อบทท. องค์กรผู้บริหารทันตแพทยศาสตร์ศึกษาแห่งประเทศไทย

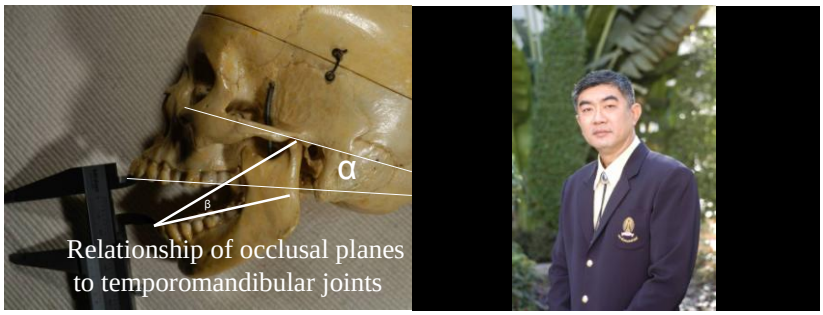
Academic Meeting and Research Presentation during February 18-20, 2009 at Brookeside Valley Resort, Rayong.

Title: **Relationship of Occlusal Planes to Temporomandibular Joints**

Submission Abstract ID: S-099: Fri.20th Oral session, O-22, Time: 08:50-09:05 ThongPlu

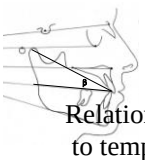
Vichet Chindavanig B.Sc., D.D.S., Dip. Post-grad. (Prosthodontics), Cert. of Proficiency in Combined Prosthodontics, M.S. (Oral Sciences), Dept. of Prosthodontics, Faculty of Dentistry, Chulalongkorn University; vichet_cu@hotmail.com

Somsak Chengprapakorn B.Sc., D.D.S., M.D.Sc., Dip.Th.B.O., Dept. of Orthodontics, Faculty of Dentistry, Chulalongkorn University



Before I speak for this scientific paper, I would like to thank the “Scientific Subcommittee” for the opportunity they approved this topic.

I also thank my deputy dean on research affairs who has made this presentation possible, Dr. Suchit Poonthong for his remarkable collaborative works.

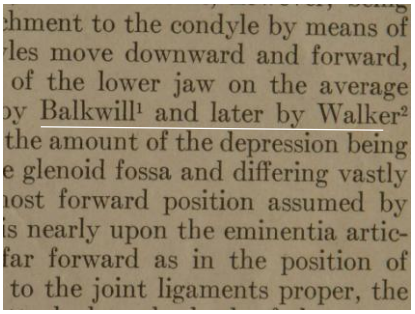


Relationship of occlusal planes
to temporomandibular joints

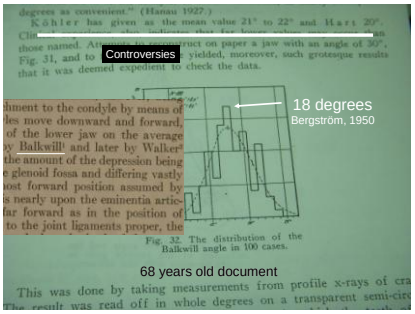
The ultimate goal at this moment is to share knowledge and exchange opinion among scholars who bear the burden in leading dental education.

Vichet Chindavanig วิเชฎฐ์ จินดาวณิค
B.Sc., D.D.S., Dip. Post-grad. (Prosthodontics),
Cert. of Proficiency in Combined Prosthodontics, M.S. (Oral Sciences)
Somsak Chengprapakorn สมศักดิ์ เจิ่งประภากร
B.Sc., D.D.S., M.D.Sc., Dip.Th.B.O

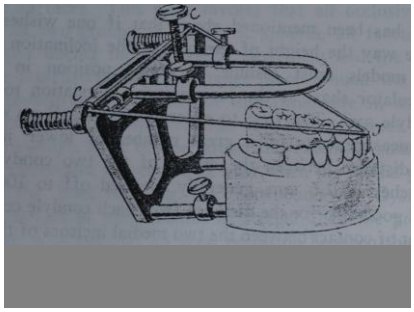
I am here today by the task of perusing the nature of human gnathostomatic system, searching for ideal relationship, where upon could take benefit of understanding this system, and then apply this knowledge to our patients.



This research topic is not new, but it is somehow extraordinary, because its citation from several scientific publications is rare.

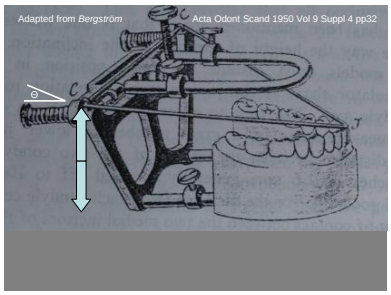


In regard to this research topic, among Caucasian data, there were *only few references*. And within all references, the existence of the latest data was the 27-year-old publication[9]. And far beyond our time, the first citation was dated back 140 years ago.

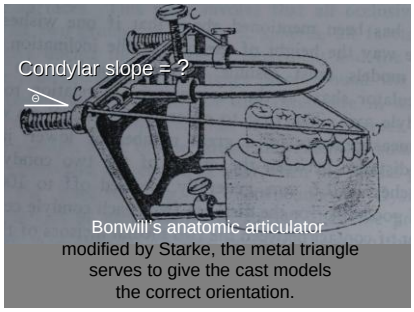


This is an archive picture, the metal triangle, *representing Bonwill triangle*. This was possibly the *first attempt* to relate mid-incisor tip of lower incisors to rotational axis of the condyles.

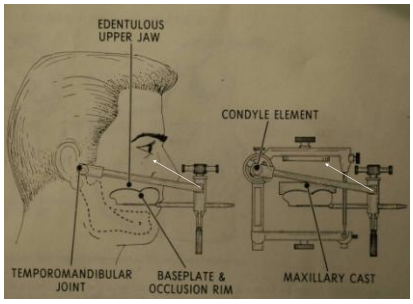
This smart mechanism seems to be the origination of the face-bow concept.



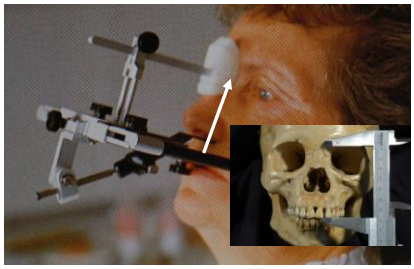
However, the height of condylar column does not agree with the actual height of the vertical part of the mandible, and in particular, the moving condylar head does not work on a slope.



Dated back 150 years ago, this revolutionized articulator was named *Bonwill's anatomic*. Would it be exiting to see a jaw model like this? By that date, it was the time my grandfather was unborn.

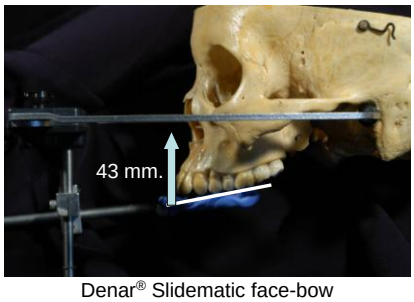


At present, the relationship of occlusal plane to temporomandibular joints is determined by a pointer. It indicates an anterior determinant. And that anterior determinant is inferior rim of the *orbitale*.



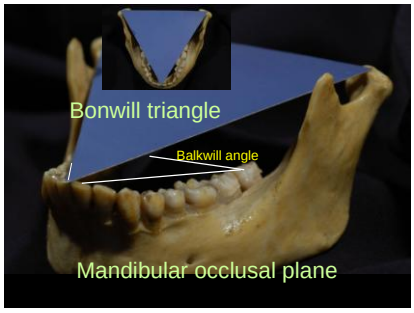
Nasion landmark between nose and forehead provides stability to weight of the face-bow

Another different method, *nasion*, another different landmark, is used as an anterior determinant.



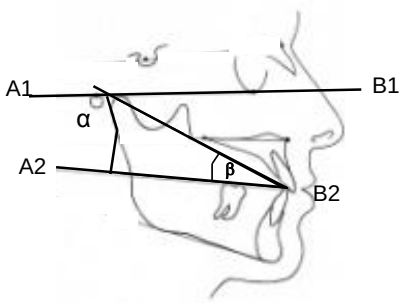
Denar® Slidematic face-bow

This is another condition. A predetermination of a fixed distance, 43 mm. is instructed by its manufacturer, Denar® Corporation, from California. This fixed distance is to apply with a Slidematic face-bow. Its purpose is *to indicate* another selected anterior determinant.

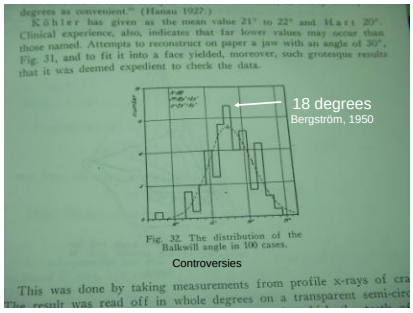


Now back to our issue. There is another *anterior determinant* that is derived from angle value. It is called "Balkwill angle" or β. This term was neglected, and none of us have paid attention to its value. This angle composes of two planes, *(pointing at the figure)* the mandibular plane, forming by the white triangular configuration, and the "Bonwill triangle".

(In recognition to *Dr. Balkwill*, Dr. Fransis Hancock Balkwill was a British dentist who made researches on the fundamentals of articulation. His life was dated back 150 years ago. He proposed the angle value, β, about 15 years after Dr. Arlington Williams Gibson Bonwill proposed equilateral triangular hypothesis, or "Bonwill triangle".

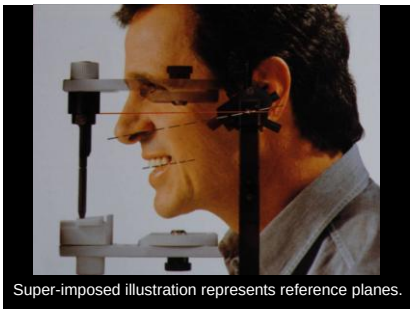


From this figure, the symbol βeta, stands for Balkwill angle. And the symbol αlpha, stands for the angle between maxillary occlusal plane and Frankfort plane.



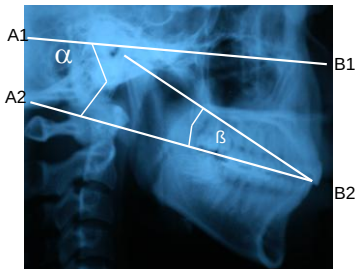
Besides controversies of these values, now it comes to the *main hypothesis*, that skull dimension and shape may slightly differ among individuals, races and genders. And the method or accuracy utilized in determination has to be questioned.

Despite the *Balkwill angle*, *the relationship between maxillary occlusal plane and Frankfort plane* is also to be questioned as well. Due to the fact that Asians mean values of both anterior determinants have never been reported, this study aimed at investigating these values. (Objective)



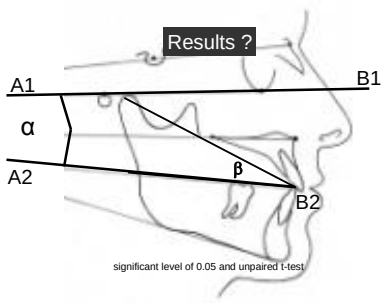
Thereby, the results could be used to explain and brought up to compare with other previous reports from the western world, following by applicating the data to face-bow recording, cast mounting and articulator design.

Eighty lateral cephalograms (40 males and 40 females) of Thai adults, their mean age were 23 years old. Subjects whose dental arches were symmetry, and most posterior teeth are present were selected, and collected for raw data.

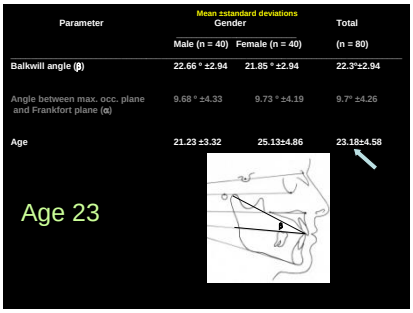


The criterion of each adult subject is that, molar loss in each arch is one tooth or none. Identification of anatomical landmarks and reference points was done on a view box with standard tracing devices.

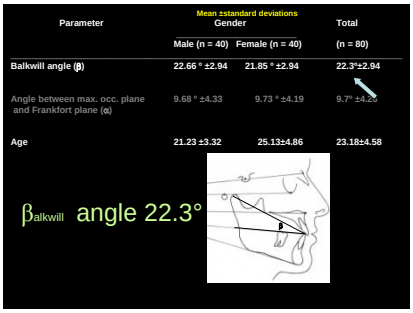
Later on, statistical values of αlpha, and βeta, were calculated. Statistical calculations at the significant level of 0.05 and unpaired t-test were conducted.



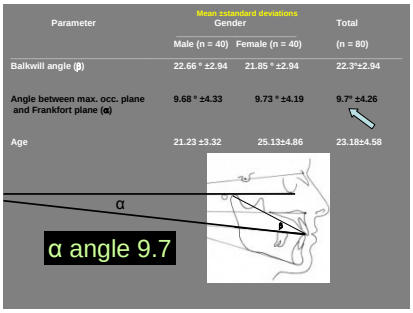
Line A2-B2 represents occlusal plane of the lower jaw. It could be the upper jaw as well, but under the circumstance that there is closed contact in centric occlusion.



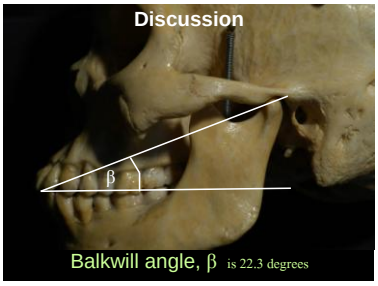
This table is the result. Regarding the subject *age*, at the third line, interpretation of the data indicates that the mean age in year-old of the subjects is 21 among males, and 25 among females.



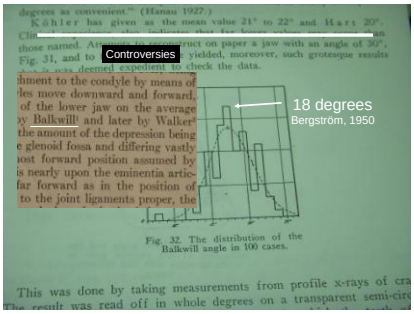
And reading at the first line, the calculated mean Balkwill angle or βeta from all subjects is 22.3 degrees.



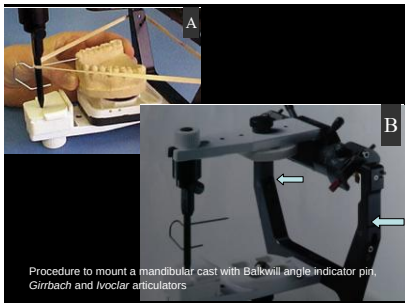
Again, reading from this table, αlpha value, or the angle between Frankfort horizontal plane to the occlusal plane, from all subjects is 9.7 degrees. Statistical calculation with unpaired t-test of both angles demonstrates that there is no significant difference of all measurements between sexes at 95 percent confidence.



My discussion would be that, one of the anterior determinants that *rules over* the relationship of occlusal plane to the temporomandibular joints is *Balkwill angle*. Dr. Balkwill in 1866, 143 years ago, had stated, defined, and given the angle value of 26 degrees. However, the finding of this study is 22.3 degrees.

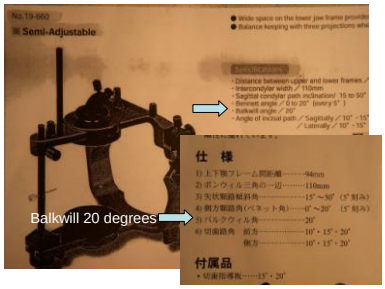


It differs from Köhler's (21 degrees)[3], Hart's (20 degrees)[3,5] and Bergström's (18 degrees)[3].

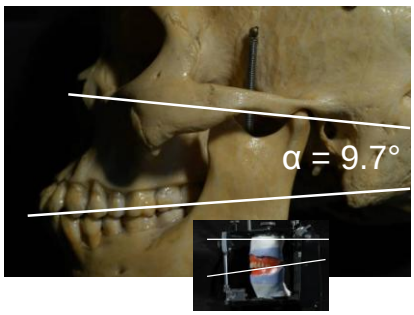


As a reference value, a Balkwill angle of 25 degrees has been recommended for the usage with some European articulators, for instance, the Artex® made by Girrbach from Germany, and the Ivoclar® from Lichtenstein.

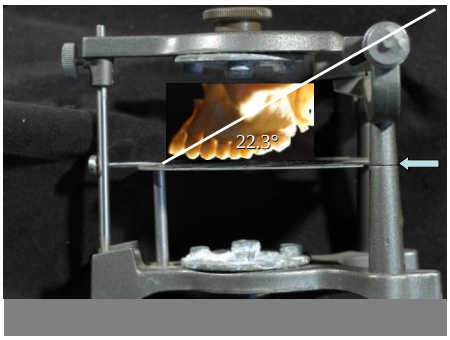
In order to indicate the angle, an indicating pin is used to determine the midsaggital point between lower central incisors



However, the German made Kavo®, and the Japanese made in this figure, Spacy® articulator, recommending 20 degrees (Balkwill angle, β).



Another anterior determinant to be discussed is the angle between occlusal plane and Frankfort plane. Dr. Ricketts[8], one of the profound orthodontist, had given the norm value of 8 degrees. But the finding value among Thai population is 9.7 degrees.

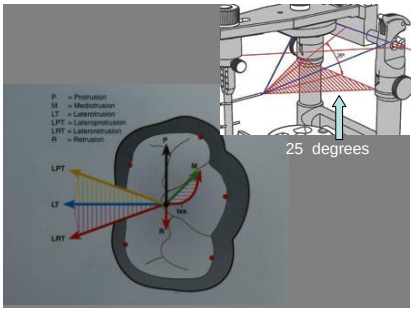


Consequential for success with this is *fundamental knowledge*, in getting better precision, but without a face-bow, the indicator pin will minimize error. Therefore, setting a dental cast with average Balkwill angle could possibly be an *"ergonomic answer"* to the face-bow and articulator design, of which their details will be left for further discussion.

Too far inward, and downward misplacement

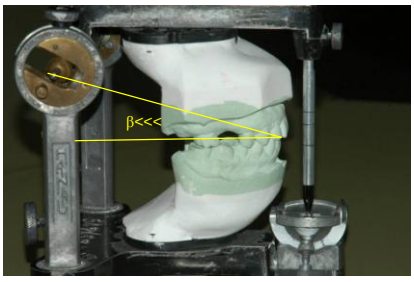
My criticism is that the mandibular cast is too far inward and downward, because many dental personnel have worked without knowing the mean values and their importance.

Corrective measures require know-how, since common errors often appear in dental clinic and laboratory.



Artex recommending setting at 25 degree

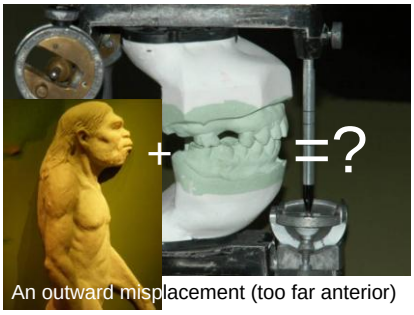
Such errors in positioning the dental casts, affect directly to incorrect lateral movement paths of the mandible, for instance, mediotrusion, laterotrusion, lateroprotrusion, lateroretrusion and perhaps the path of immediate sideshift. The curve red arrow and ISS in this figure stands for the immediate sideshift.



An outward misplacement (too far anterior)

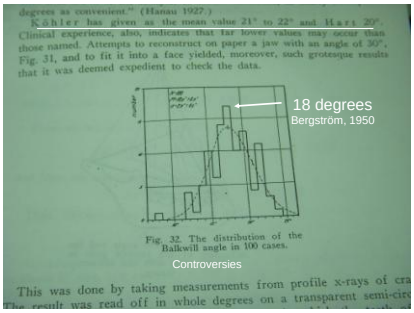
From geometrical point of view, Balkwill angle, β, also takes part and influences to cusp height and occlusal form of the tooth.

Notable deviations of Balkwill angle applied to working casts in this figure, and that of beyond *human physiological limitation* will certainly trigger gnathostomatic disturbances.



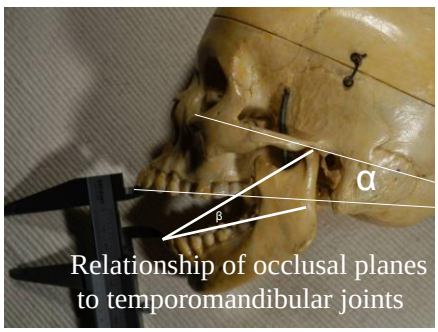
This is a *burning figure*. Cast misplacement makes another meaning, isn't it?

Balkwill angle value was rarely emphasized in dental reports, as well as teaching in dental schools. Many well-known classic documents in orthodontics[6, 7, and 8] have never revealed this value.

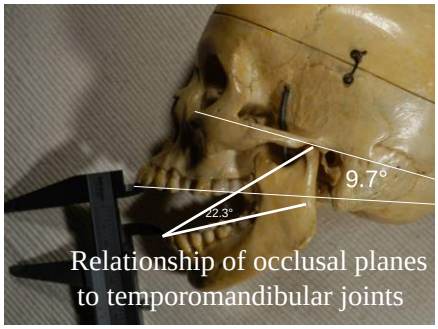


Moreover, classic articles in prosthodontics briefly mentioned this value without declaration, but with exception to Bergström that his publication (above fig.) contained a histogram.[3]

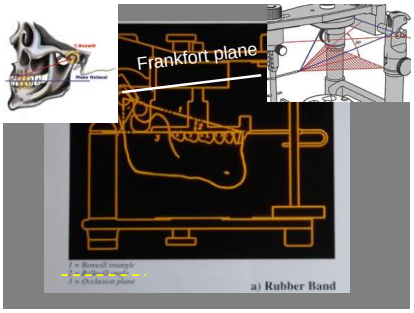
As far as descriptive articulator specification is concerned, only few models specify this value to users.



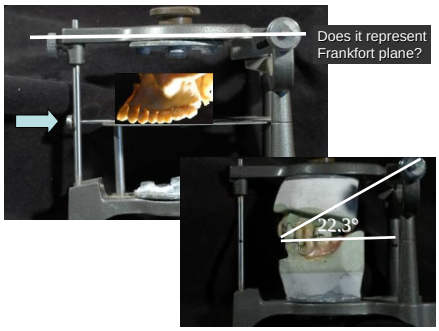
And that of the importance to this value, not many users had really understood what it is, or how it was derived.



Another angle, the angle between occlusal plane and Frankfort plane, 9.7 degrees value, may helpful to mount maxillary cast to the articulator. This value is meaningful to relate occlusal plane with Frankfort plane.

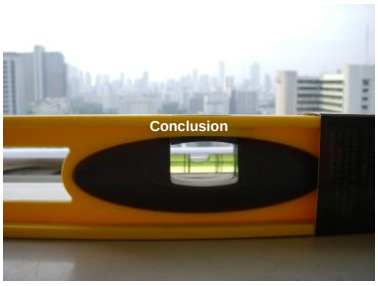


But it is only with the articulator to which its design has made the upper member platform of that articulator representing the Frankfort plane.

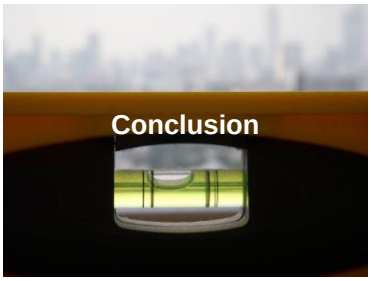


In order to maintain precision, and to minimizing mounting error, the mounting procedure with Balkwill angle, should perform with a metal plate which representing the occlusal plane.

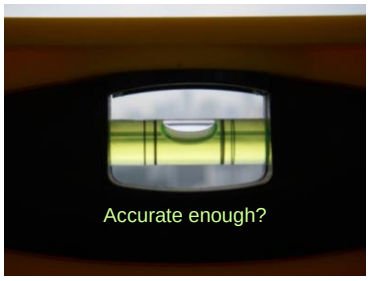
At this point, I have reported the finding and importance of these two determinant values.



Too often, though, technology ends up our way rather than passing the path to our own success.



This investigation is the wish for *how technology could be simply modified*, with the diminished "know-how and knowledge" which has been neglected and rarely emphasized in dental education.

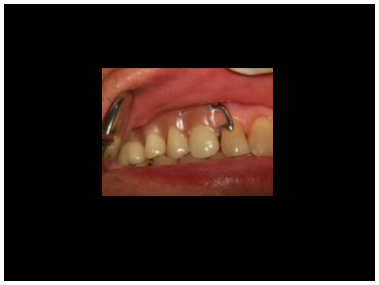


This premise may live-up to ones whose imagination inspiring to which precision is the promise.

Besides, the better mandibular kinetics we would get with the use of these mean values to mount dental cast to articulator, in addition, these values are interesting regional anthropological determinant.

This has been a part of my main-frame research, dedicating to the topic *"Articulator and its armamentarium"*. It is the simulation of human jaw biomechanics, or in other words, reproduction of dental articulation.

Because the physical events occurring with human masticatory system during normal function and dysfunction are difficult to conceptualize, therefore, the simulation of structural and functional elements working together is useful when it accounts for cause and effect. Modeling requires postulation that can be demonstrated, explained, defended or altered.

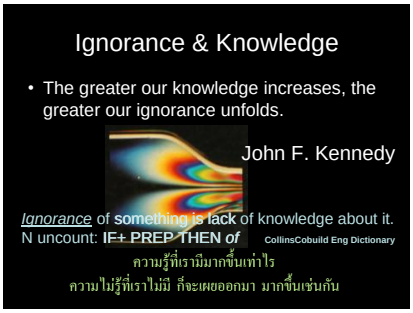

VDO clip showing moving clasp and rocking denture

From this short script motion picture, we see how improper movement of the partial denture is. So, there comes a question that how we could make a better occlusal relation in dental laboratory, the relationship that would make a *perfect* denture occlusion.

All factors relating to jaw modeling invite informed speculation, searching for natural values in numeric, understanding human gnathostomatic system. And for many different scenarios, it could be constructed to explore new ideas, could develop novel hypotheses, and could gain insight into the consequences of system variations.

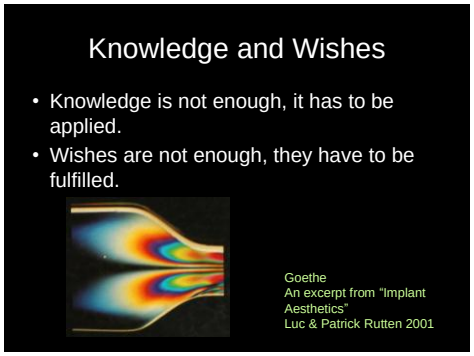
Finally, I hope to meet you again to describe this issue sooner or later.

I thank my associate researcher, an orthodontist, Dr. Somsak Chengprapakorn who spent his precious time, collecting, and compiling the research data.



By now, few slides would remind you, the reality and our nature. All are true or not, they will be left to your justification.

Now, I would turn the microphone to the *scientific committee secretary*. Thank you.



References

1. The Academy of Prosthodontics, The Academy of Prosthodontics Foundation. The Glossary of prosthodontic terms. J Prosthet Dent. 2005;94:10-92.
2. Hoffmann-Axthelm W. History of dentistry. Chicago: Quintessence, 1981.
3. Bergström G. On the reproduction of dental articulation by means of articulators. Acta Odont Scand. 1950; 9(Suppl. 4):3-149.
4. Balkwill F H. The best form and agreement of artificial teeth for mastication. Trans Odont Soc. 1866;5:133-58.
5. Hart FL. Full denture construction. J Am Dent Assoc. 1939;26:445-61.
6. Ricketts RM. The keystone triad I. Am J Orthod. 1964;50:244-64.
7. Ricketts RM. The keystone triad II. Am J Orthod. 1964;50:728-50.
8. Ricketts RM. Provocations and perceptions in cranio-facial orthopedics. 1st ed U.S.A.: Jestens, 1989.
9. Ohm E, Silness J. The size of the Balkwill angle and the height of the Bonwill triangle. J Oral Rehabil. 1982;9(4):301-6.

Table 1 (Results)

Parameter	Gender		Total
	Male (n = 40)	Female (n = 40)	(n = 80)
Balkwill angle (β)	22.66 º ±2.94	21.85 º ±2.94	**22.3º**±2.94
Angle between max. occ. plane and Frankfort plane (α)	9.68 º ±4.33	9.73 º ±4.19	**9.7º** ±4.26
Age	21.23 ±3.32	25.13±4.86	23.18±4.58