

大学の世界展開力強化事業
東南アジア医療・歯科医療ネットワークの構築を目指した
大学間交流プログラム

国際セミナーⅡ

「現在および将来における歯科矯正学の原理」

International Seminar II
“Current and Future Principles in Orthodontics”

2013 年 4 月 10, 11 日



東京医科歯科大学
TOKYO MEDICAL AND DENTAL UNIVERSITY

目次

	ページ
1. 開催概要	1
2. 講演内容	2
3. 発表スライド (抜粋)	5

1. 開催概要

本セミナーは、大学の世界展開力強化事業「東南アジア医療・歯科医療ネットワークの構築を目指した大学間交流プログラム」の一環として、日本の東京医科歯科大学歯学部とベトナムのホーチミン医科薬科大学歯科口腔医学部間で開催された合同セミナーである。本学の有する最新の臨床技術や研究内容についての発表、意見交換、知識の共有を通じ、両大学の教職員間のコミュニケーションを密にする共に、将来を嘱望されている若手研究員が本学への留学を希望するモチベーションを与えることを目的として開催された。

開催日時	2013 年 4 月 10、11 日
開催場所	ホーチミン医科薬科大学 歯科口腔医学部
開催責任者	ホーチミン医科薬科大学 歯科口腔医学部 矯正歯科分野 Prof. Dong Khac Tham

式次第

「現在および将来における歯科矯正学の原理」

“Current and Future Principles in Orthodontics”

4 月 10 日

14:00 - 17:00 Part 1 『歯の自家移植と未来の歯科矯正学』
- Tooth Autotransplantation for Future Orthodontics -

4 月 11 日

8:00 - 10:30 Part 2 『咬合機能低下歯の生物学』
- Biology of Hypofunctional teeth -

13:00 - 16:15 Part 3 『口腔機能不全と脳機能：関係はあるのか』
- Oral Dysfunction and Brain: Is There Any Relationship? -

16:30 - 17:00 L&H wire bending 実演講義

2. 講演内容

国際セミナーⅡ

“Current and Future Principles in Orthodontics”

Part 1

- Tooth Autotransplantation for Future Orthodontics -

日時 2013年4月10日 (水) 14:00 ~ 17:00

場所 University of Medicine and Pharmacy at Ho Chi Minh city

演者 小野卓史 (東京医科歯科大学 歯学部副学部長、咬合機能矯正学分野教授)

参加者 約70人

要旨

当分野では、先天性欠損歯、喪失歯、予後不良歯、外傷歯、不良補綴物を有する症例において、歯の再排列を行うため便宜的に抜去した歯を該当部位に移植する『歯の自家移植治療』を併用した矯正歯科治療に積極的に取り組んできた。自家移植治療は、便宜的に抜去する歯を再利用することができるため、天然歯を減らさないという意味において、非常に有用な治療方針の一つであり、現在世界中の臨床の現場において広く行われている。しかし、術後にアンキローシスや歯根吸収を起こしてしまうリスクもあり、未だその要因など不明な点も残る。近年の報告によると、歯根膜腔が広く、強い生活反応を有する歯根未完成歯であると、術後合併症のリスクを抑えることができるとして、世界的に受け入れられている。しかし、昨今の我が国の歯科矯正事情において、歯根の完成している成人患者の割合が増えてきていること、また予後不良歯など自家移植治療の検討を要する背景を持つ患者も増加傾向に有ることから、歯根完成歯の移植治療における術後合併症の病態究明およびそのコントロールが必要とされてきた。このような背景から、当分野では自家移植後のアンキローシスや歯根吸収の原因を追究すべく、動物実験により検討を重ねた結果、適切な咬合力を移植歯に加えることで、アンキローシスを防ぐことができる、という結論に至った。この知見を臨床に応用し、自家移植後の移植歯に、当分野で開発した改良型超弾性 NiTi ワイヤを用いて矯正力を治癒転機初期から移植歯に適応させるプロトコールを作成し、文献的な自家移植成功率を上回る良好な成績を上げている。

本章では、当科で開発したプロトコールを紹介しながら、多数の成功症例の供覧だけでなく、失敗した症例についての言及も含め、自家移植を併用した矯正治療について手ほどきする。

Part 2
- Biology of Hypofunctional teeth -

日時 2013 年 4 月 11 日 (木) 8:00 ~10:30
場所 Petchara Techagampuch room, Somdech-Yha Building, 2nd floor,
Chulalongkorn University, Thailand
演者 小野卓史 (東京医科歯科大学 歯学部副学部長、咬合機能矯正学分野
教授)
参加者 約 60 人

要旨

矯正歯科治療はどんな意義があるのだろうか。不正咬合を治療することで、咬合力が増す、顎運動が改善する、発音が明瞭化するなどの顎口腔領域における機能回復、および顔貌における審美的改善などを期待できる、と多くの臨床家らは考えているだろう。しかし、その科学的根拠に関しては長年にわたって議論がなされてきた。正常咬合と不正咬合の違いとは何か。矯正治療ではどのような咬合を目指すのか。そもそも、どうして我々は不正咬合患者を治療するのだろうか。

当分野では、『咬合機能低下歯における生物学』と評し、咬合刺激の低下した歯および歯周組織にはどのような変化があるのか、健全な顎口腔領域の成長や維持に咬合刺激がどのような役割を果たしているか、について生理学と組織学の両面から長年にわたり研究を進めてきた。その基礎研究結果を体系的に示すだけでなく、現在進行している唾液腺や味蕾などにおける最新の研究データを紹介する。一方で、臨床の現場において咬合刺激低下歯に対し矯正力を加える際に起こりうるリスクなどを紹介しながら、主に咬合刺激低下状態を呈する開咬患者の症例を供覧し、咬合刺激低下歯の生物学について詳説し、矯正歯科治療の意義について考える。

Part 3

- Oral Dysfunction and Brain: is there any relationship? -

日時 2013 年 4 月 11 日 (木) 13 : 00 ~ 16 : 00

場所 Petchara Techagampuch room, Somdech-Yha Building, 2nd floor,
Chulalongkorn University, Thailand

演者 小野卓史 (東京医科歯科大学 歯学部副学部長、咬合機能矯正学分野
教授)

参加者 約 60 人

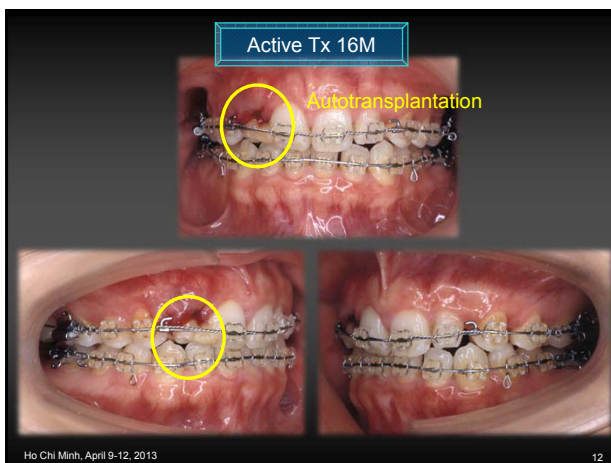
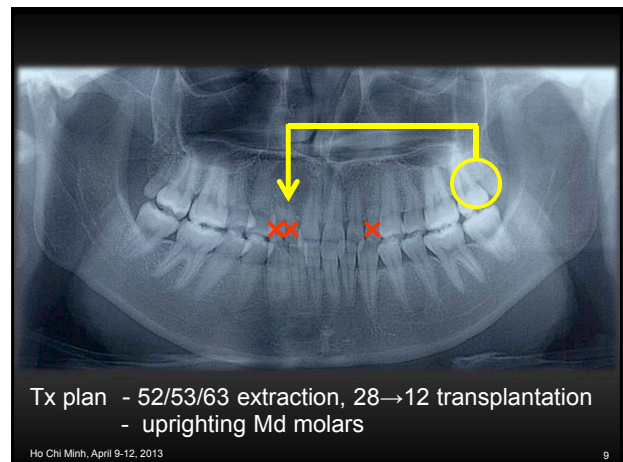
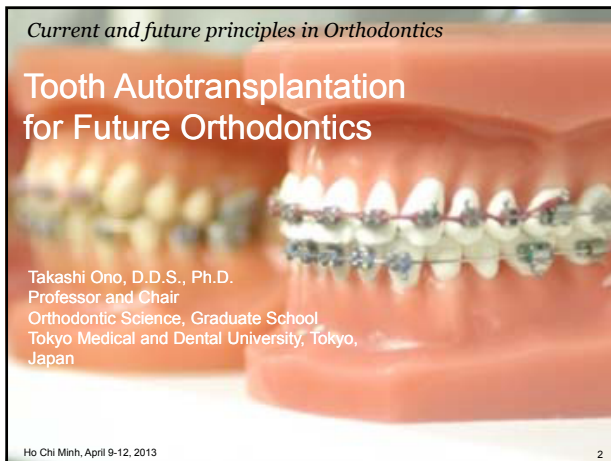
要旨

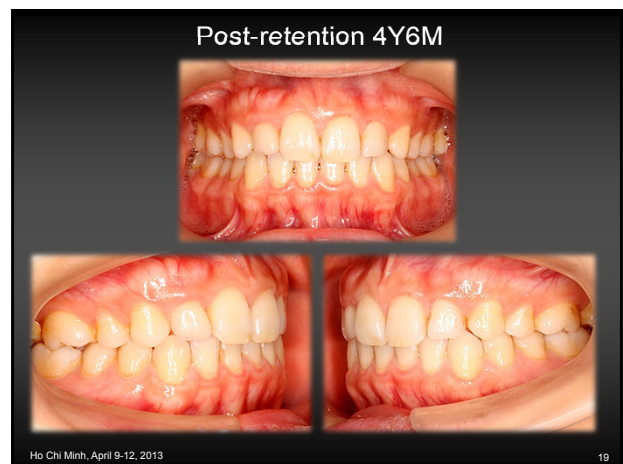
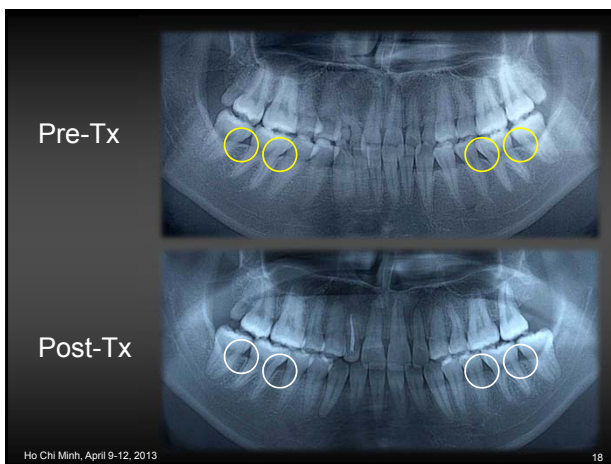
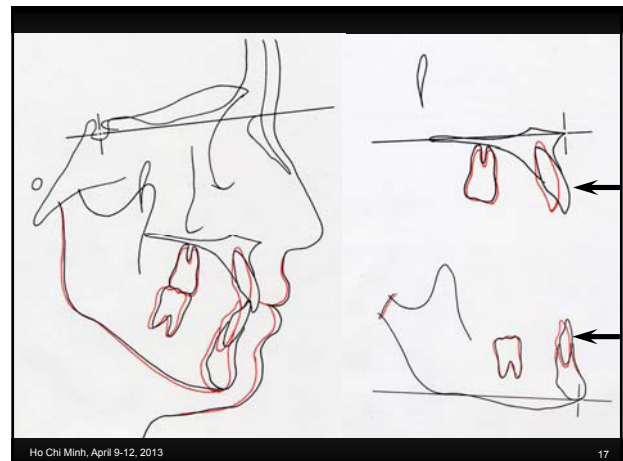
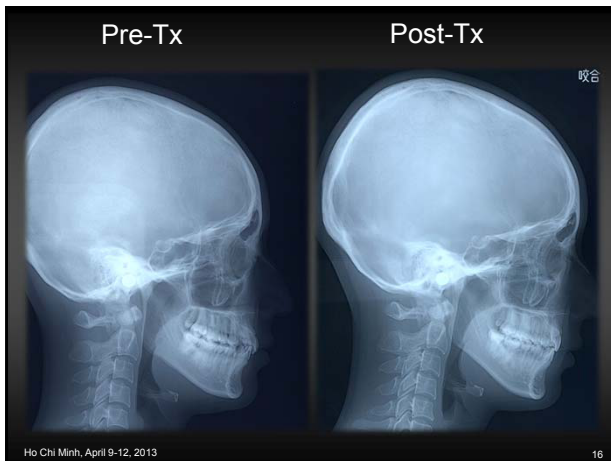
歯科矯正学は、不正咬合に関する顎顔面領域における機能不全についての学問である。顎口腔領域は多くの器官によって構成されており、咬合だけでなく、咀嚼や嚥下、呼吸や発音など様々な機能が営まれている。咬合の不調和が、顎口腔領域機能の障害を惹起することがあり、また悪習癖などの機能的要因によって不正咬合が惹起されることもしばしば経験され、その関連性について数多くの報告がなされている。すなわち、矯正歯科治療を行うにあたり、審美的な側面だけでなく、機能的な側面も合わせ包括的な改善を目指さなくてはならない。

一方、脳は全身の器官を制御する最上位のコントロールセンターである。脳の不調和が全身に与える影響は計り知れない。最新の MRI 技術を応用した顎口腔機能の解析から得られた知見により、顎口腔機能が脳の活動に影響し、脳内の可塑的变化を起こすことが分かってきた。つまり、矯正歯科治療は顎口腔領域だけに目を向けるのではなく、脳機能との関連についてもこれから注目すべきだと思われる。

そこで、本セミナーでは、症例や基礎研究データを用いて、咬合高径や発音、咀嚼などの顎口腔機能に関わる可塑性についての説明や、近年の研究結果まで話題を提供し、「口腔機能と脳機能の関連」について提言を行う。

3. スライド資料(抜粋)





Autotransplantation

Autotransplantation is one of reliable treatment options →

- agenesis of teeth
- lost teeth
- trauma
- poor prognosed teeth etc...

Advantages

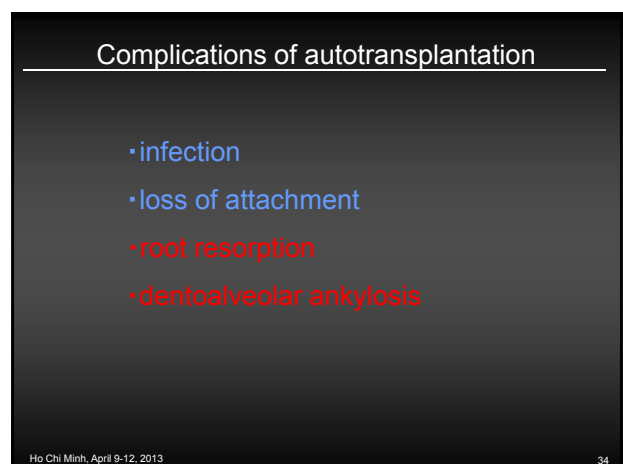
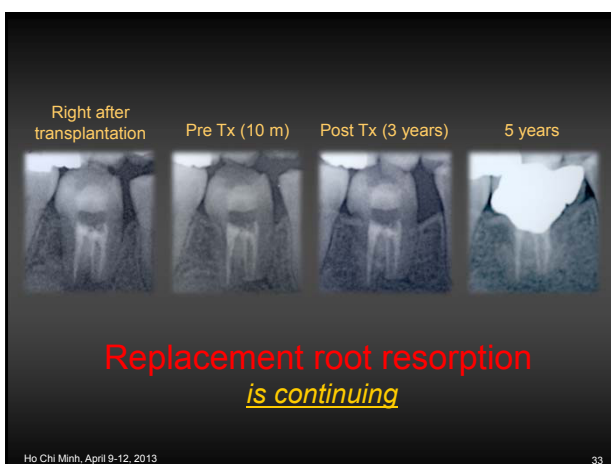
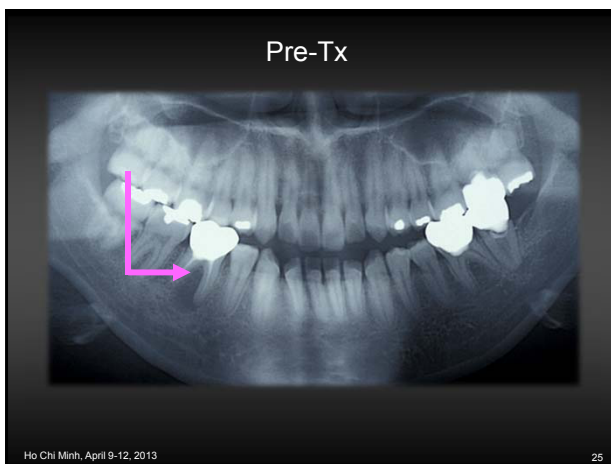
- ✓ To avoid prosthetic treatment
- ✓ To utilize the extracting tooth by orthodontic treatment
- ✓ To prevent reduction in the teeth number

Disadvantages

- ✓ Involvement of surgical procedure
- ✓ Extended treatment time
- ✓ Doubtful prognosis compared to conventional prosthetic treatment

Ho Chi Minh, April 9-12, 2013 21





Keys for successful autotransplantation

Procedure factors

- careful management of PDLs
- fixation

Host factors

- age
- donor tooth
- periodontal pocket depth
- root canal treatment
- multi-rooted teeth

Ho Chi Minh, April 9-12, 2013

35

How does ankylosis occur?

- PDL of donor tooth may injury during extraction
- Root does not fit normally in the socket
- long-term & rigid splinting after transplantation

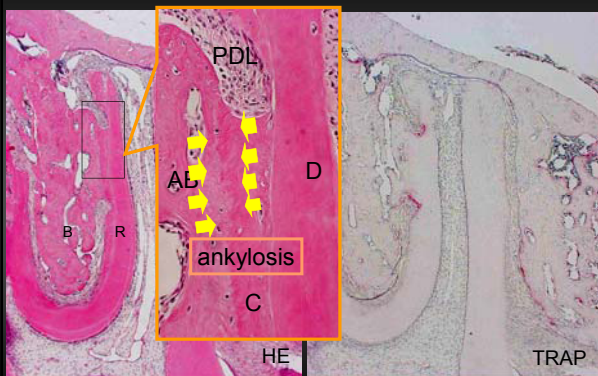
Andreasen et al. Endod Dent Traumatol 1995;11:51-58.

→ Occlusal hypofunction

Ho Chi Minh, April 9-12, 2013

36

Without occlusal stimulation

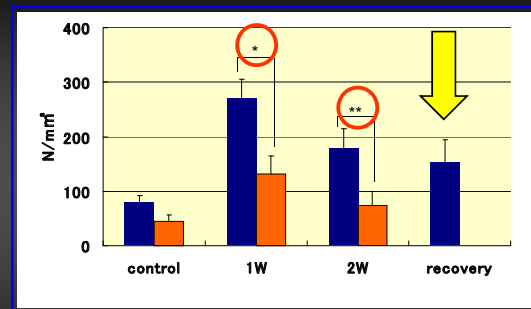


Ho Chi Minh, April 9-12, 2013

Mine et al. Angle Orthod 2005;75:545-552

39

Number of BrdU-positive cells



■ Occluded group
■ Non-occluded group

** : $p < 0.01$

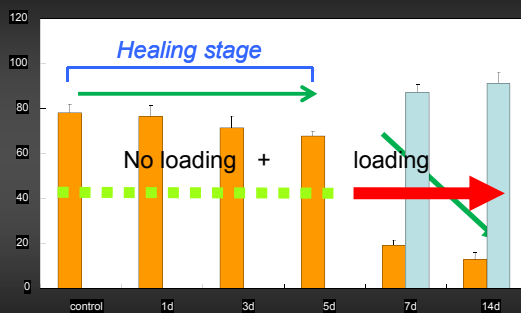
* : $p < 0.05$

Mine et al. Angle Orthod 2005;75:545-552

Ho Chi Minh, April 9-12, 2013

Mine et al. (2011) 42

Number of iNOS-positive cells



Cellular activity is enhanced after loading

Ho Chi Minh, April 9-12, 2013

Chen et al. J Med Dent Sci. 2005;52:59-64.

43

But, those results were **not consistent**

This might because of the unstability of occlusal contact

More appropriate force is needed !

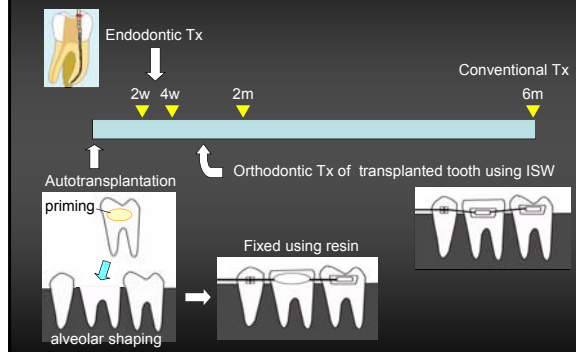
||
Orthodontic force !

Ho Chi Minh, April 9-12, 2013

45

Appropriate mechanical force, which is provided through orthodontic wire, and also in the appropriate timing, may promote periodontal healing after transplantation and prevent ankylosis.

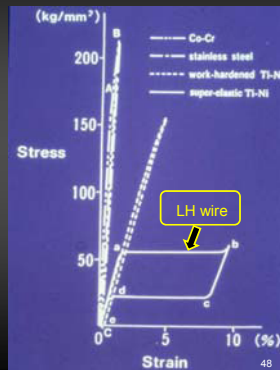
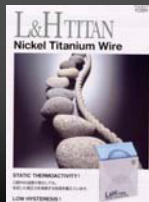
Protocols for autotransplantation



Improved super-elastic Ti-Ni alloy wire (LH wire)

Characteristics

- Shaping memory
- Super elasticity



ISW

On clinic

- Arch expansion
- Mx molar distalization
- Md molar mesialization
- Md molar uprighting
- Mx anterior depression
- Md molar depression
- Application with elastics, J-hook HG, TAD etc.

Light continuous force

- Super elasticity
- Shape memory
- Low hysteresis
- Damping capacity
- Anti-wearing property
- Low ion-release rate
- Photocatalysis

One-wire technique

What's up

- Loading-level control
- Non-invasiveness on periodontal tissue
- Easy to clean
- Effective tooth movement
- Less chair-time
- Less pain

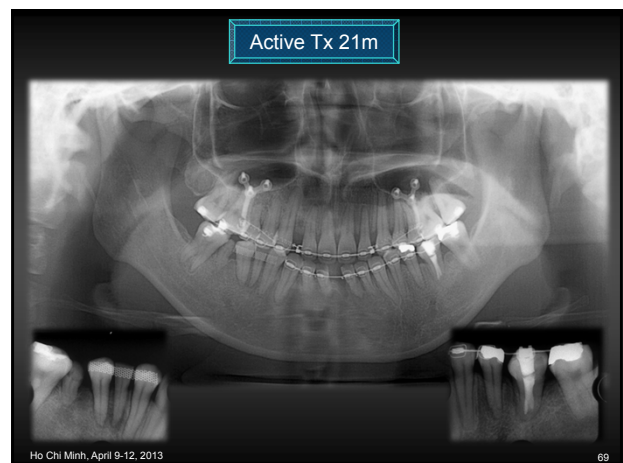
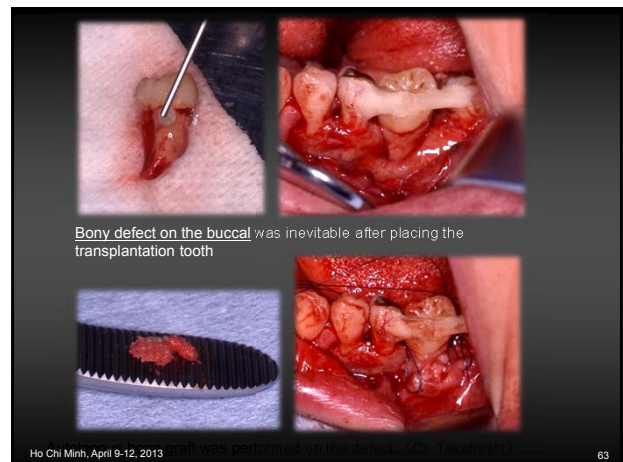
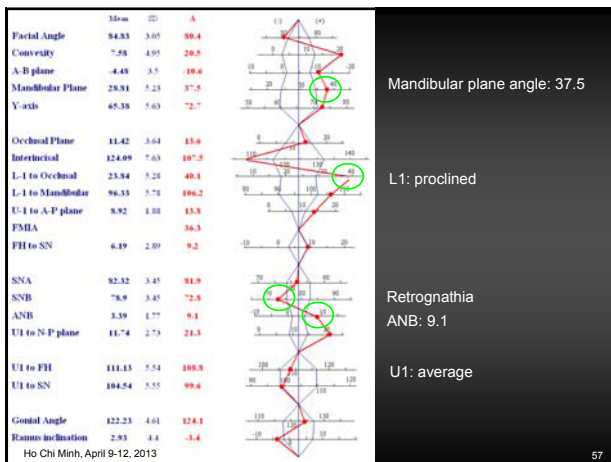
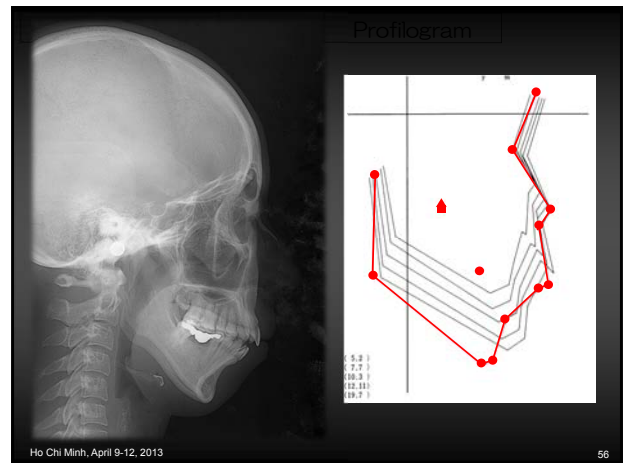
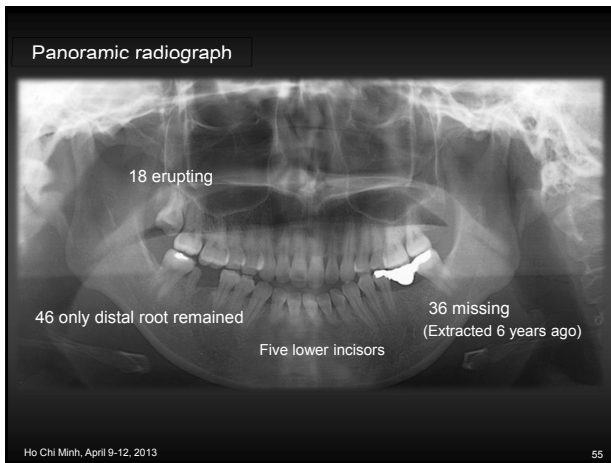
Case #3

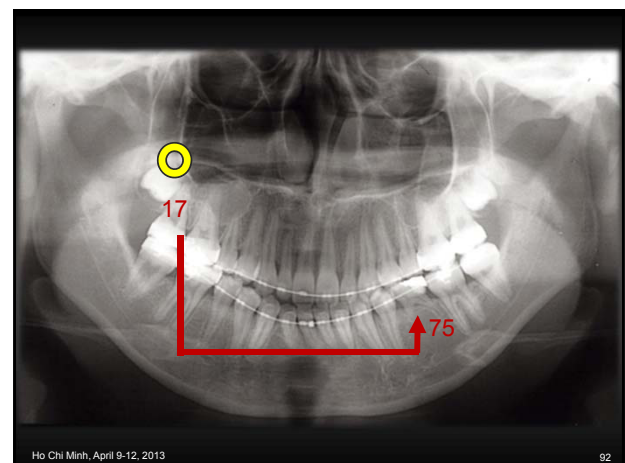
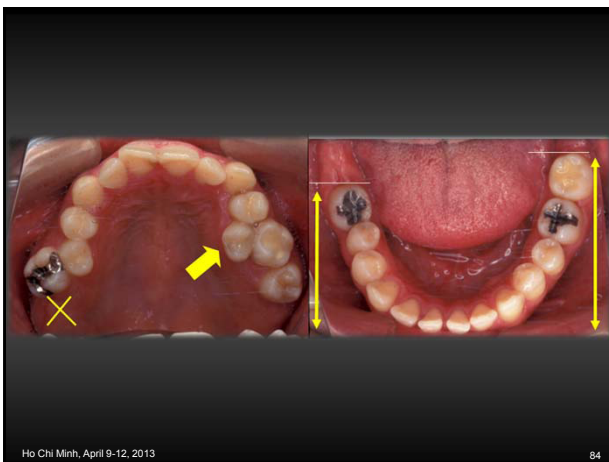


Five incisors



16/26 elongated





After autotransplantation

0 month 1 month 3 months Post-Tx



Ho Chi Minh, April 9-12, 2013

96

Case #6



Ho Chi Minh, April 9-12, 2013

97

Pre-Tx



Ho Chi Minh, April 9-12, 2013

99

Pre-Tx

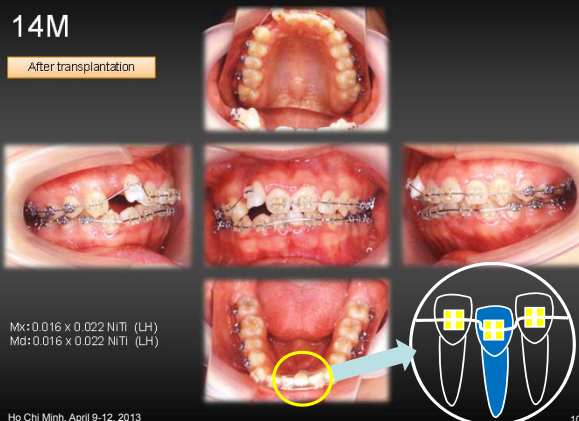


Ho Chi Minh, April 9-12, 2013

100

14M

After transplantation



Mx: 0.016 x 0.022 NiTi (LH)
Md: 0.016 x 0.022 NiTi (LH)

Ho Chi Minh, April 9-12, 2013

108

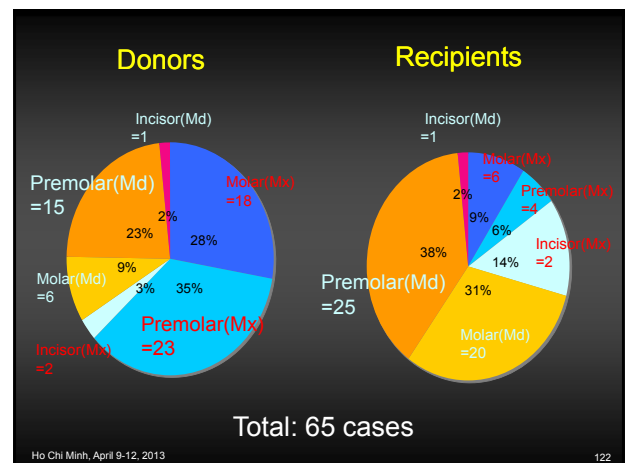
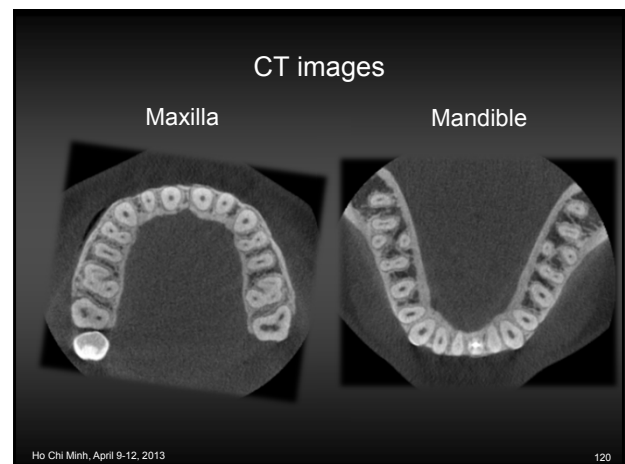
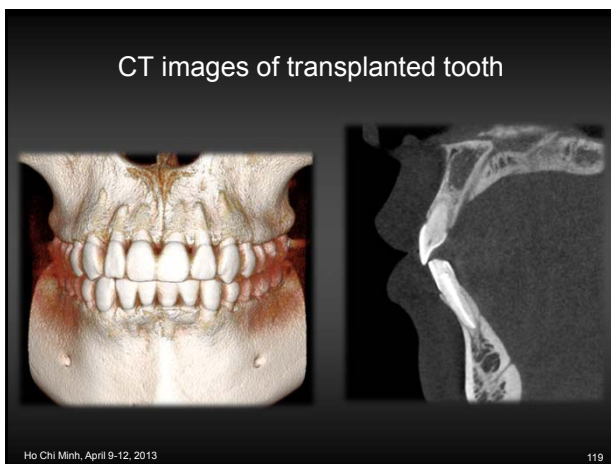
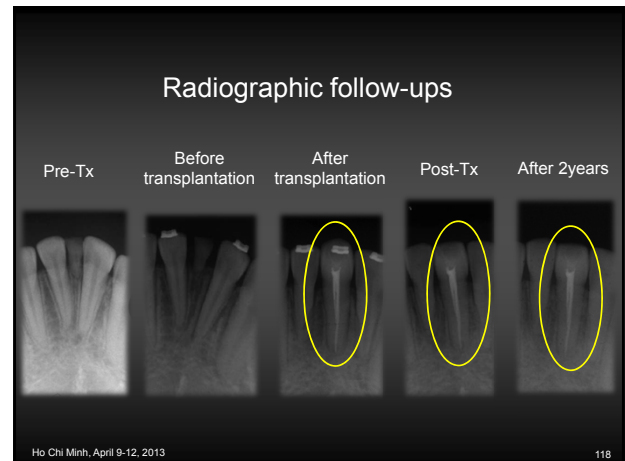
Post-Tx

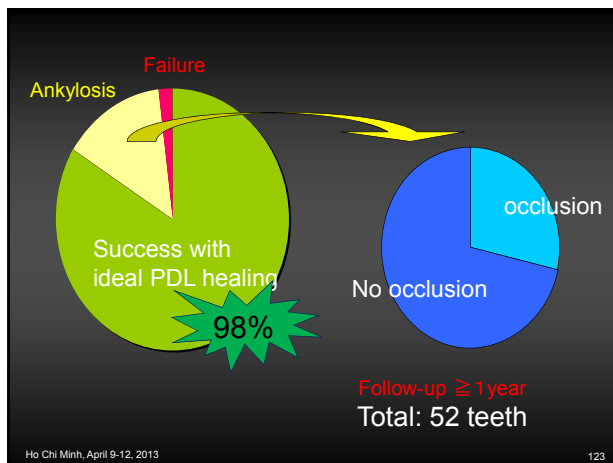
debonding



Ho Chi Minh, April 9-12, 2013

109





Success rate in the literature

Success Rate	Author	Journal	Year	n	Age Group
92.5%	Jonsson T	AJODO	2004	40	10-15yr
93.5%	Arikan F	J Period	2008	32	22yr-
81%	Kvint S	Angle Orthod	2010	269	9-56yr
86.8%	Watanabe Y	AJODO	2010	38	10-43yr
57.5%	Gonnissen H	OOOO	2010	73	11-46yr
96%	Sugai T	Int J Oral Maxillo	2010	117	11-75yr

Ho Chi Minh, April 9-12, 2013 124

Current and future principles in Orthodontics

Tooth Autotransplantation for Future Orthodontics

Thank you for your attention

Takashi Ogo, D.D.S., Ph.D.
Professor and Chair
Orthodontic Science, Graduate School
Tokyo Medical and Dental University, Tokyo,
Japan

Ho Chi Minh, April 9-12, 2013 125

Current and future principles in Orthodontics

Biology of Hypofunctional teeth

Takashi Ono, D.D.S., Ph.D.
Professor and Chair
Orthodontic Science, Graduate School
Tokyo Medical and Dental University, Tokyo,
Japan

Ho Chi Minh, April 9-12, 2013

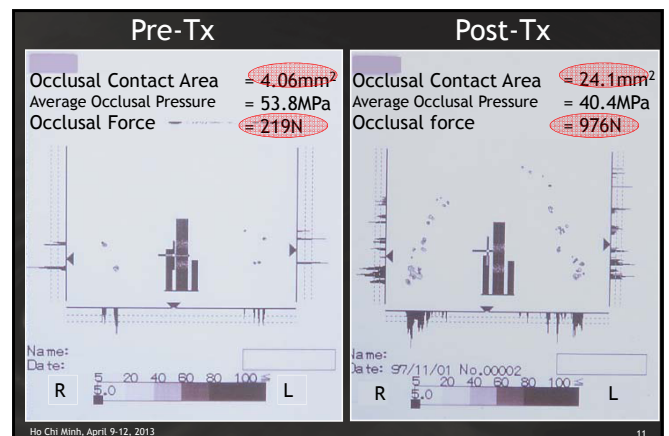
What's the significance of orthodontic treatment?

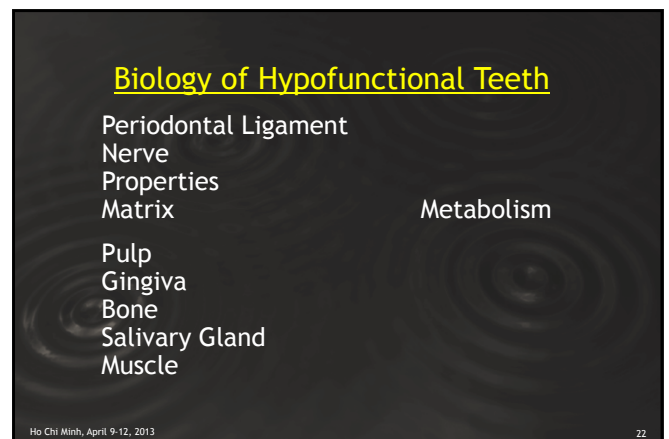
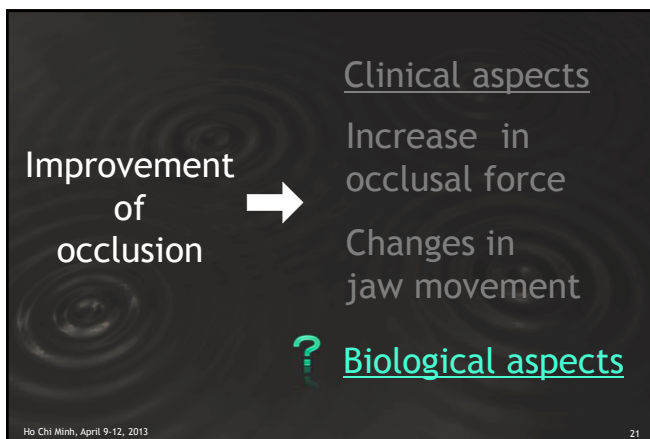
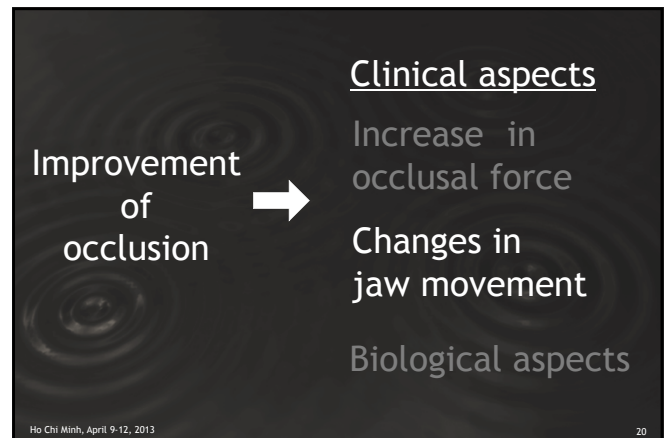
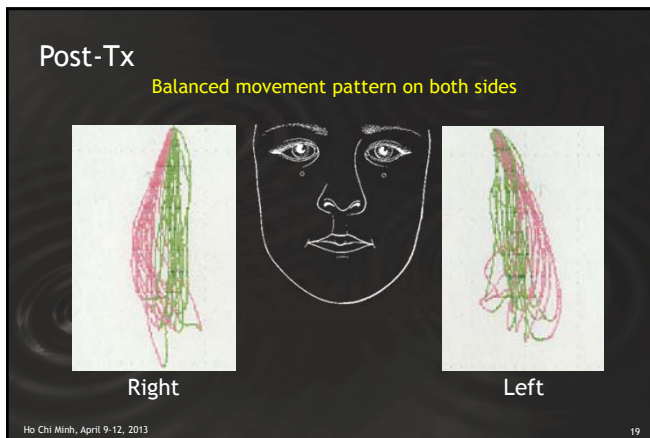
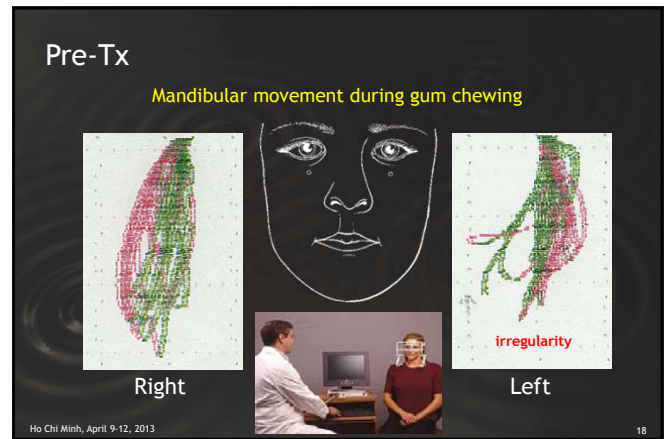
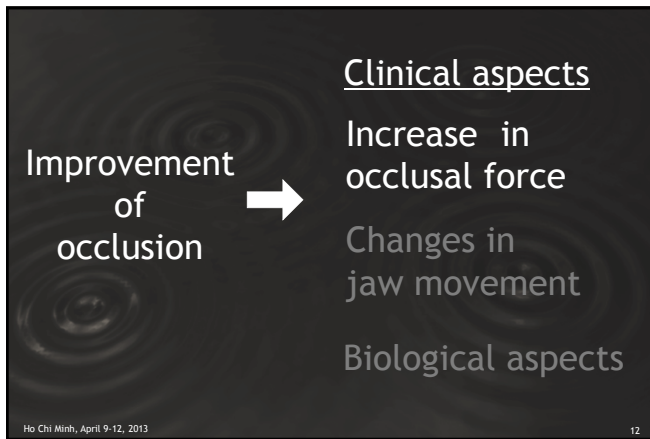
- Improvement/amelioration of malocclusion?
⇒ esthetic, function, rehabilitation, etc...
- Quest for scientific premises
⇒ but only inconsistency was found
- Paradoxically, how come we treat the patient?

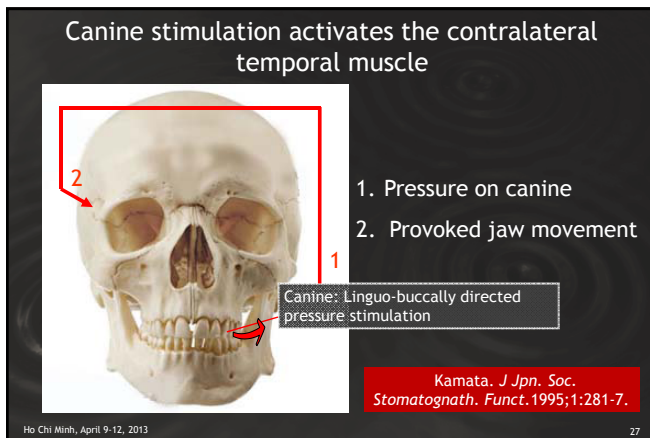
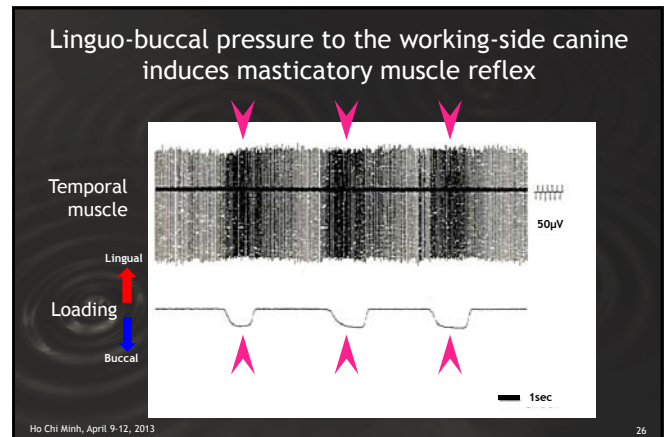
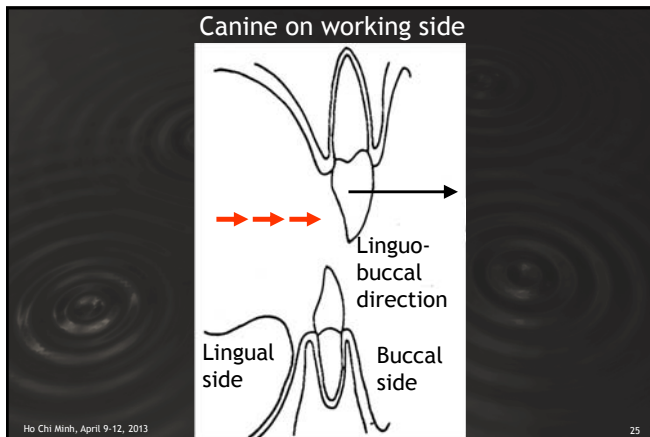
Ho Chi Minh, April 9-12, 2013

Why do we treat malocclusion ????

Ho Chi Minh, April 9-12, 2013







Improvement of occlusion →

Clinical aspects

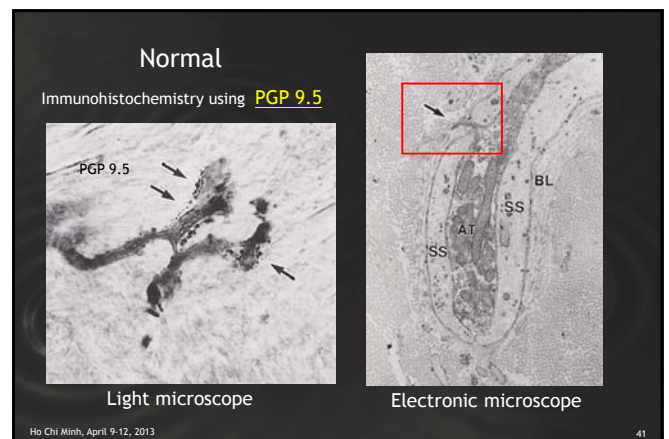
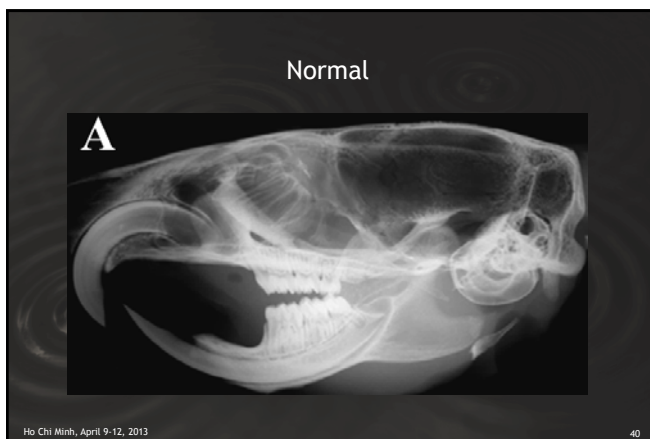
- Increase in occlusal force
- Changes in jaw movement

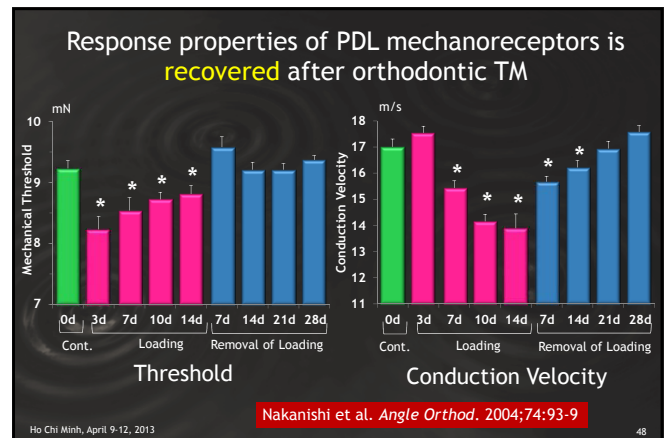
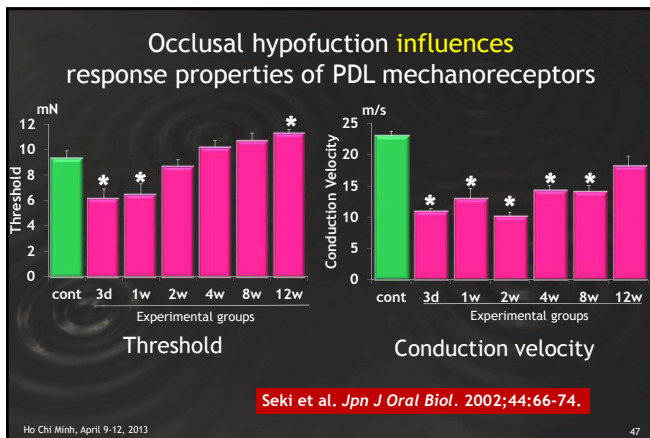
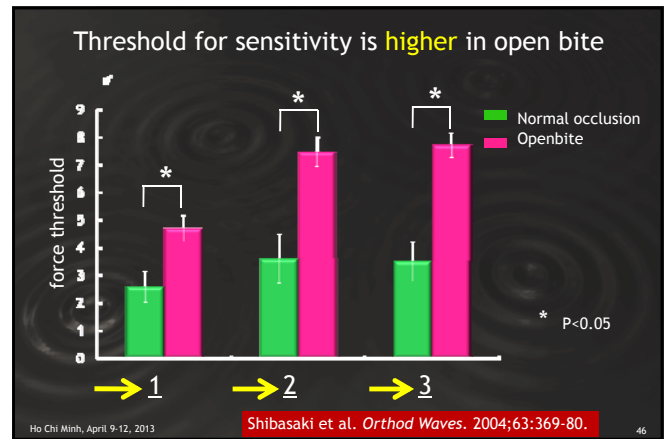
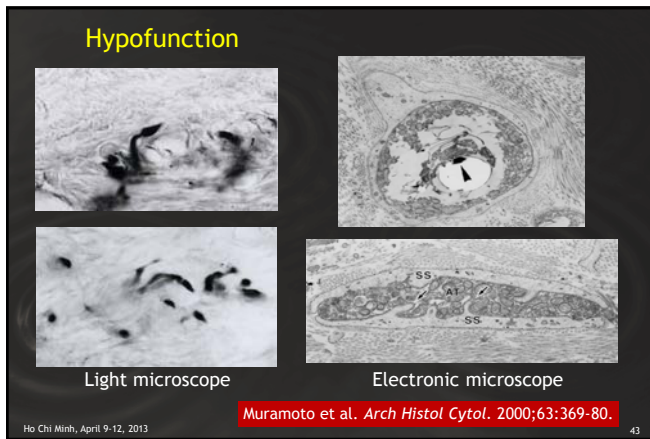
Biological aspects

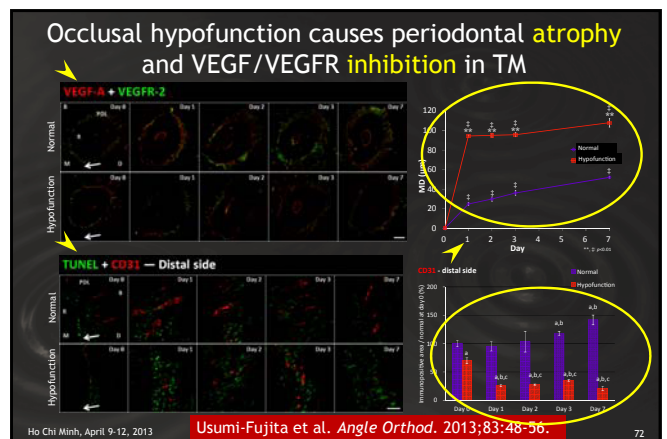
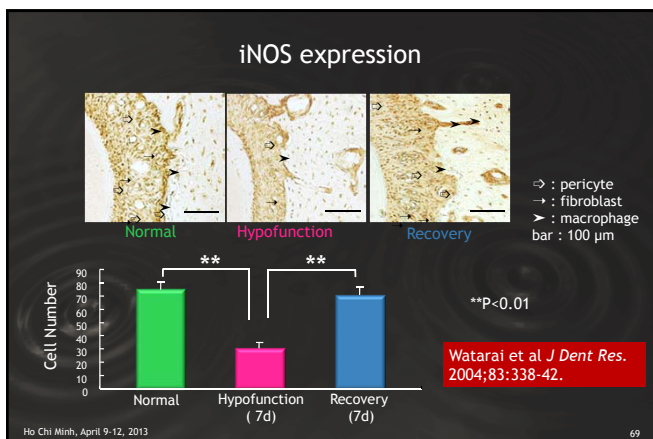
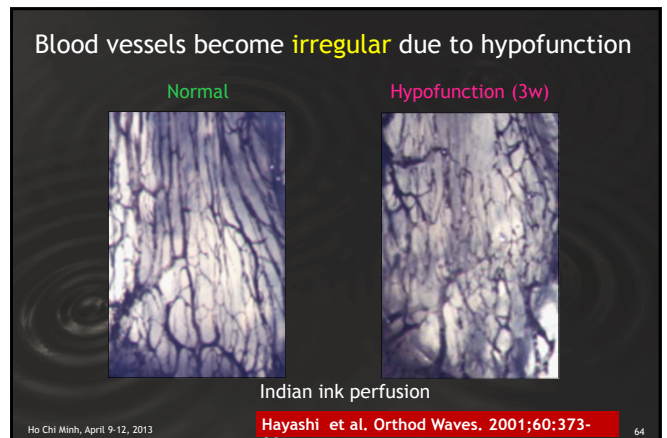
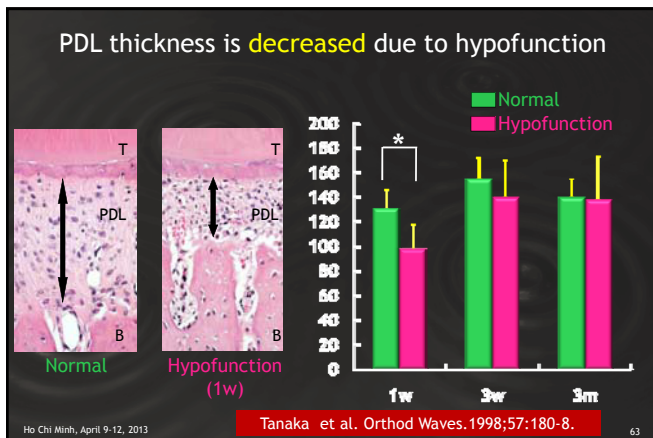
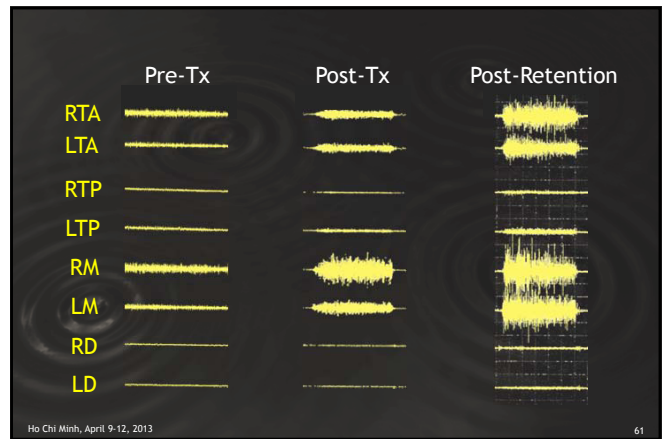
- Remodeling of muscle reflex

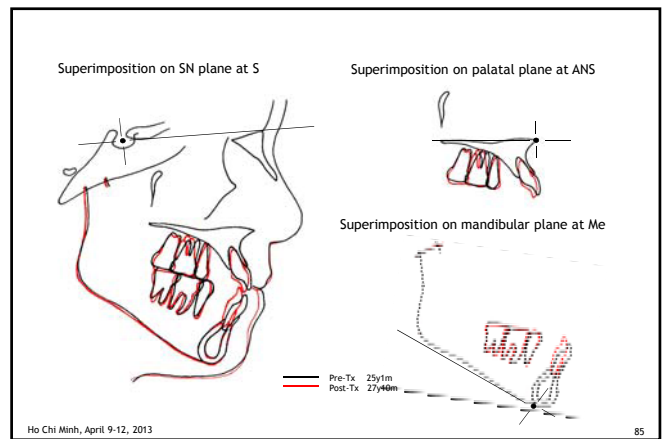
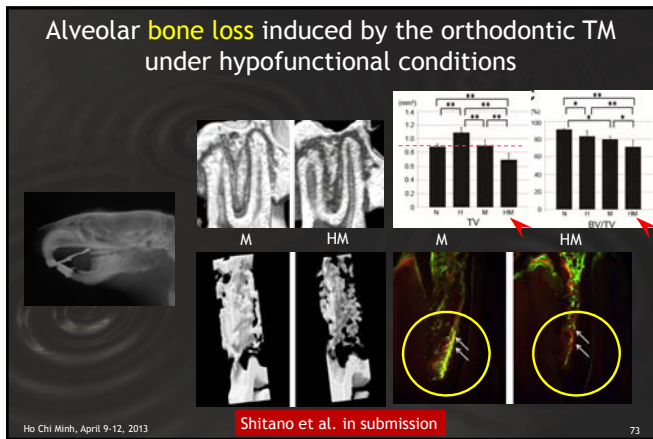
Ho Chi Minh, April 9-12, 2013

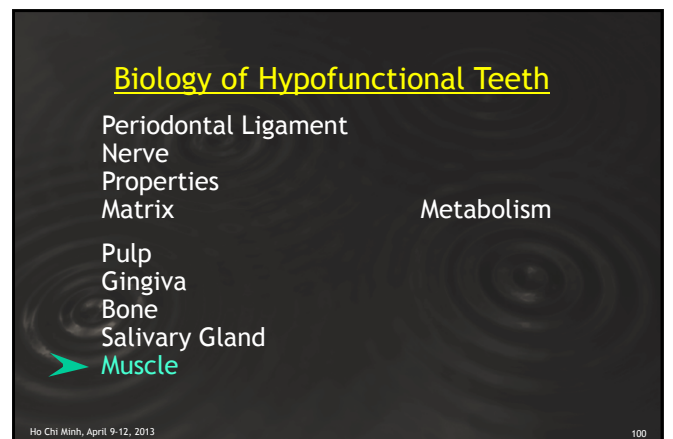
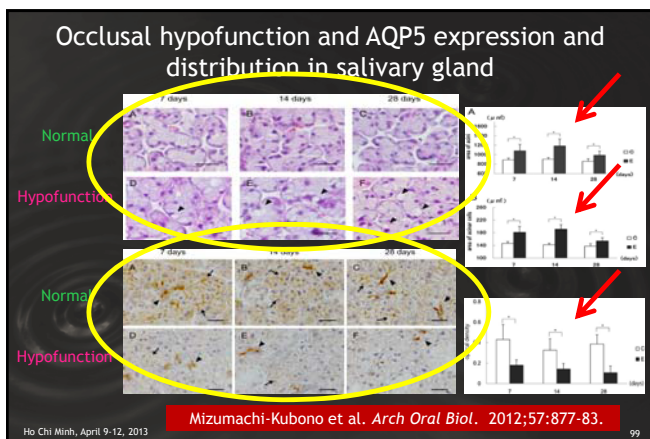
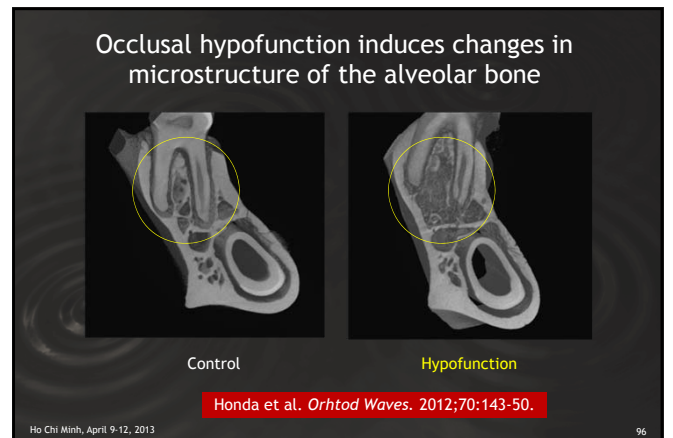
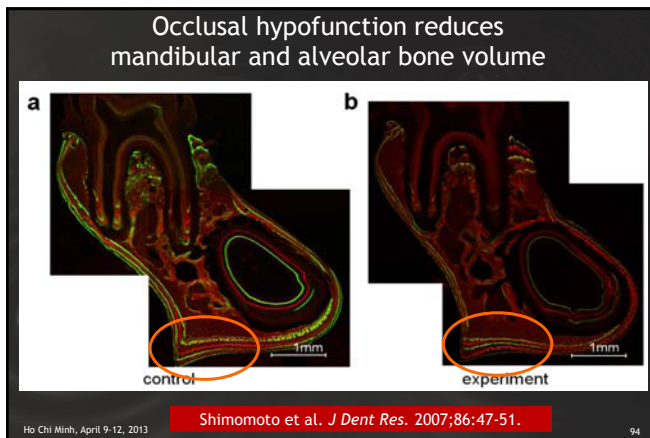
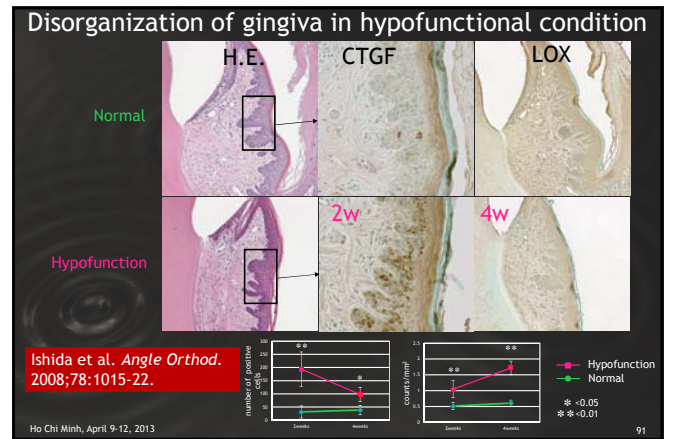
38

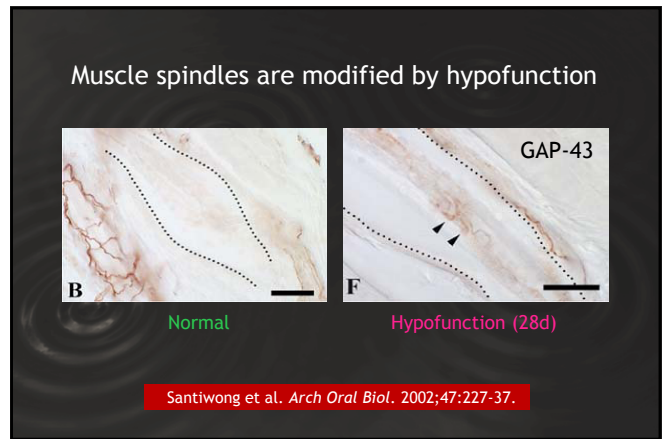
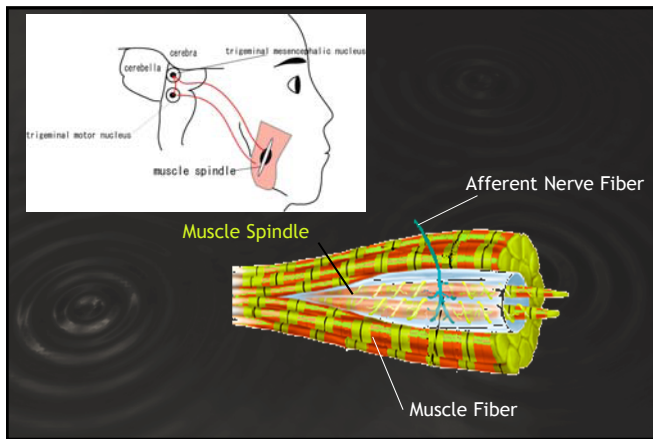












Current and future principles in Orthodontics

Biology of Hypofunctional teeth

Thank you for your attention

Takashi Ono, D.D.S., Ph.D.
 Professor and Chair
 Orthodontic Science, Graduate School
 Tokyo Medical and Dental University, Tokyo,
 Japan

Ho Chi Minh, April 9-12, 2013

114

Current and future principles in Orthodontics

Oral Dysfunction and Brain
: is there any relationship?

Takashi Ono, D.D.S., Ph.D.
Professor and Chair
Orthodontic Science, Graduate School
Tokyo Medical and Dental University, Tokyo, Japan

Ho Chi Minh, April 9-12, 2013

2

Overview

Q. What is "Orthodontics" ?

Ortho-: straight
dont: teeth
-tics: science

A. A scientific field to study craniofacial & oropharyngeal dysfunction related to malocclusion

Ho Chi Minh, April 9-12, 2013

3

Overview

Orofacial dysfunction and malocclusion

Ho Chi Minh, April 9-12, 2013

Kuroda T., Ono T. World J Orthod. 2000;1:125-133.

5

Overview

Occlusion vs. function

Dysfunction → malocclusion

Oral respiration → Adenoid face, narrowed Mx arch, etc.
Low tongue position → open bite, widened Md arch, etc.
Abnormal swallowing → open bite, etc.

Malocclusion → dysfunction

Mx protrusion, facial deformity → chewing disorder
Cleft lip/palate → speech disorder

Close relationship with the tongue
(the biggest multifunctional organ in the oropharyngeal area)

Ho Chi Minh, April 9-12, 2013

6

Overview

Oral cavity and neighboring organs

the oral organs are not independent, but are involved in the whole system

it is important that you have to see the "mountain", not a "tree".

Ho Chi Minh, April 9-12, 2013

8

Overview

Functional control by the CNS

Static: respiration

Dynamic: mastication, swallowing, speech

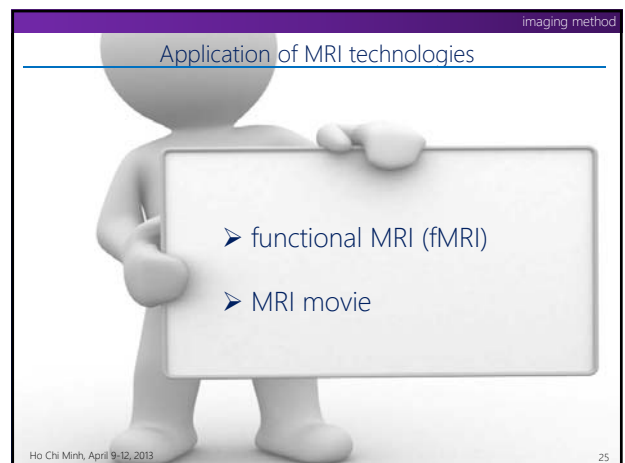
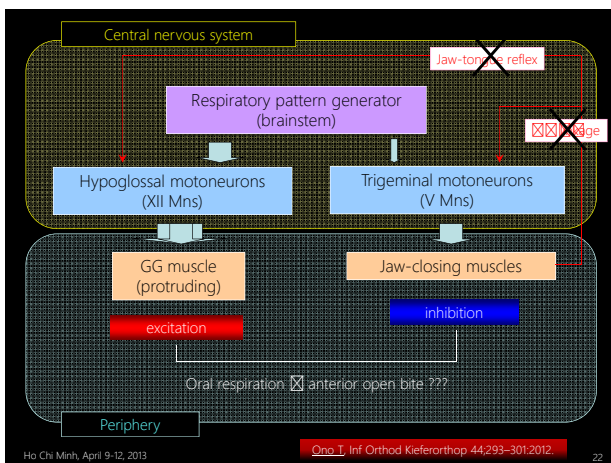
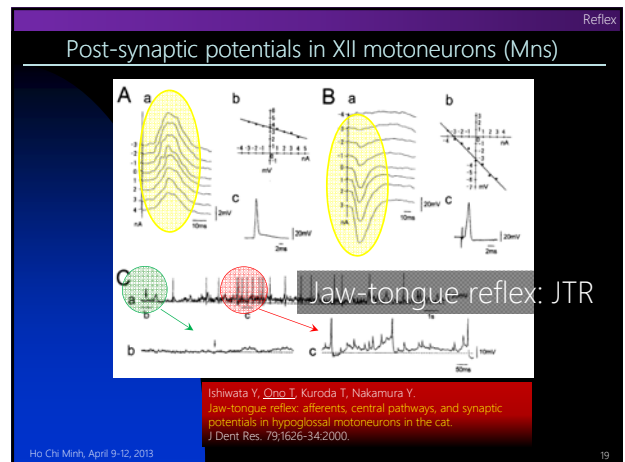
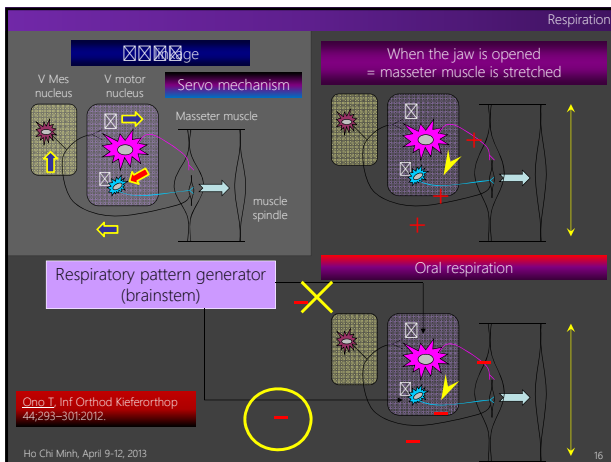
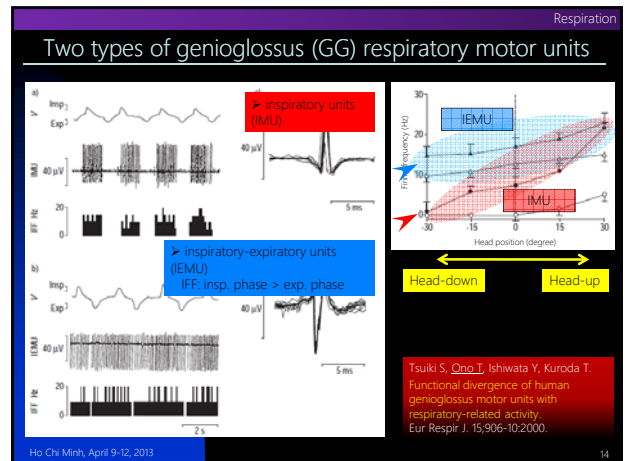
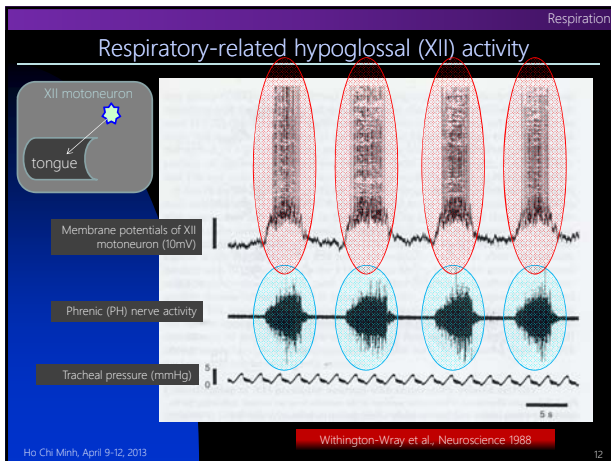
rhythmical movement

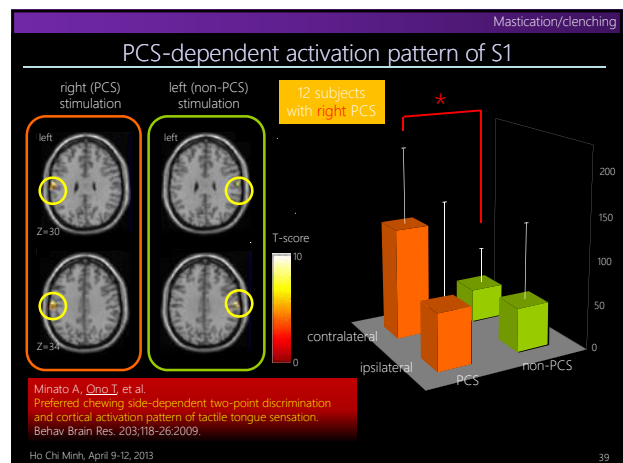
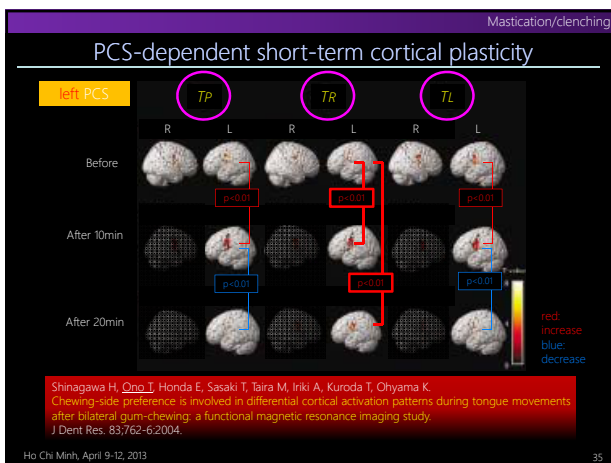
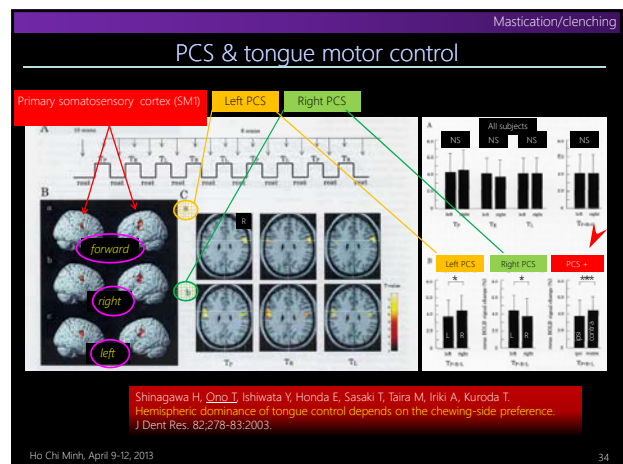
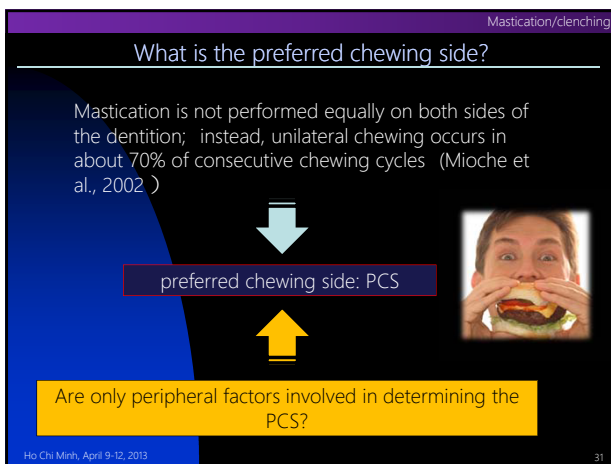
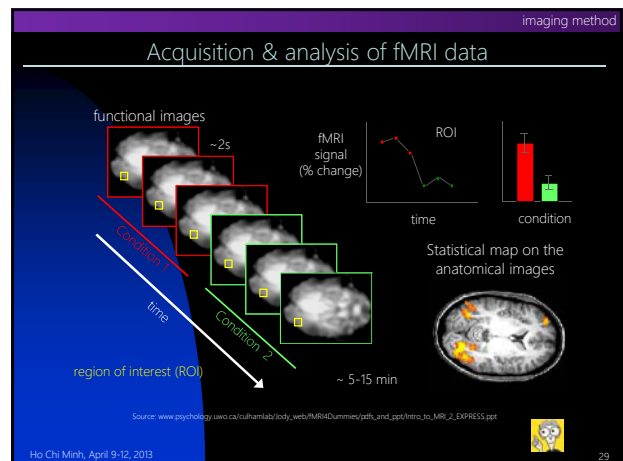
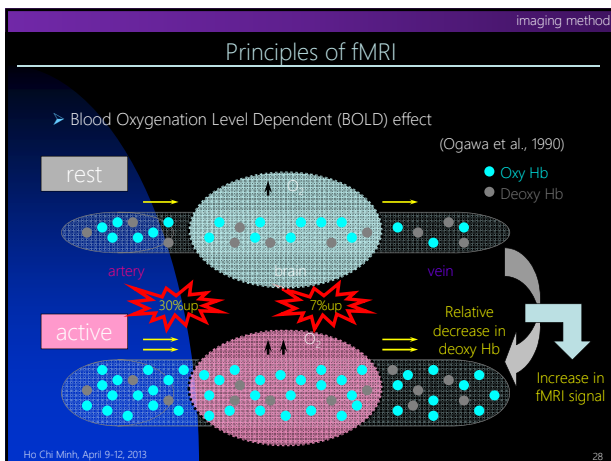
Central pattern generator

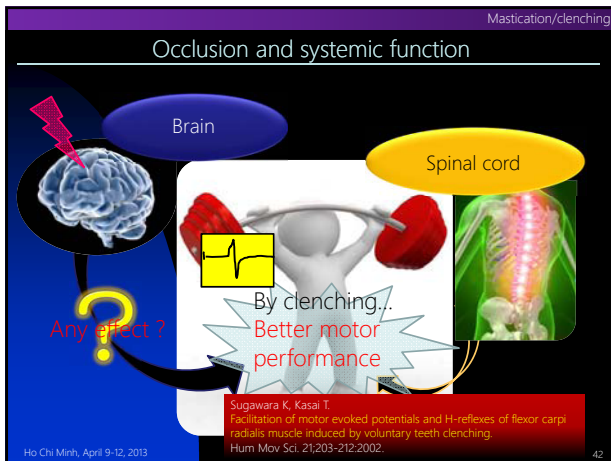
Central nervous system (CNS)

Ho Chi Minh, April 9-12, 2013

10







Mastication/clenching

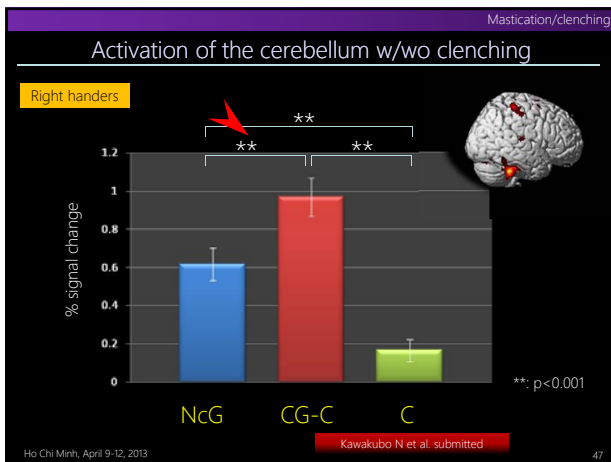
Tasks and activated regions

	Clenching+Gripping(CG)	Clenching only(C)	Gripping only(NcG)	CG-C
Clenching-related	○	○		
Gripping-related	○		○	○
Activation map				?

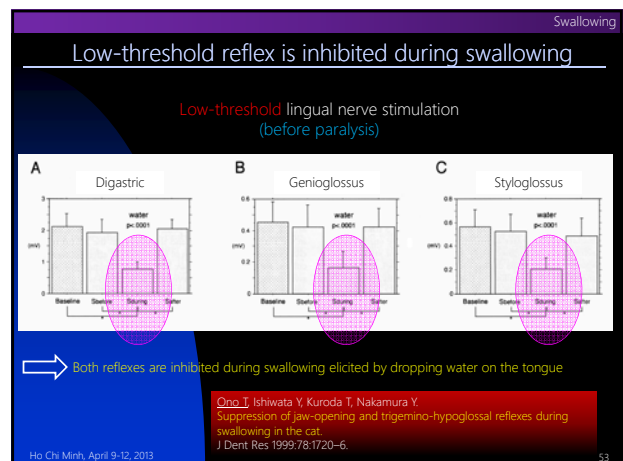
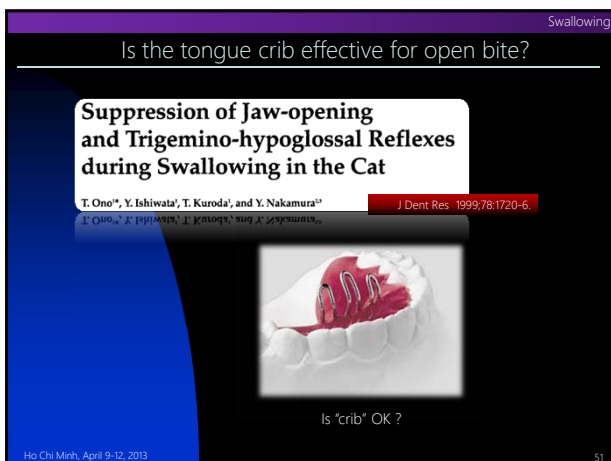
comparison

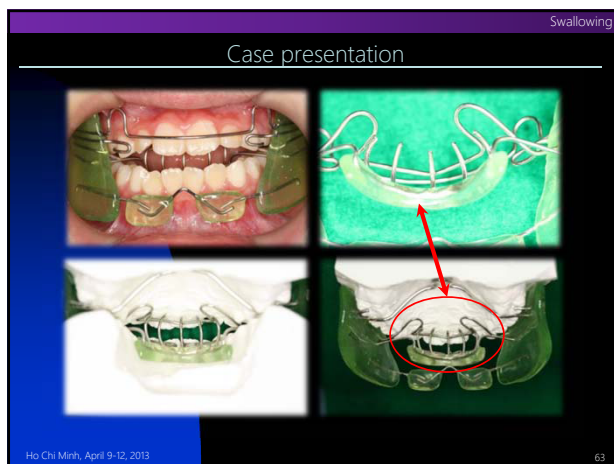
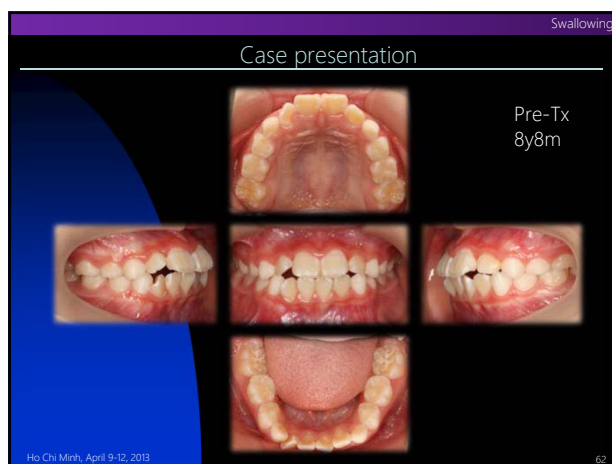
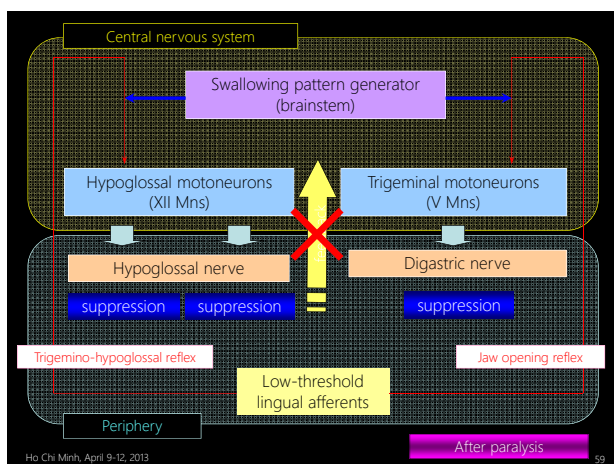
Ho Chi Minh, April 9-12, 2013

44



- Oral function and brain:
mastication & clenching
- ✓ **Not only** the peripheral organs are involved in the chewing side preference, **but also** the central nervous systems that control motor/sensory functions are involved
 - ✓ The masticatory-related central nervous systems may be **plastic** to respond to motor training
 - ✓ Thus, we should pay attention to the **chewing side preference** and **plasticity** in the orthodontic treatment
 - ✓ Clenching exerts a significant effect on systemic motor performance through the CNS
 - ✓ Orthodontic treatment to establish the rigid occlusion **may activate the silent neural network** to strengthen the **motor function** of the body
- Ho Chi Minh, April 9-12, 2013
- 49





Oral function and brain:
swallowing

- ✓ Reflexive activity evoked by low-threshold lingual afferents were suppressed during swallowing before and after paralysis
- ✓ It is suggested that coordinated tongue and jaw movements during swallowing are centrally programmed and exempt from undesirable perturbations from peripheral afferent impulses
- ✓ Thus, we should be aware that orthodontic approach that targets solely at peripheral organs (e.g., tongue) may not necessarily work

Ho Chi Minh, April 9-12, 2013

67

Speech

Speech impairment in CLP

Cleft lip and palate (CLP)

- Mid-face hypoplasia
- Velopharyngeal incompetence

↓ surgery

Post-surgical problems

- Scarred lip and palate
- Shallow palate
- Reduced oral volume
- Oronasal fistulae

↓

Compensatory misarticulation

Do the lips play an important role in speech?

pre Tx

post Tx

Ho Chi Minh, April 9-12, 2013

69

Speech

Role of the lips in speech

- ✓ Lips are rich in **mechanoreceptors** (Stohr and Pentrich, 1979)
- ✓ Afferents from the lips project to a **wider area of cortical representation** somatosensory homunculus than do those of other areas of the body (Penfield and Boldrey, 1937)
- ✓ Receptors in the upper lip encode **site-specific, precise somatosensory information** (Mogliner et al, 1994)

Ho Chi Minh, April 9-12, 2013

71

Speech

Role of the lips in speech in CLP

- ✓ Development of sounds with **anterior place of articulation** (e.g., /pa/) is **delayed** in CLP (O'Gara and Logemann, 1988)
- ✓ Adaptation to impaired articulators in CLP subjects through novel strategies that use **limited perioral structures and function** may be associated with **restructuring neural network** (Riecker et al, 2002)

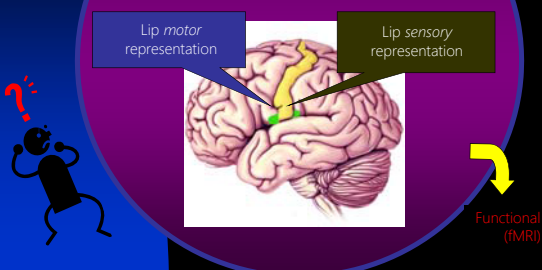


Ho Chi Minh, April 9-12, 2013 72

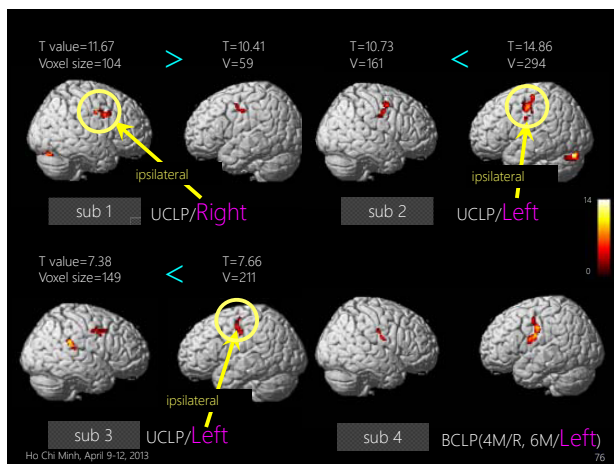
Speech

Hypothesis

Sensorimotor representation of /pa/-articulation in CLP subjects is different from that in non-CLP subjects



Ho Chi Minh, April 9-12, 2013 73

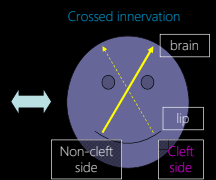


Speech

Cortical activation in bilabial plosive

- Bilateral activation of the SM1 in all CLP subjects
- Greater activation of SM1 **ipsilateral** to the side of cleft in unilateral CLP subjects
- Greater activation of SM1 **ipsilateral** to the side on which labioplasty had been performed later in a bilateral CLP subject

An ipsilateral dominance in bilabial plosive may compensate for less sensory projection from the clefted upper lip

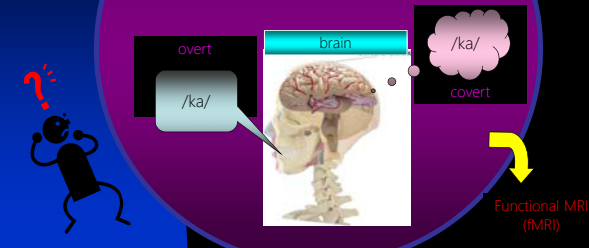


Ho Chi Minh, April 9-12, 2013 78

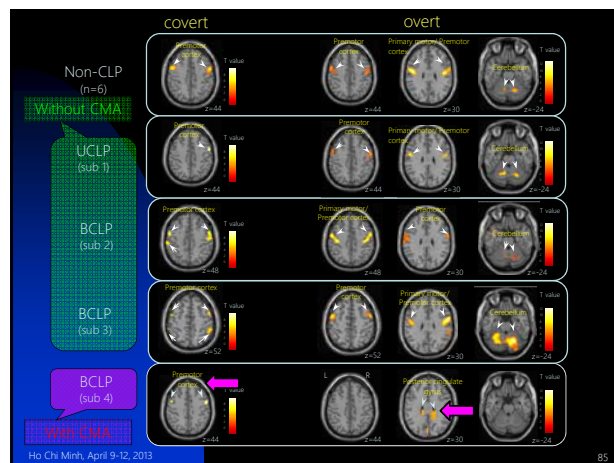
Speech

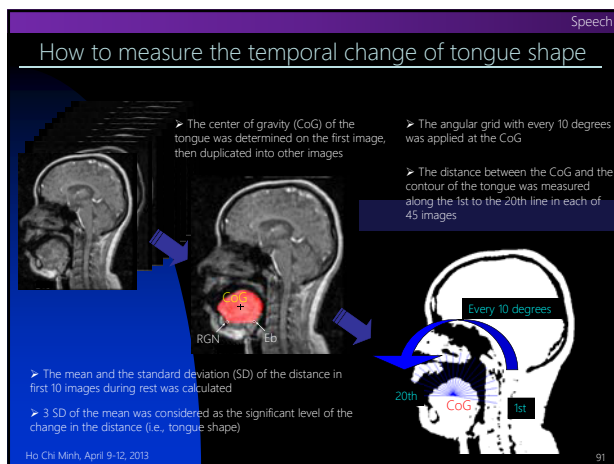
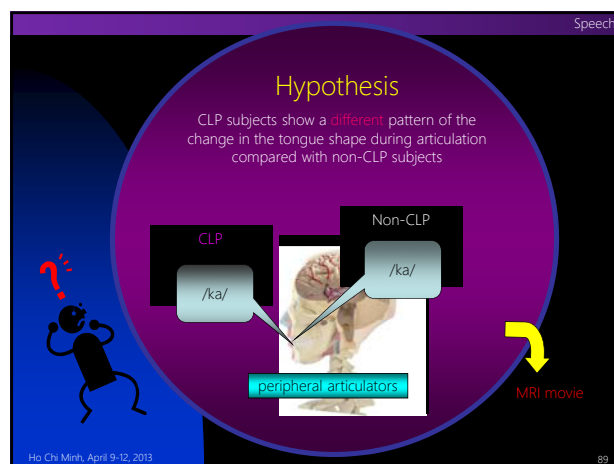
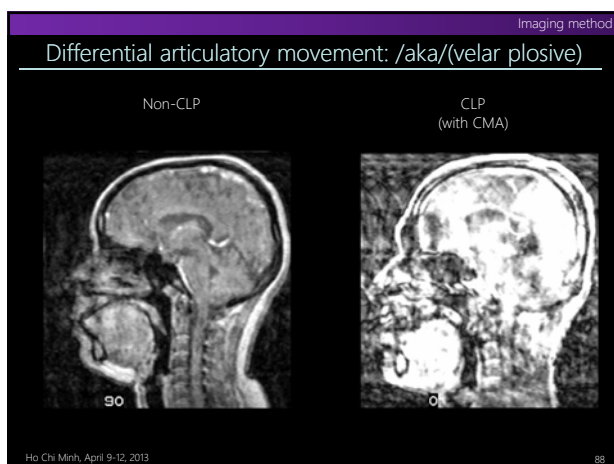
Hypothesis

CLP subjects show a different cortical activation pattern in overt articulation, but not in covert articulation compared with non-CLP subjects



Ho Chi Minh, April 9-12, 2013 81





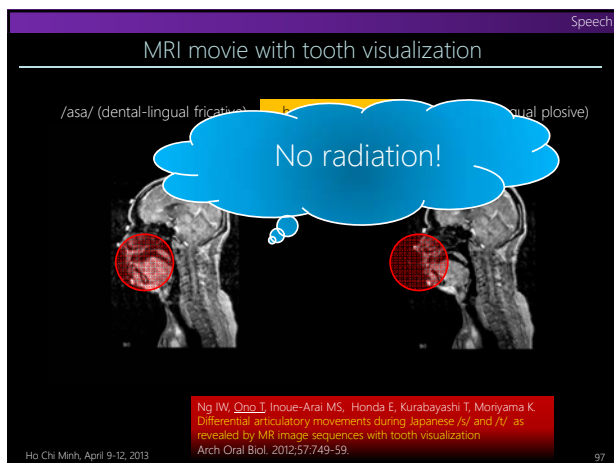
Speech

Similarities (☒) & differences (+)

Brain activity

	CMA	UCLP	BCLP	controls
No		☒	☒	☒
Yes			+	

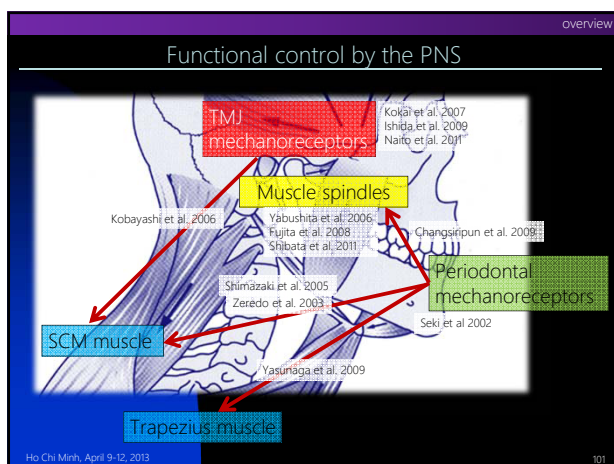
Ho Chi Minh, April 9-12, 2013 95



Oral function and brain: **speech**

- ✓ Compensatory misarticulation (CMA) in subjects with cleft lip and palate is **not** only the simple problem in the periphery, **but** the complex defect that involves the central nervous system
- ✓ It seems that the differences in execution (not motor imaginary) of speech are **not** dependent on the type of CLP, **but** on the degree/type of CMA
- ✓ Thus, the speech therapy in conjunction with orthodontic treatment may induce the **plastic change in the brain**; and once the change occurs, it may help the peripheral organs function properly

Ho Chi Minh, April 9-12, 2013 98



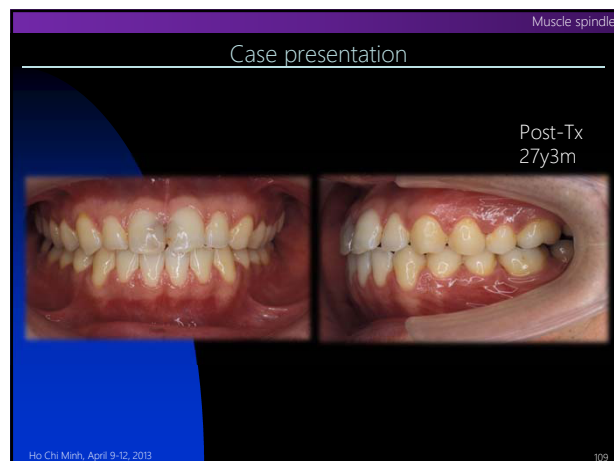
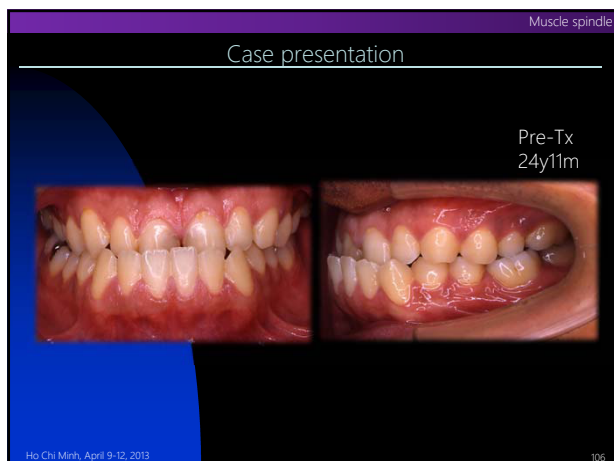
Muscle spindle

Role of muscle spindles and occlusal vertical dimension

- Several reports indicate that **jaw-muscle spindles**, which are sensitive to muscle length and changes therein, would be responsible for the **perception of jaw position and opening magnitude** (Brill and Tryde, 1974; Zhang *et al.*, 2003)
- Changes in the **occlusal vertical dimension (OVD)** are often associated with certain syndromes, such as TMDs (Christensen, 1970) and headache (Hellsing, 1990)
- The perturbation of a habituated **OVD** may have such a strong effect on the entire body that even symptoms of tinnitus and vertigo will appear (*e.g.*, Costen, 1936)

Ho Chi Minh, April 9-12, 2013

103



Muscle spindle

iOVD and muscle spindles: short-term effects

RESEARCH REPORTS
Biological

T. Yabushita^{1,2*}, J.L. Zeredo³, K. Toda⁴, and K. Soma⁵

Role of Occlusal Vertical Dimension in Spindle Function

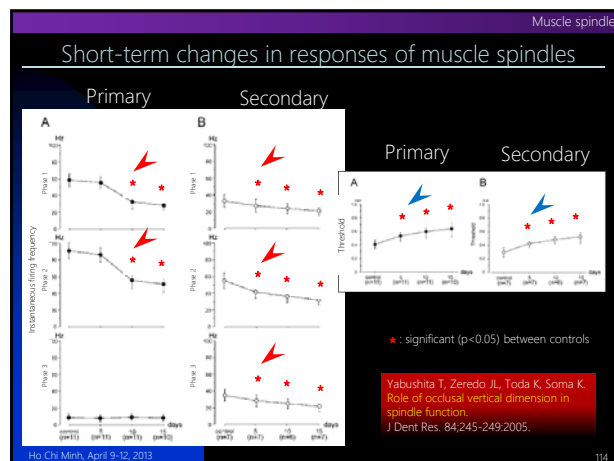
A

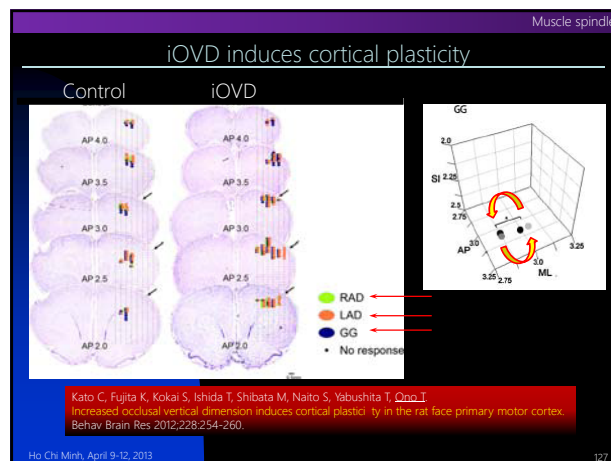
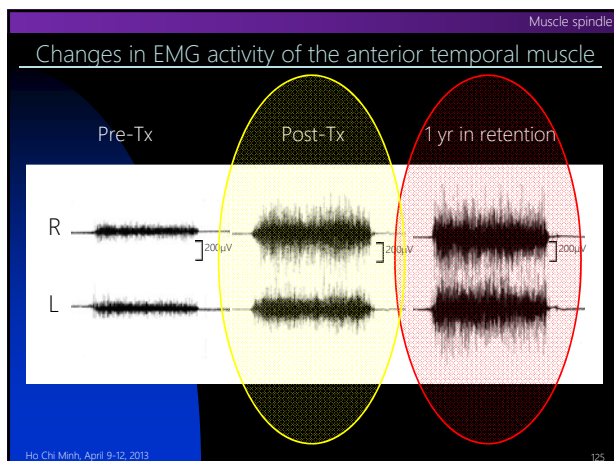
B

- ✓ Twenty female Wistar rats
- ✓ Control and iOVD subgroups
- ✓ Stretch responses of spindle endings were recorded from the masseteric nerve filaments
- ✓ Recordings at 5, 10 and 15 days of iOVD (2mm in molar region with a resin built-up)

Ho Chi Minh, April 9-12, 2013

112





From our recent study ...

The purpose of the study was to clarify the relationship between difficulty of pronunciation and habituation (eg, wearing retainers)

Kaneshima T, Usui N, Wada J, Inukai S, Ohmori H, Shimazaki K, Hideshima M, Matsuura H, Igarashi Y, Kurabayashi T, Taira M, Ono T.
The time course change of brain activation pattern during pronunciation with orthodontic retainer: an fMRI study.
Neuroimage. submitted.

Ho Chi Minh, April 9-12, 2013

129

From our recent study

Background

In this study,
We examined the changes with the use of retainers in three ways;
1. Self-evaluation of difficulty in speech articulation
2. Intelligibility of speech sounds
3. Brain activation associated with speaking

Hypothesis

✓The neural changes of tuning and/or learning new motor control of speech articulation would come out with speaking with retainers
✓Getting to feel easier in speaking with retainers would be the result of gaining the motor control of articulation with retainers

© hakoon

Ho Chi Minh, April 9-12, 2013

137

