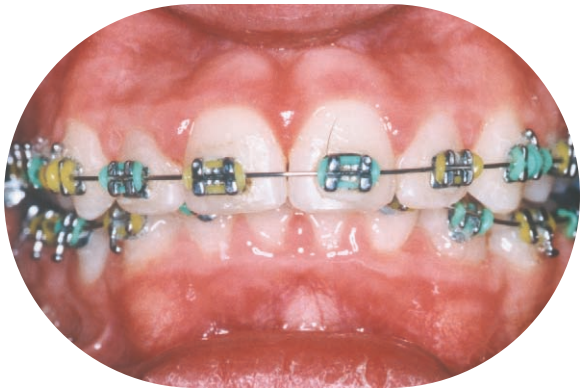
The areas of awareness and judgment are prudent to reevaluate in an evolution of orthodontics from 1952 to the contemporary. The Storey and Smith Force in Orthodontics and its relation to Tooth Movements Aus. D. J. , 56: 11-18 Feb. 1952 article is another prudent area to use awareness and judgment. All these examples and others are made to bring home the point of the prudent use of awareness and judgment. The acceptance of tradition has its' applications but it is far from universal.

In a revolution, not just an evolution, qualitative and quantitative orthodontics and Bio\Analytic™ Mechanics + Vectorloy™ Wire = Revolutionary Results it is imperative not just prudent to use awareness and judgment to practice the highest standard of care.

EXAMPLE OF VECTOR III® CLASSICS WIRES™ LEVELING AN ARCH

Beginning photos upper Classics Flat Series standard wire & lower Classics Reverse Curve Series standard wire

Progress photos at 1 month 5 days



Progress photos & x-rays at 2 months 16 days shows no distal tipping of lower first molars & no mesial movement of lower first molar roots.

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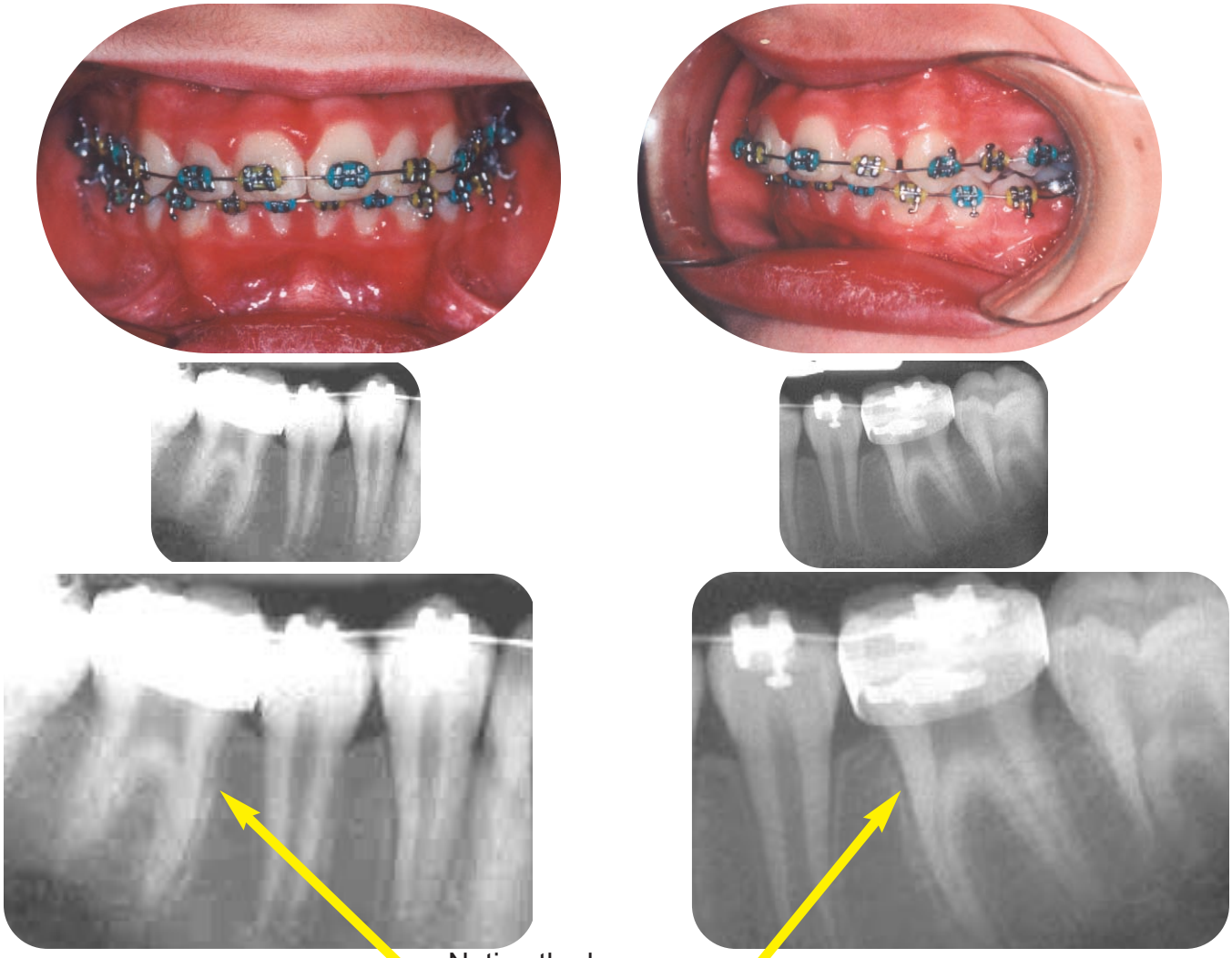


Notice the bone osteoblasts + new bone (white on x-ray)

The traditional “potato chip” reverse curve Nitinol wires used to level the curve of spee and open the vertical dimension have side effects (Newton’s Law III):

1. Distal tipping of 1st molars 2. Distal rotation of the 1st molars
3. 1st molar roots tend to move mesially and to the buccal.

The arch length from the mesial of the 1st molar to the lower anterior teeth increases to accommodate the bicuspids extruding or the curve of spee leveling. The leveling of the curve of spee tends to tip the lower anteriors to the labial as they intrude. There is a tendency of the cuspids to tip as they move. Literature states 6.1 months to 6.3 months for this leveling of the curve of spee and the resultant opening of the vertical dimension. The variation due to combinations of round vs rectangular and square wires.

The side effects of this phase of treatment are significant and require being addressed in the finishing and detailing of the case. Envision the result if the treatment progress closely resembled the beginning shape of the “potato chip” arch. Thus there is a judgment of progress in leveling the curve of spee and minimizing the negative side effects. Even this option is more acceptable than earlier orthodontic edgewise heavy force, go-stop, type treatments often resulting in root resorption and other negative side effects and significant patient discomfort. The 2 factors to consider being the type of force application light/heavy, continuous/intermittent and the vectors of force application direction and magnitude.

BIO\ANALYTIC MECHANICS,
LIVING FUNCTIONAL FACTOR +VECTORLOY™ WIRE
= REVOLUTIONARY RESULTS

It has generally been accepted that orthodontic treatment would be divided into half clinical treatment of the malocclusion and the other half of the treatment time managing the side effects of the treatment. To significantly reduce side effects would logically reduce treatment time and potentially enhance the treatment result. This potentially could positively impact retention of treated cases.

We define the specialty of orthodontics to be the art and science of diagnosing and treating malocclusions. When recognizing the considerable education of orthodontic specialists both in didactic (the science) and the clinical skills (the art) the side effects, the treatment time and the retention stability become an integral part of the clinical management or the art portion of orthodontics as a specialty.

Historically the lack of specialist training presented limitations and challenges in orthodontic clinical management of patients. Often practitioners would make statements in recognition of their limitation with the statement "We only do the easy cases and refer out the others".This statement would seem to be responsible and yet does not address or negate the art and science differences in formal training as such. To address the art and science standard of care as practiced by the orthodontic specialist currently would seem to be a logical base (reference point).

With an effort to be politically correct and at the same time accurate, we will endeavor to present the VECTOR III® REVOLUTION not EVOLUTION in relation to new science and new clinical management/treatment of patients. This material may not be comprehensive in its' scope but could be considered a "superficial overview". The VECTOR III® textbook Volume I and Volume II will afford an extensive and comprehensive information source for your awareness and judgment. Please note this material is revolutionary over any orthodontic graduate program in the past and present. It is hoped it will implement a significant advancement in the future of orthodontics both in science and clinical/treatment/management.

NEW SCIENCE:

1. VECTOR III® THEOREM
2. VECTOR III® HYPOTHESIS
3. VECTORLOY™ WIRE

GOOD NEWS FOR ORTHODONTIC SPECIALISTS AND GENERAL DENTISTS ALIKE

A PREMISE TO CONSIDER:

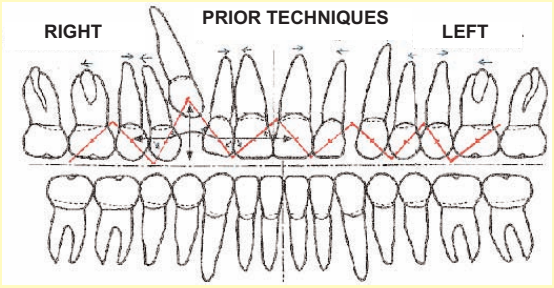
A) If the new science is in the appliance.

B) Bio\Analytic™ mechanics and VECTORLOY™ Wire are incorporated into the VECTOR III® support products. This revolutionary clinical treatment/management of orthodontic patients realistically could reduce the treatment side effects and thus 50% (+-) of treatment time.

THUS: 24-30 months as per the AAO down to
12-24 months per 100 patients with VECTOR III®.

C) Good news, the new science as to how it works and why is far less of a commitment of time and funds as compared to a Graduate Orthodontic Program. The important factor being that it affords the General Practitioner and the Orthodontic Specialist a HIGHER STANDARD OF CARE than current conventional orthodontic treatment.

VECTOR III® IS BEING ACCLAIMED BY EDUCATORS & CLINICIANS AS BEING THE GREATEST ADVANCEMENT IN THE STANDARD OF ORTHODONTIC CARE IN 30+ YEARS.



IN CONVENTIONAL WIRE TOOTH MOVEMENT THE TEETH ARE PRIMARILY MOVED BY TIPPING TEETH ALTERNATELY IN MESIAL, DISTAL, MESIAL, DISTAL ETC. DIRECTIONS, THEREBY RESULTING IN AND EVEN CAUSING NON-PARALLEL ROOT POSITIONING.

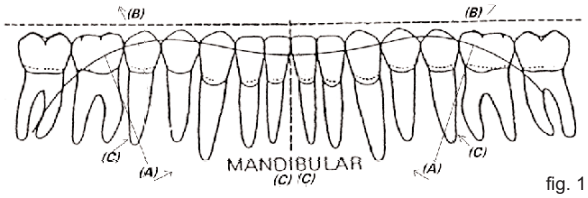


fig. 1

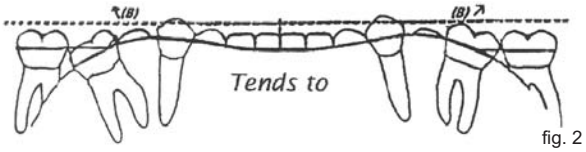


fig. 2

Fig. 1 & fig.2 demonstrate what happens using the conventional "potato chip" design wire.

TENDS TO;

1. TIP CROWNS TO THE DISTAL AND TIP THE ROOTS TO THE MESIAL OF THE 1ST MOLARS.
2. DISTALLY ROTATES THE 1ST MOLARS.
3. MOVES THE 1ST MOLAR MESIAL ROOTS TO THE BUCCAL AS A REACTION TO THE CROWNS TIPPING TO THE DISTAL AND THE DISTAL ROTATION.

VECTOR III® CLASSICS WIRES™ ELIMINATES THESE PROBLEMS!

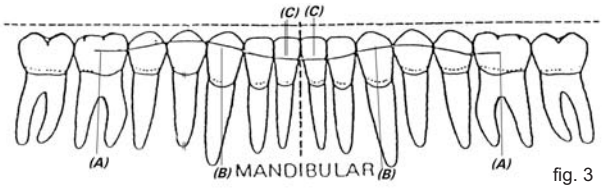


fig. 3

As seen in fig.3 our wires

TEND TO;

1. INTRUDE **NOT** TIP OR ROTATE THE 1ST MOLARS.
2. EXTRUDE THE BI-CUSPIDS
3. INTRUDE THE ANTERIORS (BELOW ARCH BRACKET HEIGHT) WITH **LESS** TENDENCY TO TIP TO THE LABIAL.

GENERALLY TRADITIONAL ORTHODONTIC WIRES FALL WITHIN TWO TYPES;

A. EARLY TREATMENT WIRE WITH CONSIDERABLE FLEX AND RETURN (LOW RATE GRAM PER MM). THEY USUALLY GENERATE HIGHER FORCES (GRAMS) ONLY BY BEING ACTIVATED OVER A CONSIDERABLE DISTANCE. WHEN THIS TYPE OF WIRE IS TIED INTO ALL THE TEETH IN AN ARCH (MODERATELY AND SEVERELY MALPOSED TEETH ALIKE) IT RESULTS IN A SIGNIFICANT "TEETER TOTTER" EFFECT.

B. FINISHING WIRES WITH CONSIDERABLE CONTROL AND HIGH RATE. THEY EXHIBIT HIGH FORCES WITH MINIMAL DEFLECTION. THE DEGREE OF FLEX IS MINIMAL WITHOUT PERMANENTLY DEFORMING THE WIRE.

VECTOR III® CLASSICS WIRES™ PATENTED FUNCTIONAL DESIGN, WITH THEIR HORIZONTALLY AND VERTICALLY ACTING CAPABILITIES, SUPERIOR WIRE WITH HIGH FLEX AND OPTIMAL FORCE, MAKES POSSIBLE SIGNIFICANT REDUCTIONS IN ACTIVE TREATMENT TIMES.

VECTOR III® CLASSICS WIRES™ **are made from a very specially formulated and uniquely heat-treated wire called VECTORLOY™ providing you a wire with superior flex and force control, without brittleness in one wire.**

THE USE OF AWARENESS AND JUDGMENT IN THE CLINICAL DESIGN OF ORTHODONTIC APPLIANCES REGARDING BRACKETS/BANDS.

The vertical dimension (overbite) of orthodontic malocclusions can be addressed/altered in the design off orthodontic appliances.

Brackets and bands in design and positions of placement are clinical factors that require awareness and judgment. There are significant factors that have clinical treatment ramifications. The orthodontic clinical management of vertical dimension (overbite) ranges from a normal range to open bites and the opposite closed bites.

The etiology or cause is to be part of the diagnosis and treatment plan but is not being addressed here. The factors of angulated brackets in relation to clinical management of orthodontic malocclusions needs to be evaluated in parts. A separate evaluation of posterior segments is useful. Two factors that are significant are ;

1. Angulations of brackets/tubes
2. The placement or position on the tooth in relation to the incisal/occlusal surfaces. The “high or low” position as it were on the crown of the tooth.

Awareness of the factors and judgment for the individual malocclusion being the objective here not the traditional or the “cookbook” approach. When one evaluates the normal range of vertical dimension (overbite) in a malocclusion the upper and lower would generally each be normal in contribution to the “bite”. When an open bite or closed bite malocclusion is to be addressed the upper and the lower need to be evaluated as to the contribution of each to the “altered bite”. The orthodontic models both upper and lower when placed on a flat plane help evaluate the occlusal plane of each.

It is appropriate to make a commentary statement at this point.
The etiology or cause of a malocclusion may be complex and multiple in nature. The orthodontic intervention for correction of the malocclusion and the clinical management of the side effects of treatment can be expected to be complex in nature also. With that said an effort to be as simple and straightforward , and at the same time acceptable, will be the format and style to continue.

An excellent source of information on this subject material has been found in the textbook, ***TECHNIQUE AND TREATMENT WITH LIGHT-WIRE EDGEWISE APPLIANCES by JOSEPH R. JARABAK, D. D. S., M. S. PhD., LLD. (Hon.) Clinical professor, Department of Orthodontics, Wyler Memorial Hospital Division of Zoller Memorial Clinic, University of Chicago and JAMES A. FIZZELL, B. S. (E. E.) Administrative Engineer, Alnor Instrument Company, Chicago*** See pages 290 thru 295.
VECTOR III® has been given the rights to use this book in it’s entirety. In Chapter II Volume I of ORTHODONTIC PRINCIPLES NOT JUST ANOTHER SPRING BEYOND BIO-MECHANICS TO BIO\ANALYTIC MECHANICS you can find parts of this book.

A shortened synopsis or overview for our purposes is as follows:

Second-order mechanics. Second-order mechanics may be defined as a system of forces that changes the axes of teeth mesiodistally. Second-order mechanics are used to change the mesiodistal axial-relation of either the anterior or the posterior teeth, or both. Second-order tooth movements can be accomplished by two methods. In the first method, the plane of the wire is modified by bending into it a series of short mesiodistal levers that are oblique to the occlusal plane of the teeth.

The same tipping action can be done by stressing a wire, within its elastic limit, in a bracket that has been angulated on the band. This builds treatment into the appliance through the angulated bracket (Holdaway[1]), which is a passive component of the appliance.

As has already been stated, second-order mechanics can be designed to change the long axes of teeth, either mesially or distally. If these mechanics are applied to the anterior teeth, they cause these teeth either to converge or to diverge from the midsagittal plane of the palate and face. The long axes of each of the anterior teeth are caused to converge when the brackets are angulated.

When second-order mechanics are used on the posterior teeth, they tip them either toward (mesially) or away (distally) from the midline. If teeth are tipped toward the midline, the overbite of the anterior teeth is increased, because the vertical dimension between the two dental arches is decreased. If, on the other hand, the posterior teeth are tipped distally, the overbite is reduced because the vertical dimension between the two dental arches is increased.

The factor of bracket/tube placement on the crown of the tooth can be most easily stated as the following: Placement toward the incisal or occlusal surface of the crown tends to intrude a tooth. Placement farther than customary from the incisal/occlusal surface tends to extrude a tooth. The use of judgment in open bites or closed bites can be implemented via awareness.

An example of placement of brackets on lower anterior teeth away from the incsal edge (lower than customary) in a case with a closed vertical (overbite) would be contraindicated using awareness and judgment over “clinical expediency” or “trial and error” causing the opposite from the desired effect of extruding the teeth.

The factors of second-order mechanics to open a bite or close a bite and the factors of angulated brackets and arch wires has now been covered.

The size of the bracket slot .018, .022 etc. in relation to the wire size and shape is also prudent to be considered in appliance design. The torque in the bracket slot and how much the wire “fills up” the slot size is a factor as well as the round, square and rectangular shapes. The modulus of elasticity of the wire, flex and return 100%, without permanent deformation and the rate of force or grams/mm of deflection are additional awareness concerns.

Vector force systems added to the design factors of brackets and wires are significant factors, elastic (rubber bands) forces added to the force systems developed in wires and brackets can augment or negate orthodontic treatment objectives. These factors can be in one, two or three planes of space.

An example of elastics used for Class II mechanics in conjunction with triangular elastics with a Class III component when resolved or added together result in a vector with direction and magnitude of vertical bite opening potential when designed and applied to appliances of brackets and wires. The awareness of elastic forces, rate-gram/mm, not being linear and wires, rate-gram/mm, being linear are additional factors for the development of judgment. The useful rate at the distance range of use is appropriately understood by awareness vs. trial and error or clinical experience (art). The science portion, of the art and science of orthodontics as the specialty, is the “short way home” over “trial and error” or the “cookbook” as the art portion. “The science is in the appliance”. The awareness of that used to develop judgment in diagnosis and treatment planning would not only be an option but an opportunity to practice orthodontics at the highest standard of care, This additionally provides for addressing patients rights for advised informed consent. Sharing and explaining information between doctors, staff and patients. Using information developed via awarenesses and judgment both qualitative and quantitative has the potential to be revolutionary vs. evolutionary with traditional clinical intervention.

A patient must be informed of his or her diagnosis, alternative methods of treatment, and the risks and benefits of each treatment, including the probability of success or failure.

A helpful example in the development of judgment may be the following:
A question to ponder using

If angulated posterior brackets have tip back angulations to augment vertical opening would reversing right and left sides tend to close a bite in cases with an open bite? * NOTE As the 1st step determine the contribution of the upper and lower arches to the open bite.