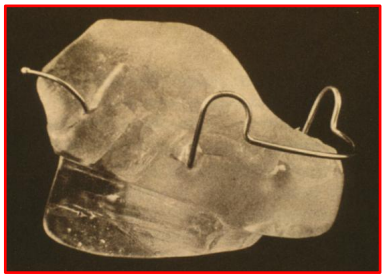
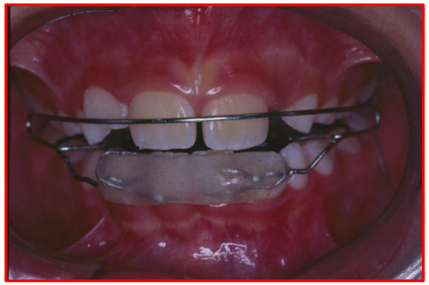
APARELHOS FUNCIONAIS

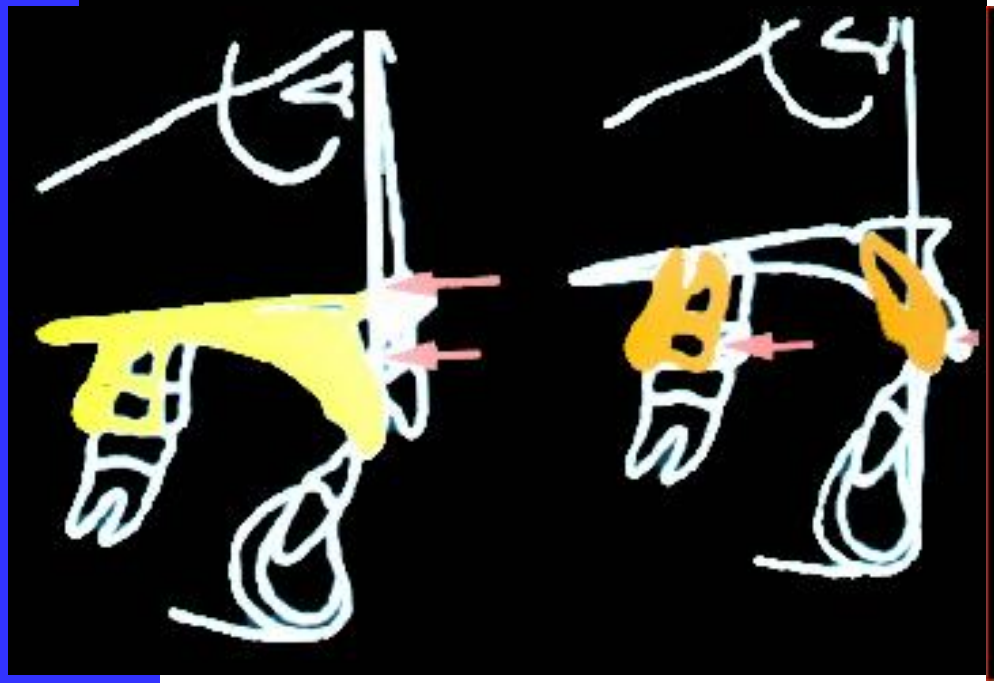


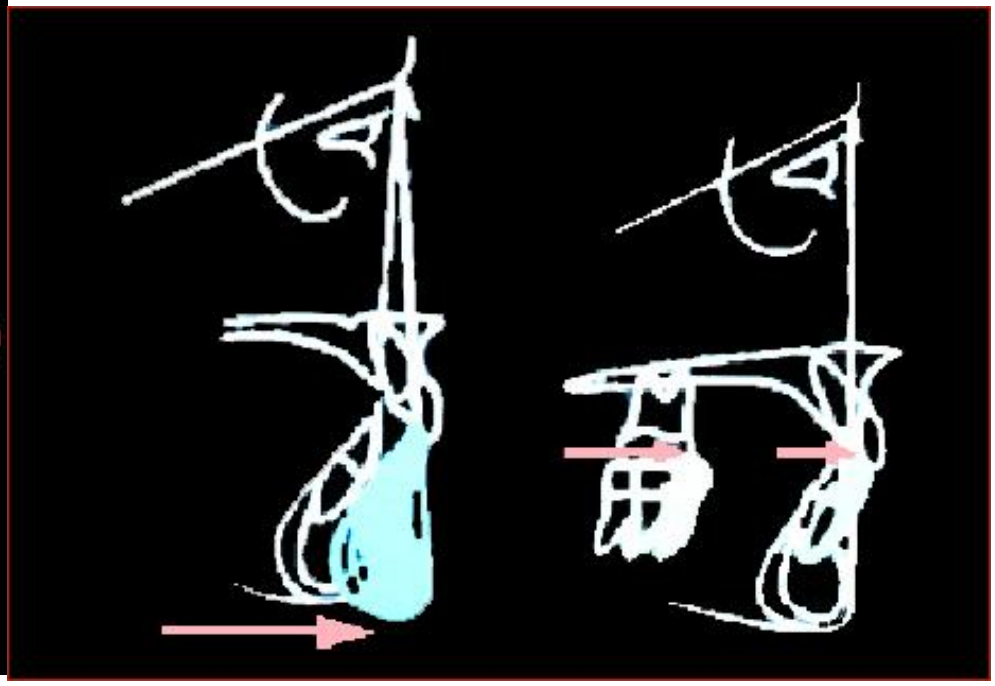


TRATAMENTO DA MÁ-OCLUSÃO DE CLASSE II

-
-

CORREÇÃO DA MÁ-OCLUSÃO DE CLASSE II





Ortopedia funcional

n

n

HISTÓRICO

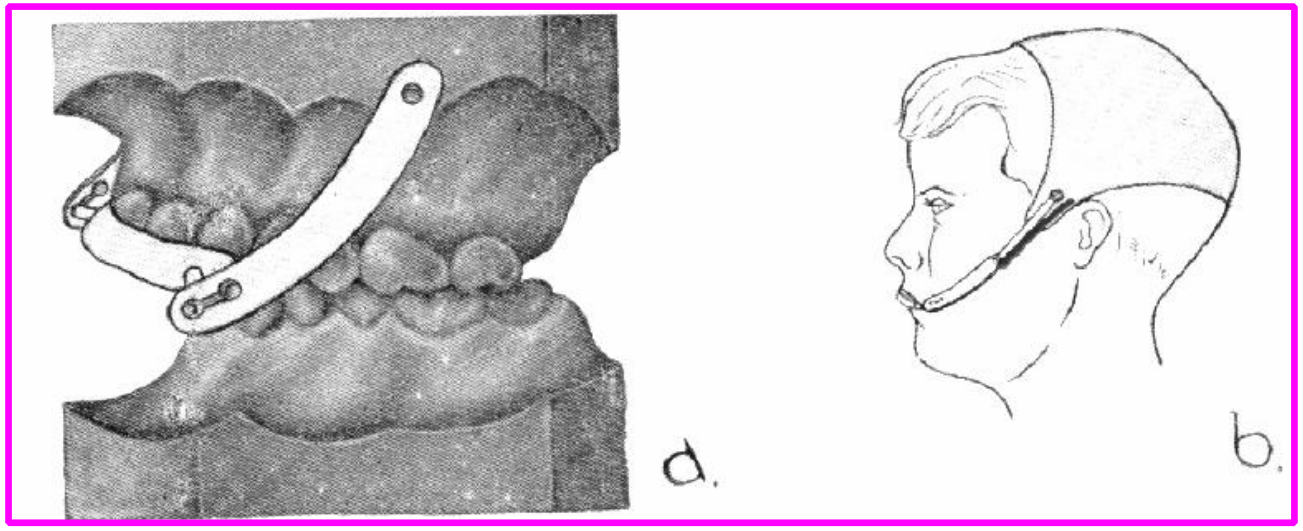
* ROUX (1893), introduziu os termos função, estimulação funcional, e adaptação funcional.
* PIERRE ROBIN (1902), observou que os aparelhos poderiam ser utilizados para influenciar as forças musculares.
* ANDRESEN (1936), desenvolveu a Ortopedia Funcional dos maxilares, através do ativador.
* HAUPL, ajudou na publicação do livro (1936). Os aparelhos eram capazes de corrigir as alterações maxilares aplicando "estímulos funcionais". Os aparelhos fixos eram considerados abordagens mecânicas simplistas, e portanto, completamente rejeitados.

Fig 2. Viggo Andresen's activator was archetype of many of today's functional appliances.

Kingsley (1866)

-

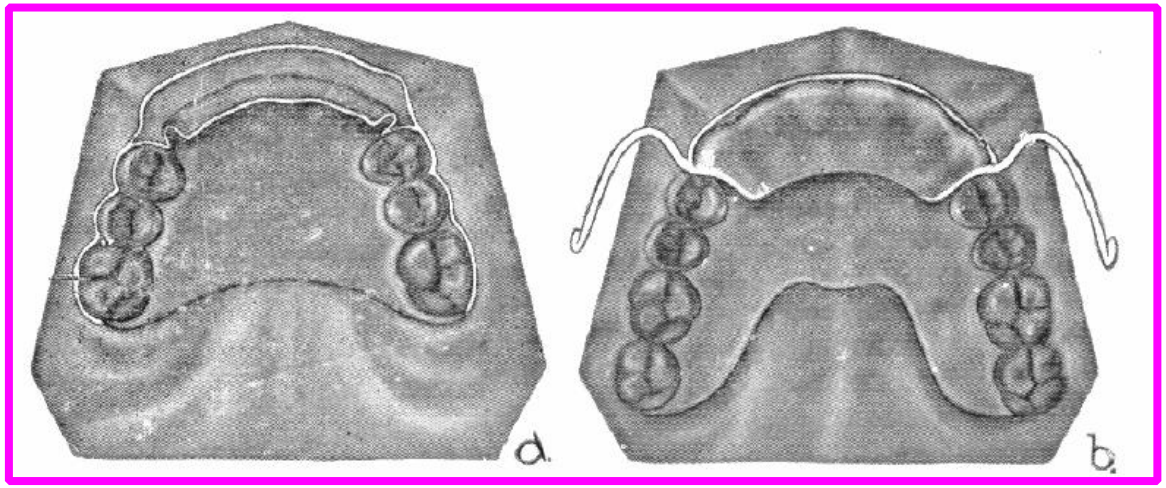
Correção da Classe II



A- Goteira anterior B- Braços laterais

- Introduziu a ancoragem occiptal

Kingsley



A- Placa palatina - Arco vestibular
B- Ganchos laterais - Aparelho extrabucal

Aparelho MARA

Eckhart - 1998

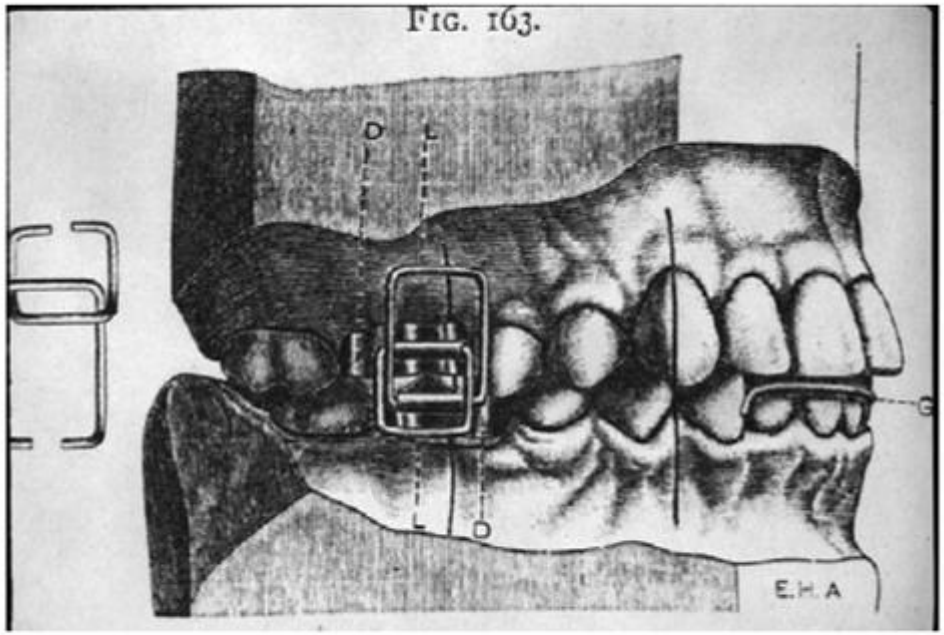
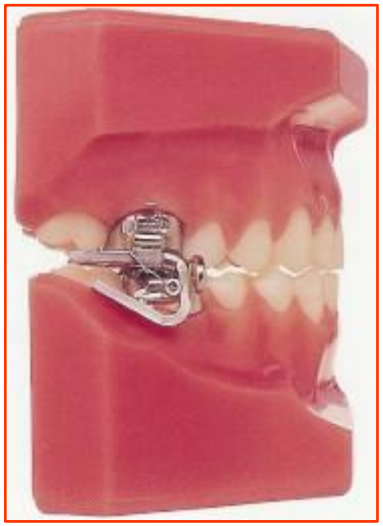


Fig 1. Angle's noncompliance, functional Class II corrector.



Alterações esqueléticas na Classe II

MOYERS, 1980

McNAMARA JR., 1981

~~RETRUSÃO MANDIBULAR~~

Principais dúvidas a serem esclarecidas:

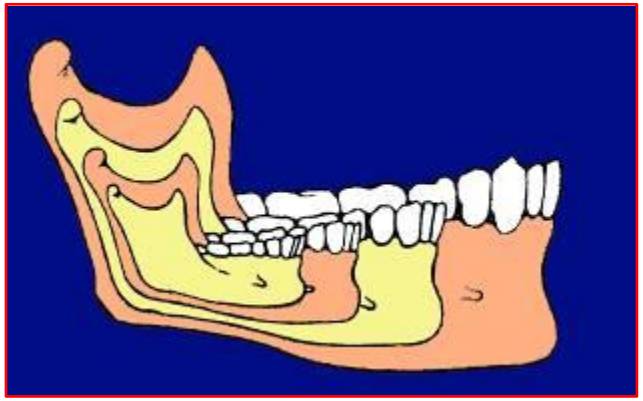
-
-
-

Até a década de 80:

- O crescimento do côndilo é geneticamente pré-determinado e não pode ser alterado, a não ser por trauma ou por deficiência sistêmica

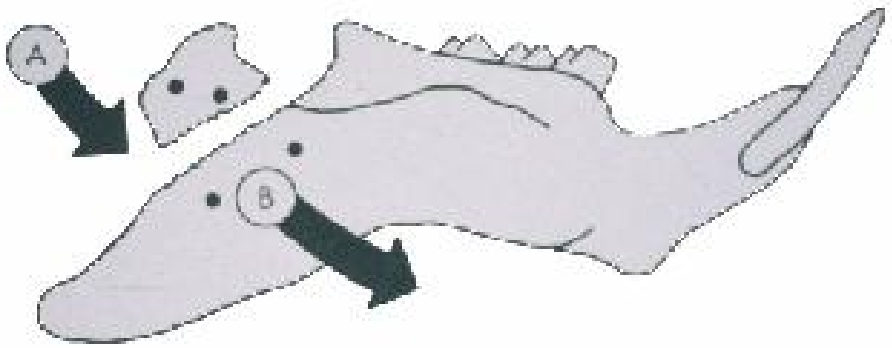
- Diziam que se mandíbula fosse trazida para frente, haveria a correção da Classe II por reabsorção da fossa mandibular e crescimento do côndilo, em pessoas de qualquer idade.

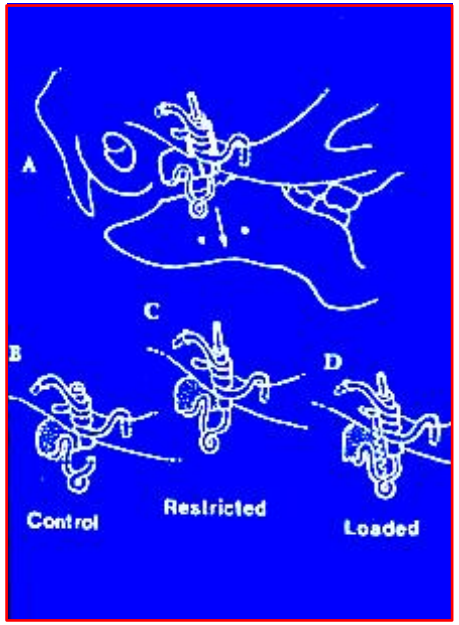
HIPÓTESES QUE TENTAM EXPLICAR O CRESCIMENTO MANDIBULAR



HIPÓTESE DA EPÍFISE CONDILAR

-
  - Sicher, Symons, Brodie, Scott
-
-
-


A
B


A
B
C
D
Control
Restricted
Loaded

Hipótese da Matriz Funcional (Moss-1962)

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A
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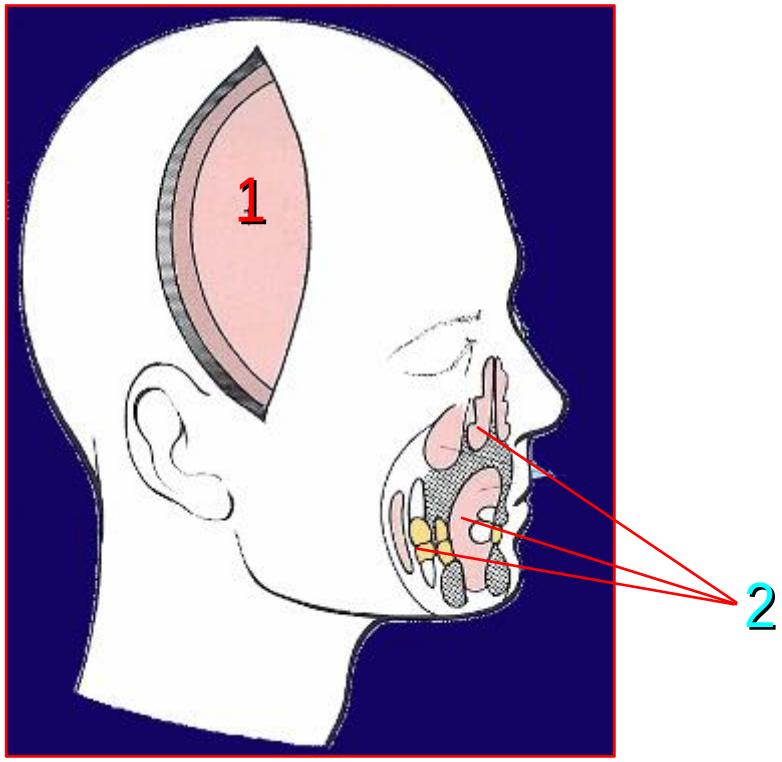
a

O tecido esquelético cresce apenas em resposta ao crescimento do tecido mole.

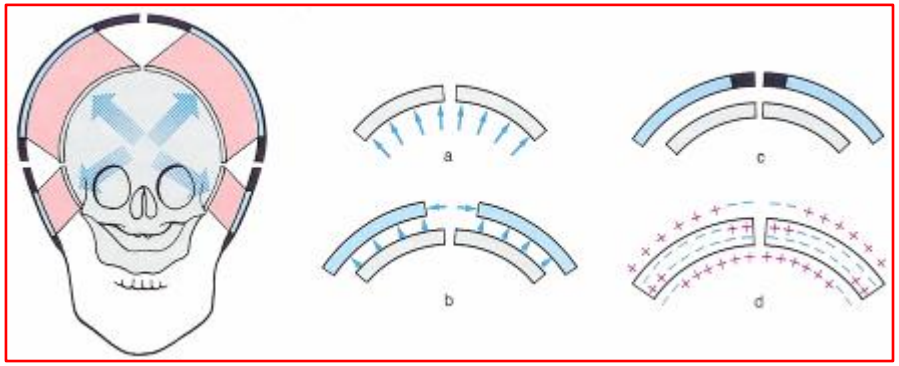


1 = Matriz neurocranial

Representada pelo cérebro, meninges e liquor.

2 = Matriz orofacial

Formada pelos espaços funcionais, bucal, nasal e faríngeo.


a
b
c
d

HIPÓTESE DA MATRIZ FUNCIONAL

HIPÓTESE DA DESCOMPRESSÃO CONDILAR

- Lance Whetten e Lysle Johnston
  -
  -
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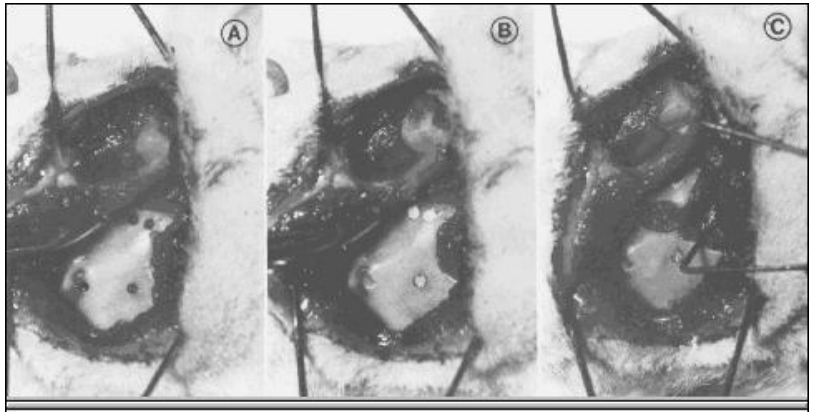


Fig. 3. Surgical preparation. **A**, Condyle and ramus exposed and implant holes prepared. **B**, Amalgam implants placed. **C**, Division of condylar neck. A fifth implant was placed in the root of the zygomatic arch above the glenoid fossa.

Temporomandibular synovial [fluid] pressure response to altered mandibular positions

nnis M. Ward, DDS, MS, Rolf G. Behrents, DDS, MS, PhD, and Jerold S. Goldberg, DDS, MS De
land, Ohio, and Memphis, Tenn Clev

tic synovial fluid pressure within the superior aspect of the temporomandibular joint space of the growing pig, Sus scrofa domesticus, was Hydrosta
response to various acute and chronic alterations of mandibular position. Bilateral measurements of pressure were recorded with examined in
planted wick catheters in three 8-week-old pigs before and at the time of appliance placement and then at 2-day intervals until the chronically imp
weeks old. Besides confirming the observations of a previous study, we noted that forward positioning of the mandible caused an animals were 20
fluid pressure that decayed to baseline levels within 2 hours. Posterior positioning of the mandible effected a larger increase in increase in synovial
decayed over 2 hours but did not return to baseline levels over the entire course of the experiment. These results may have pressure that partially
tanding of the physiology of the temporomandibular joint, local control mechanisms involved in the normal and significance in the unders
he mandible, and disorders of the temporomandibular joint. (AM J ORTHOD DENTOFAC ORTHOP 1990;98:22-8.) treatment-aided growth of th

nporomandibular joint (TMJ) has been focused on growth processes and on the modification of those *H*istorically, research on the tem
however, research on the TMJ focuses on the causes of pathological processes and their treatment. processes through treatment. At present,
sts, the processes involved in each may be related. Although diverse concerns fuel these intere

oblems except that they are multifactorial in nature. As a result, treatments for TMJ disorders Very little is known about the cause of TMJ pr
y tenet of treatment has been to effect a change in the position of the mandible. The range of often involve a multitude of approaches. One primar
limits of anatomy from retrusion to protrusion, supposedly determined by condition or suggested positions for the mandible seems to span the
known about the physiologic response to the obtained positions. philosophy. Regardless of the position advocated, little is

nce growth of the mandible also span the range of possibilities in that a retruded Orthodontic appliances that are designed to diminish or enha
the direction of the initial deviation and our present knowledge of growth. Over or protruded position of the mandible is advocated on the basis of
e the mechanisms that control the growth of the condylar cartilage. Most, if the years, craniofacial biologists have posed many theories concernin
n or lack thereof. Weinmann, Sicher, Scott, Moss, and Petrovic have not all, of the theories have been based on concepts of pressure or tensi
fails to explain how the cells of the condylar cartilage are incited to proposed separate and diverse mechanisms of control, but each theory still
jor determinants in the control of condylar growth. Regardless of grow. Petrovic et al.[1] have pointed to the lateral pterygoid muscles as being ma
tivity of the lateral pterygoid muscles "signals" the whether the theories of Petrovic are correct, it has not been explained how the ac

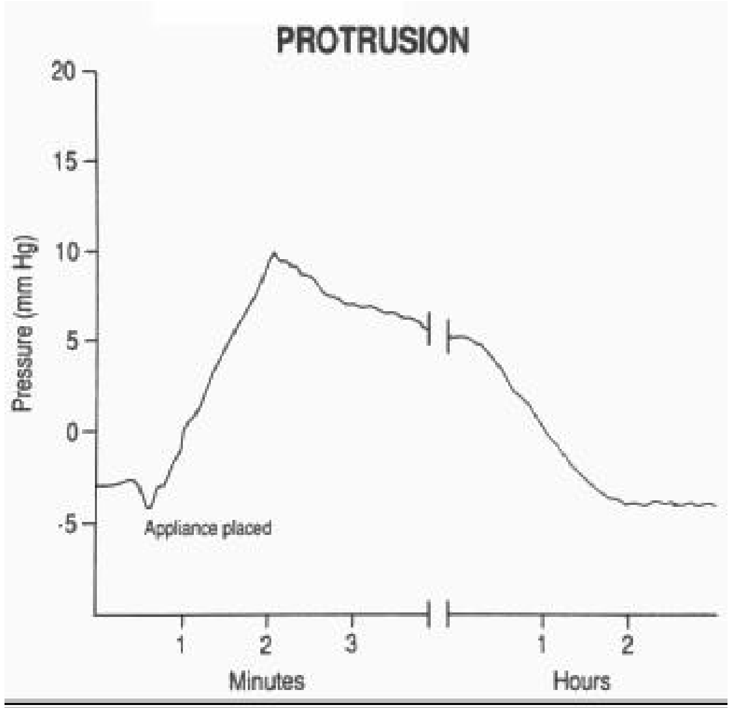


Fig. 4. Synovial fluid pressure response when the protrusion appliance was placed. Peak pressure approximates 10 mm Hg with pressure decay over the course of 2 hours.

TEORIA DO SERVOSSISTEMA DO CRESCIMENTO FACIAL

ALEXANDRE PETROVIC

1974

TEORIA DO SERVOSSISTEMA

-
-
- arcada superior "referência constantemente mutável",

  "porção escrava"

-

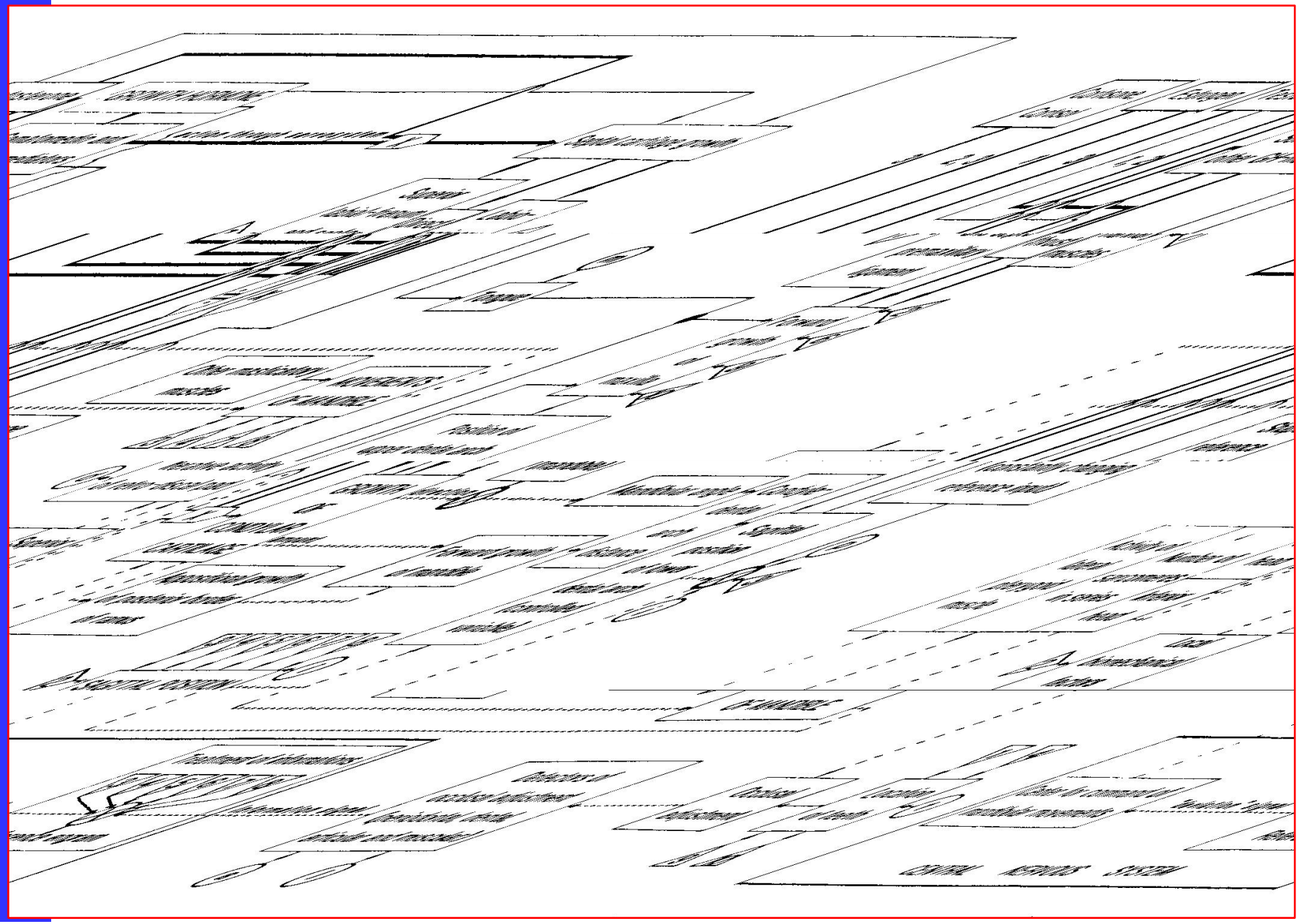
TEORIA DO SERVOSSISTEMA

-
- "comparador periférico"
- estado estável
- estados não estáveis
- "comparador central".

TEORIA DO SERVOSSISTEMA

- mal funcionamento do Servossistema
- a- MAL FUNCIONAMENTO DO SERVOSSISTEMA ENVOLVENDO PRINCIPALMENTE O COMPARADOR PERIFÉRICO:
  -
  -
- b- MAL FUNCIONAMENTO DO PROCESSO DE CRESCIMENTO APARENTEMENTE RESULTANTE DE DEFEITOS DO SERVOSSISTEMA

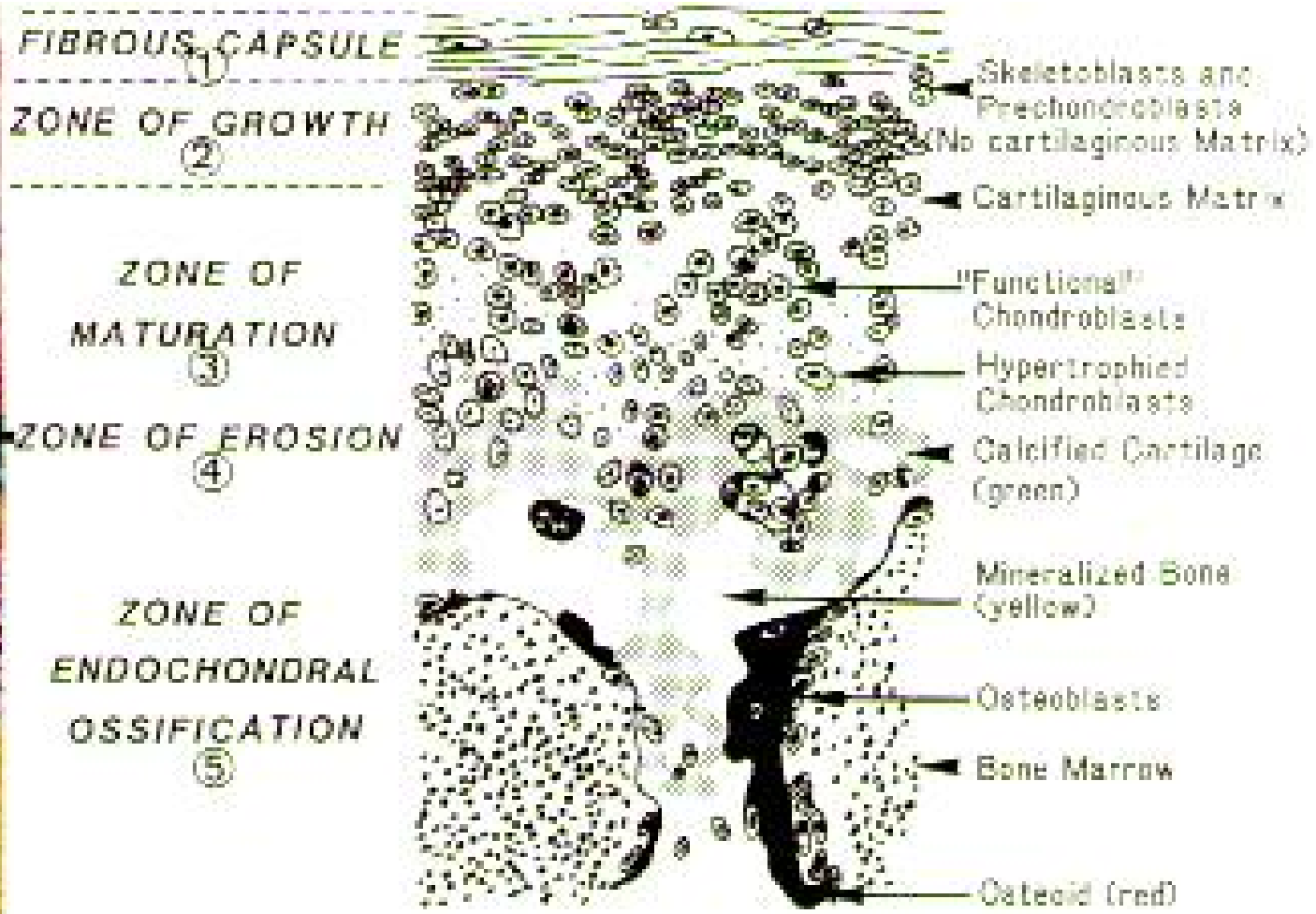
TEORIA DO SERVOSSISTEMA



Características da cartilagem condilar

- não estão envoltos por matriz cartilaginosa

Cartilagem condilar



EXPERIMENTAÇÃO ANIMAL

Experimentos com a administração do hormônio do crescimento

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-

Experimentos com o hiperpropulsor postural e aparelhos com modo de ação semelhantes

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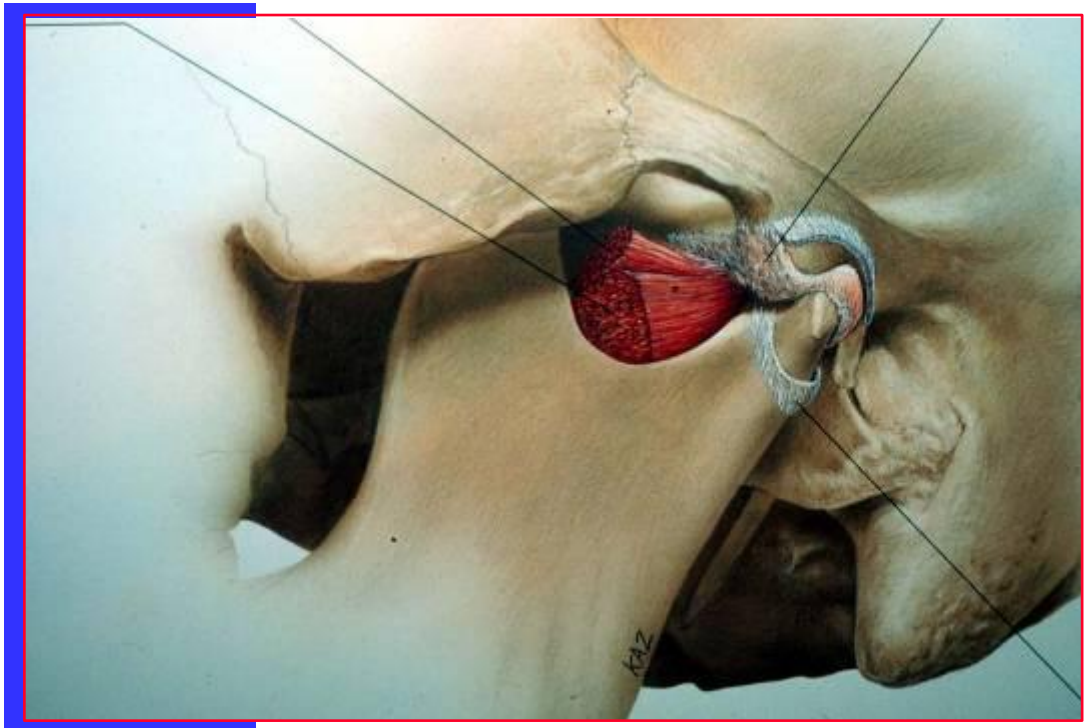
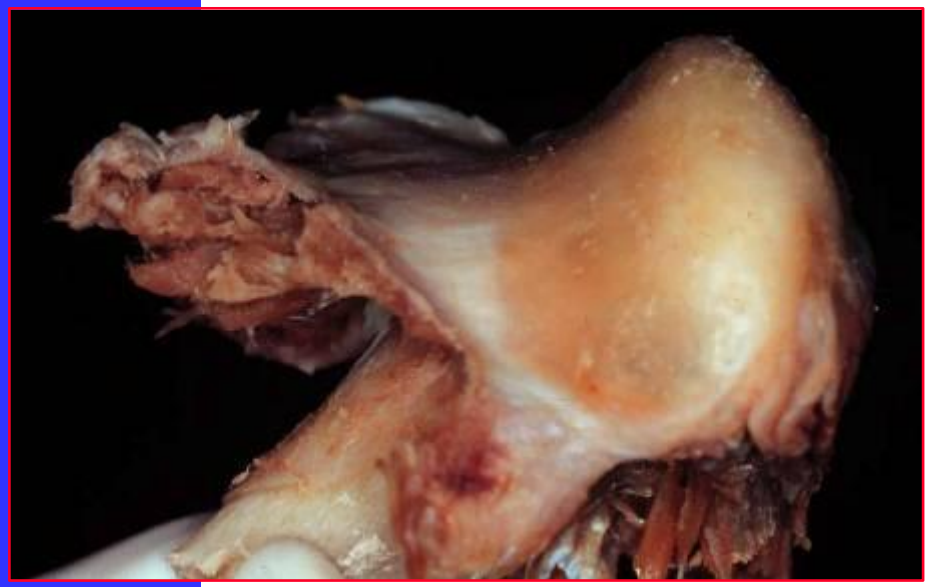
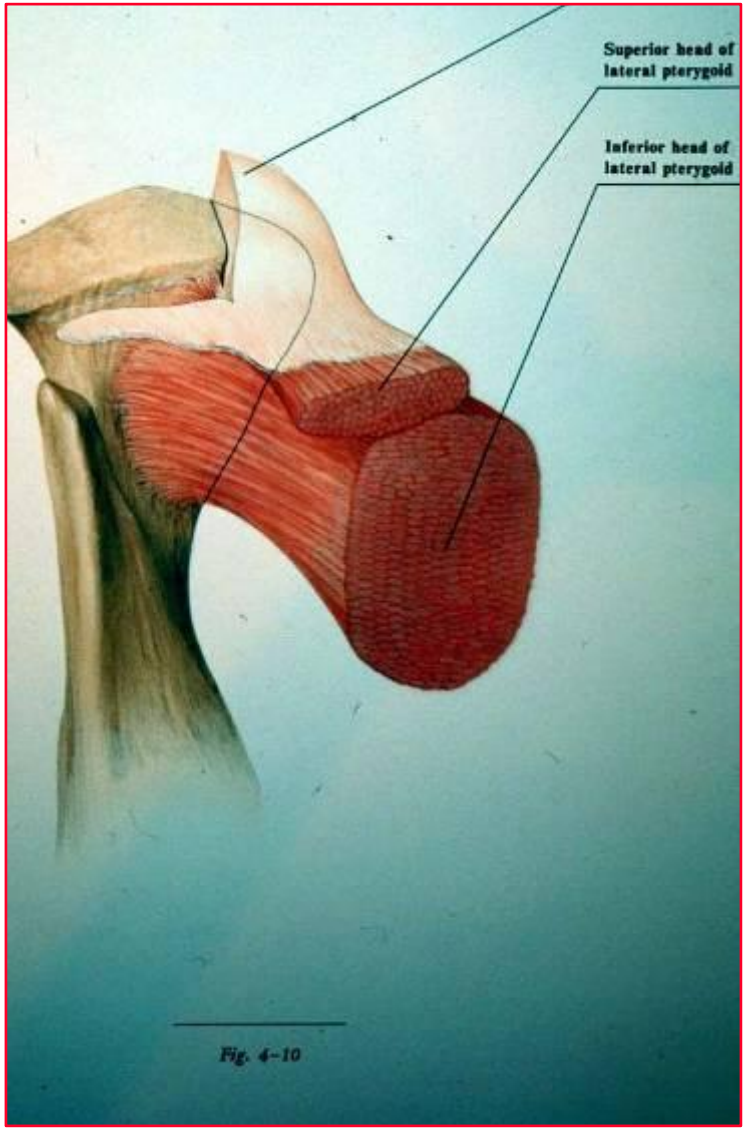
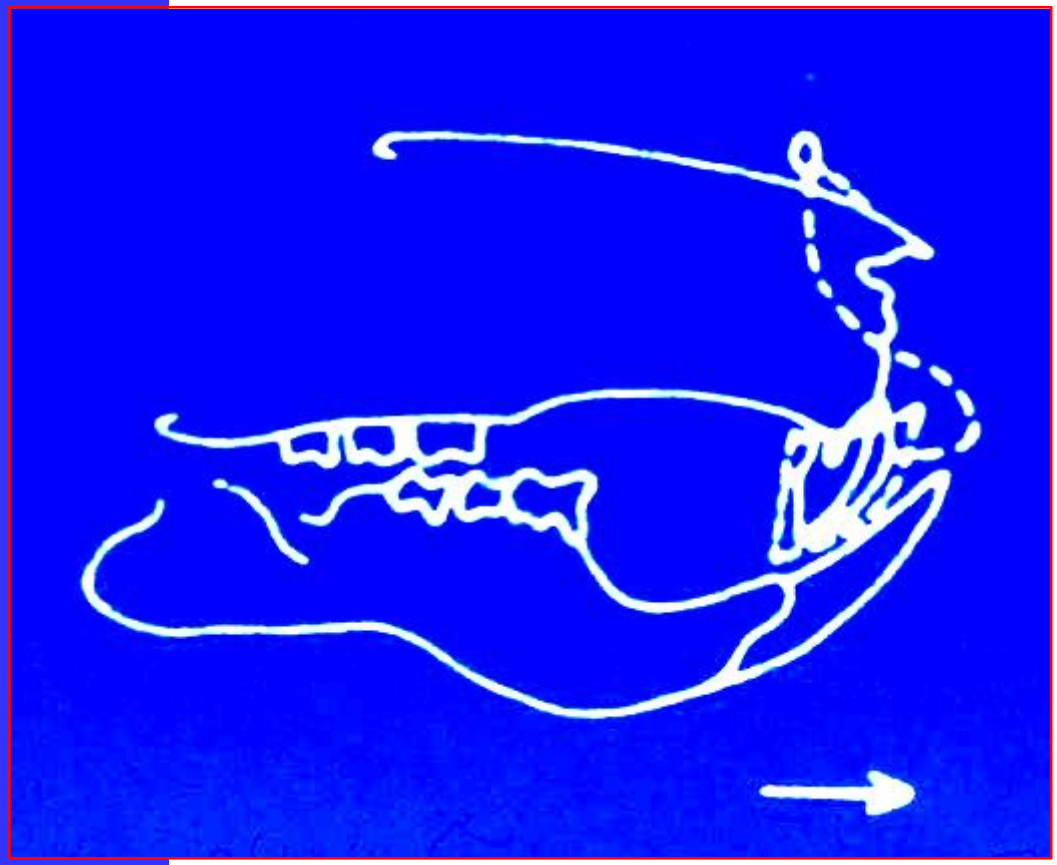
PTERIGÓIDEO LATERAL

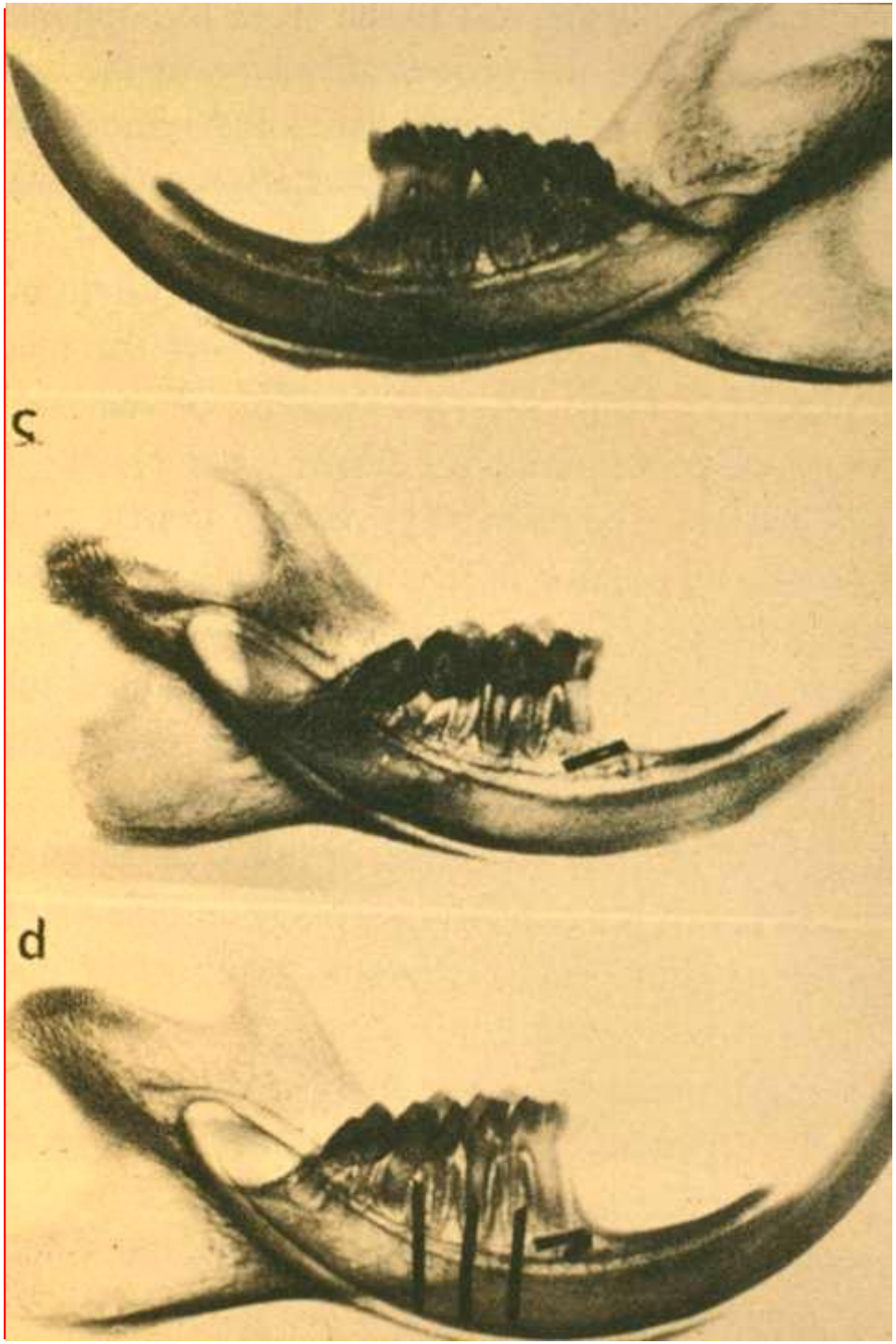




PTERIGÓIDEO LATERAL






c
d

O comprimento final da mandíbula não é determinado geneticamente.

- Orthod.Fr

- Am.J.Orthod.Dentofac.Orthop

Experimentos com o hiperpropulsor postural e hormônio do crescimento

n

Experimentos com a ressecção do músculo pterigóideo lateral

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“ligação comum final”

Experimentos com elástico de Classe II

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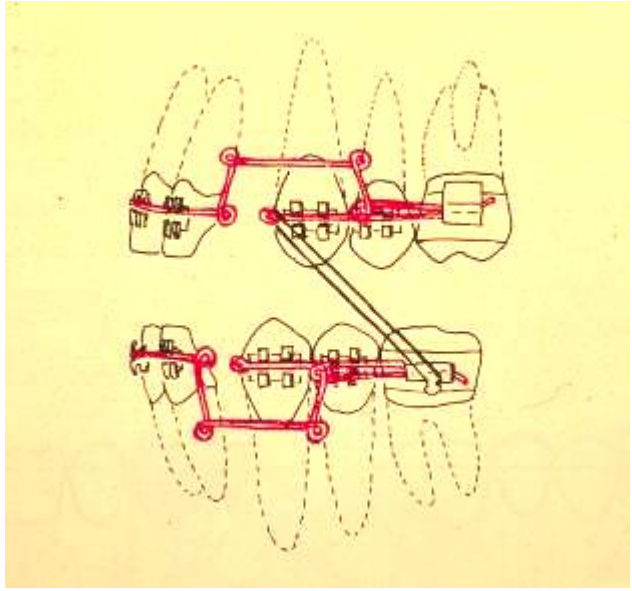

Experimentos com a ressecção da zona bilaminar

-
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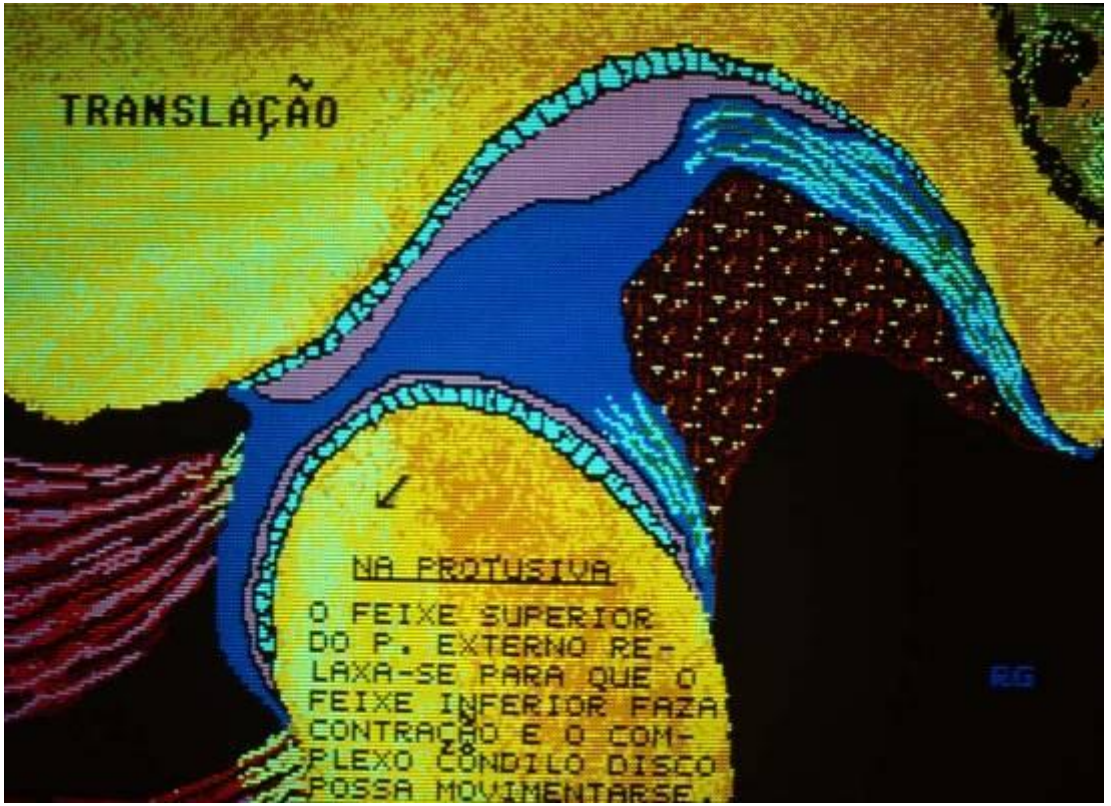
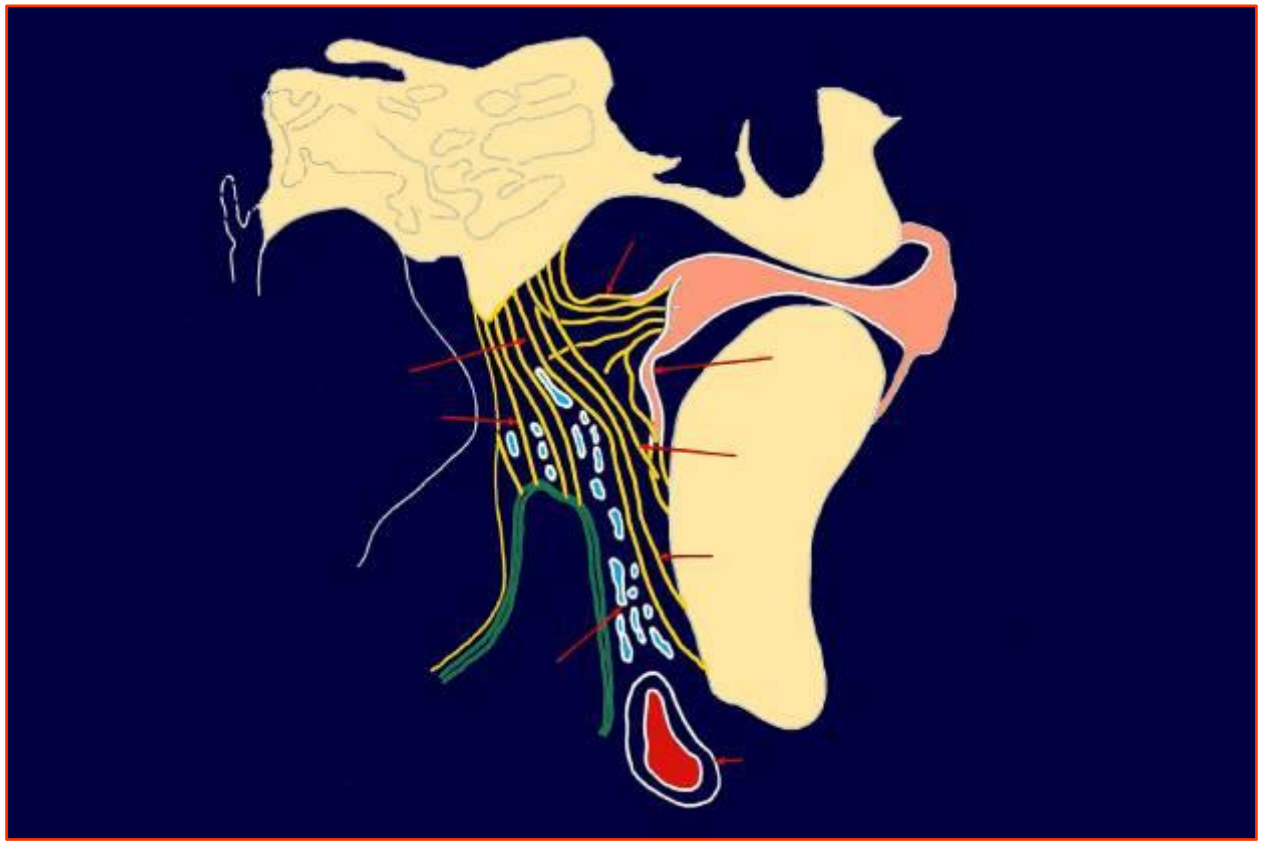
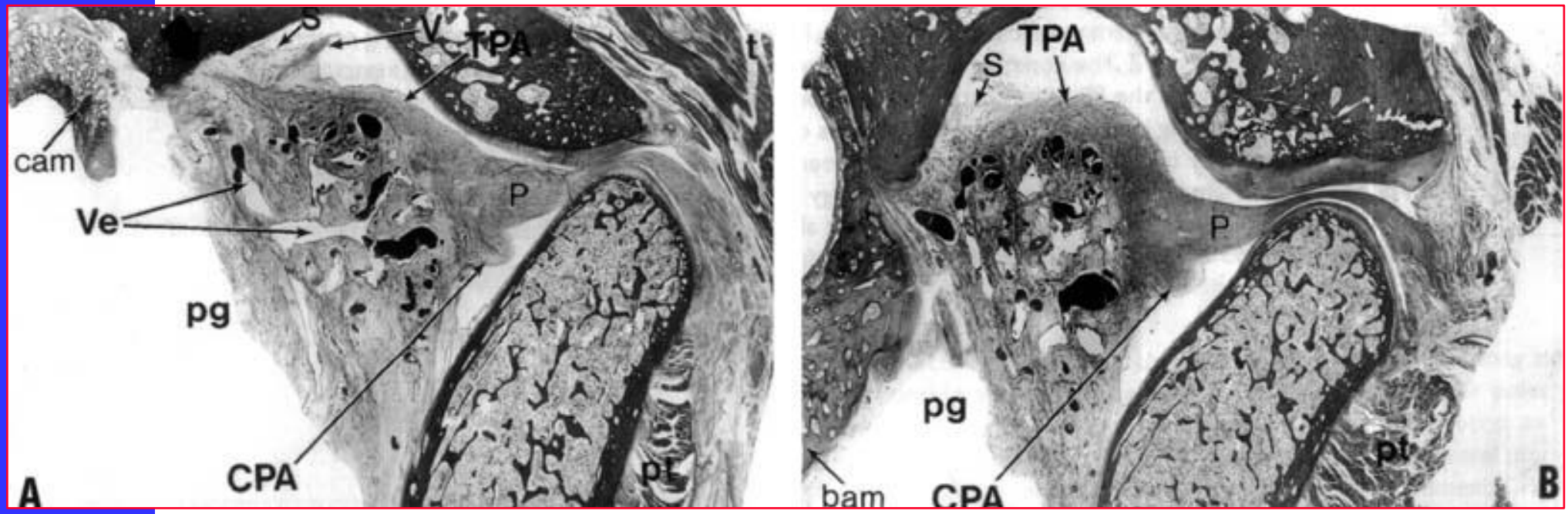
-
  - Aumento nos metábolitos que favorecem o crescimento.
  - Diminuição nos catabólitos e no feed-back negativo.


TRANSLAÇÃO
NA PROTUSIVA
O FEIXE SUPERIOR DO P. EXTERNO RELAXA-SE PARA QUE O FEIXE INFERIOR FAZA CONTRAÇÃO E O COMPLEXO CÔNDILO DISCO POSSA MOVIMENTARSE.

FIBRAS DA ZONA BILAMINAR SEGUNDO SCAPINO



Abertura bucal



Experimentos com o ativador tipo Herren ou LSU

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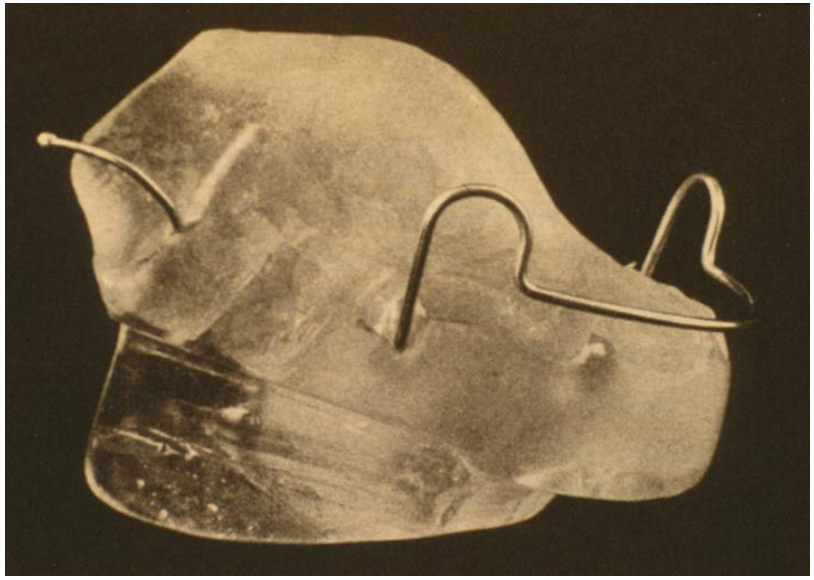
Ativador tipo Herren ou LSU

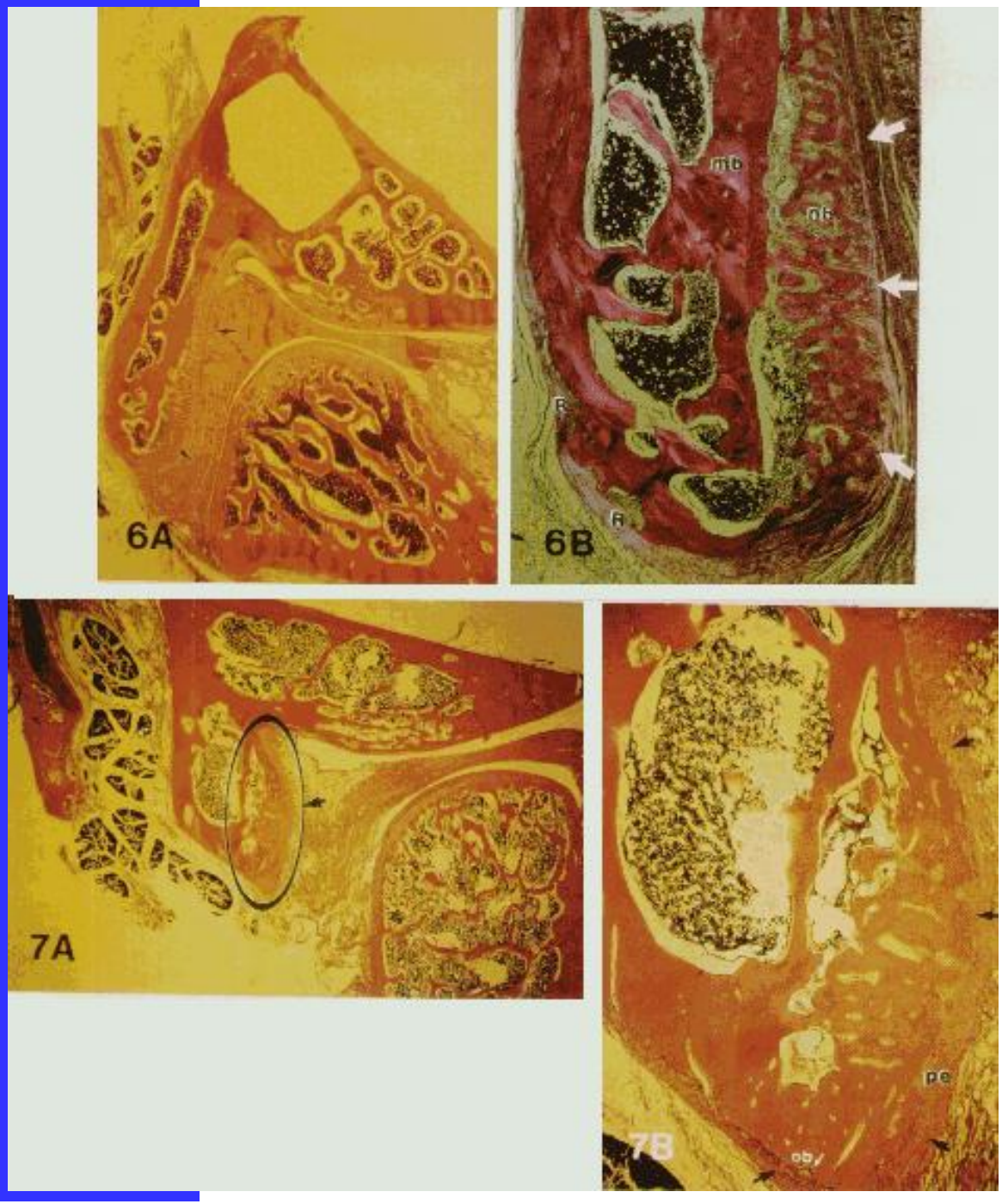


Aparelho de Herbst

WOODSIDE DG et al. The influence of functional appliance therapy on glenoid fossa remodeling. AJODO 1987; 92: 181-98

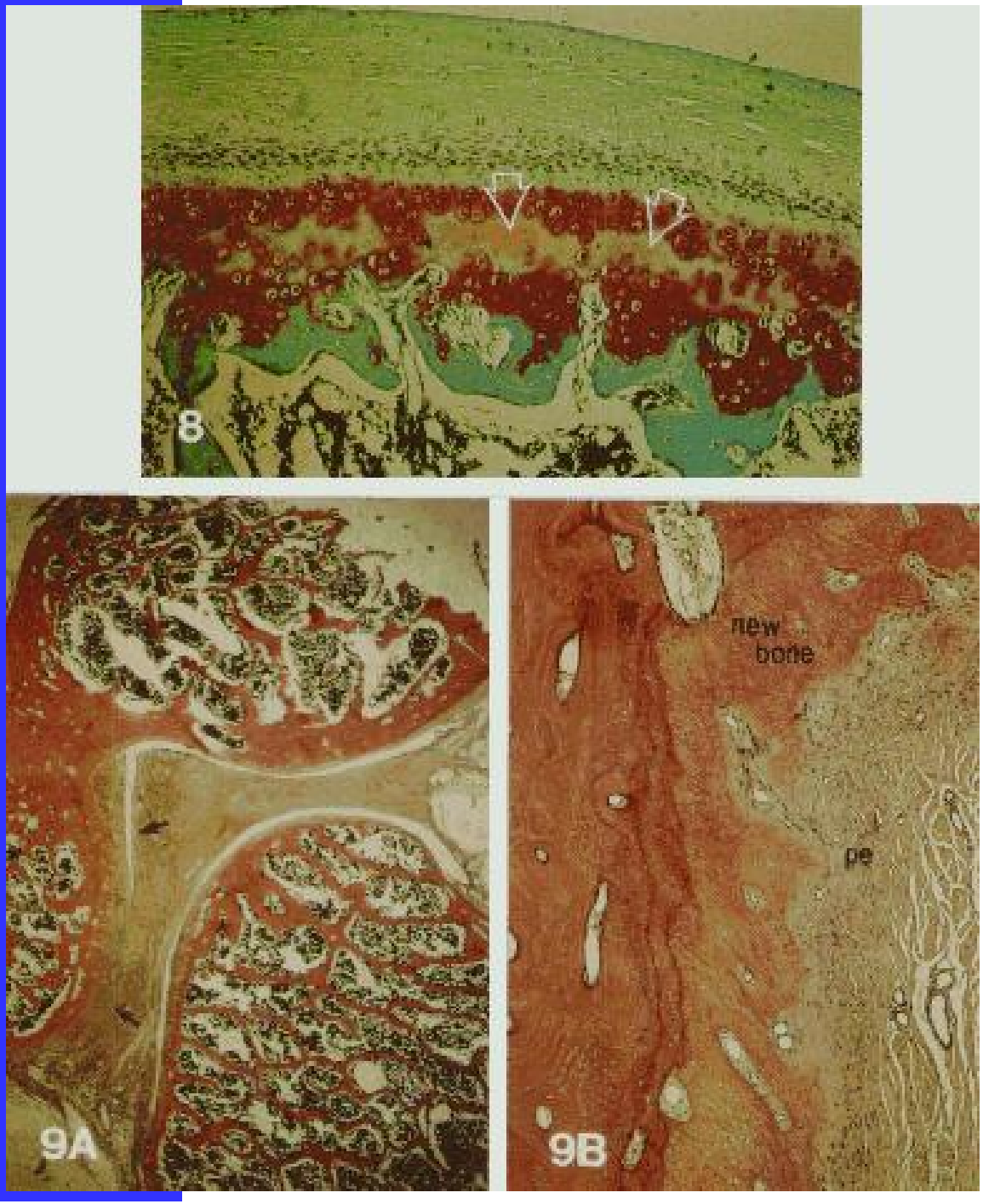
amostra:

5 macacos no grupo experimental e 2 no grupo controle.



6- formação óssea na borda anterior da fossa mandibular e na espinha pós-glenóide, 6 semanas após o início.

7- grande formação óssea na borda anterior da espinha pós-glenóide e aumento da espessura da parte posterior do disco, 12 semanas após o início. O côndilo está numa posição anterior.



8- aumento da área superior e anterior do côndilo, 12 semanas após o início.

9a - corte mostrando aposição óssea na borda anterior da fossa mandibular e da espinha pós-glenóide. Há um aumento da espessura da parte posterior do disco articular.

9b- aposição óssea em maior aumento.

Achados biológicos celulares e moleculares relativos ao modo de ação dos aparelhos funcionais

-
  - Hormônio do crescimento
  - Testosterona
  - Insulina
  - Tiroxina
  - Calcitonina
  - Paratohormônio
  - Peptídeos que promovem o crescimento

Achados biológicos celulares e moleculares relativos ao modo de ação dos aparelhos funcionais

-
  - AMP cíclico
  - Prostaglandina
  - Substância parecida com a somatomedina

Achados biológicos celulares e moleculares relativos ao modo de ação dos aparelhos funcionais

- Encurtamento do músculo pterigóideo lateral.
- Criação de um novo engrama
- Manutenção de uma relação normal côndilo-disco.

Modo de ação dos aparelhos funcionais

Classificação baseada no tipo de aparelho e escala de uso diário.

1-

- u
- u
- u
- u

- São de uso integral

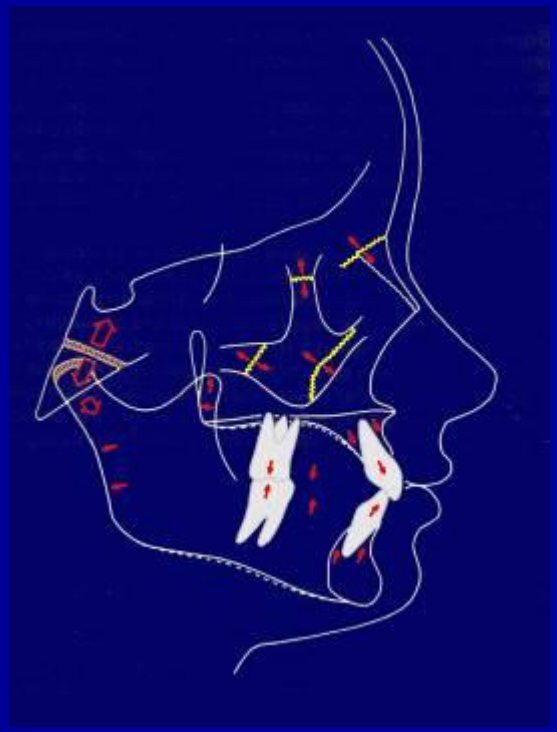
Modo de ação dos aparelhos funcionais

2-

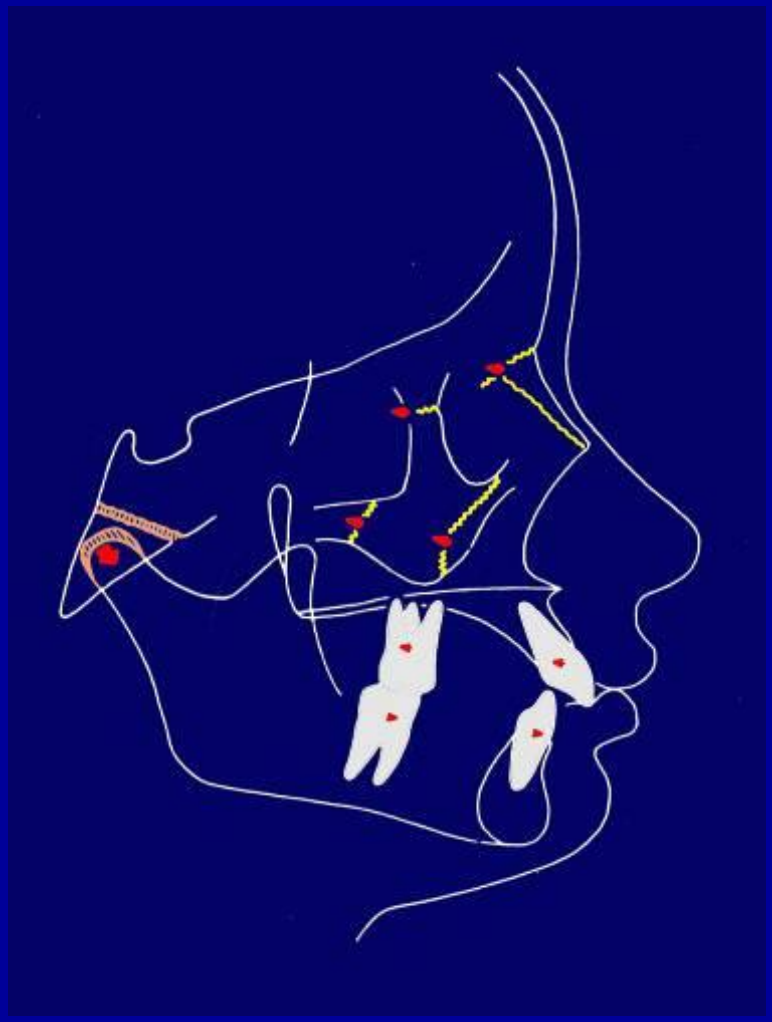
Diminuem o crescimneto do MPL e fazem o reposicionamento ant da mand com a criação de um novo engrama

- u
- u
- u

- São de uso parcial



REGIÕES DO CRESCIMENTO FACIAL



MODO DE AÇÃO DE UM ATIVADOR NO PLANO SAGITAL

EXPERIMENTAÇÃO EM SERES HUMANOS

Experimentos com hormôniuo do crescimento

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  -

Experimentos com hormônio do crescimento e aparelhos funcionais

-
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-
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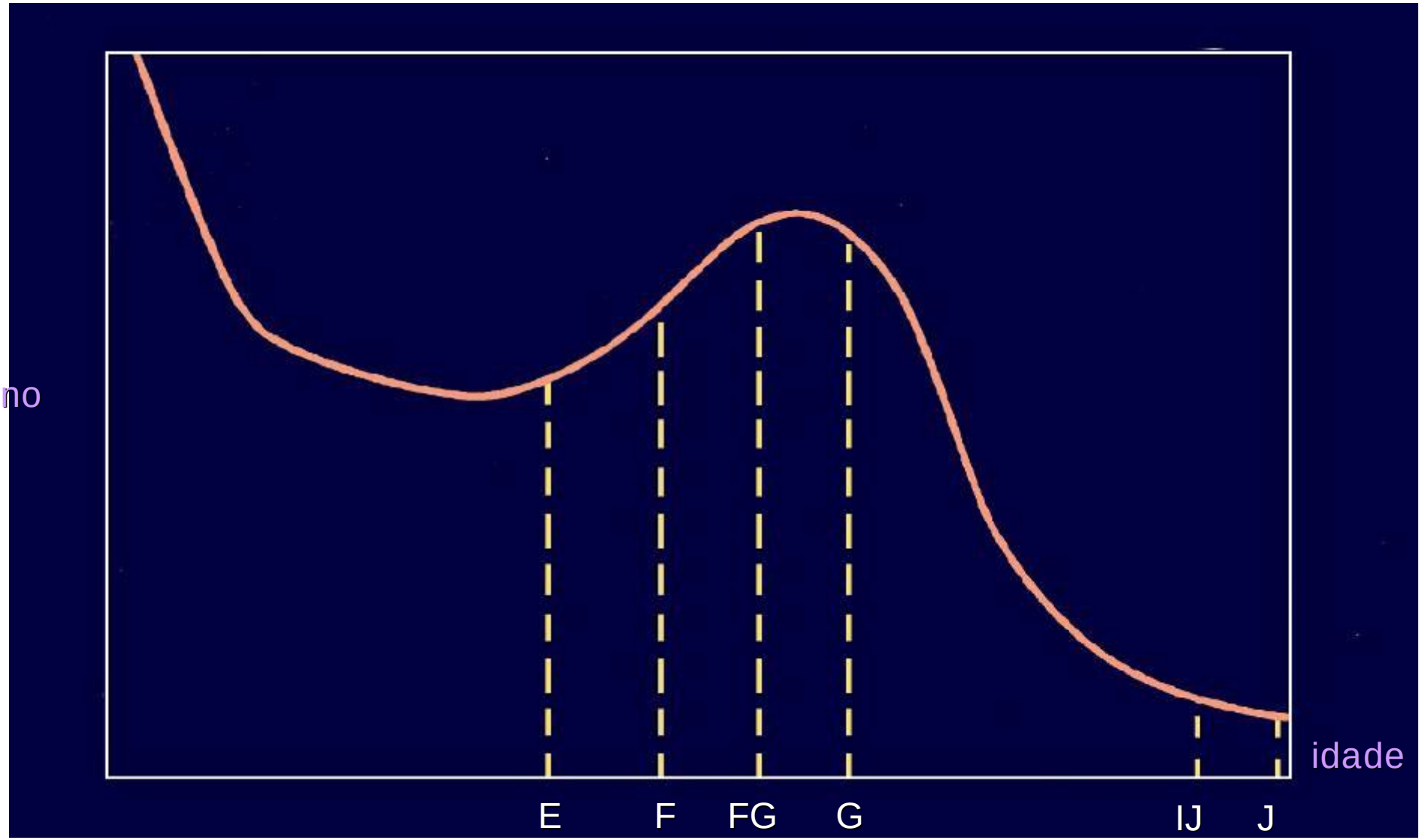
ASSOCIAÇÃO ENTRE A VELOCIDADE DE CRESCIMENTO ESTATURAL E OS ESTÁGIOS DE MATURAÇÃO ESQUELÉTICA

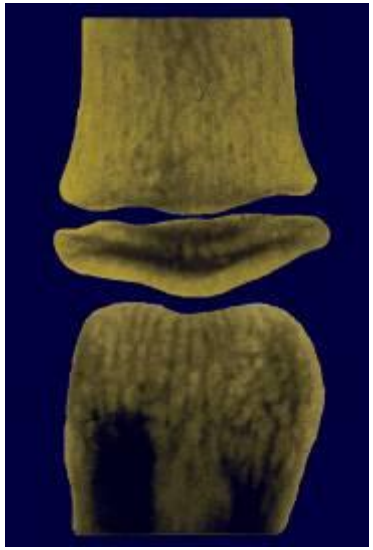


M P 3

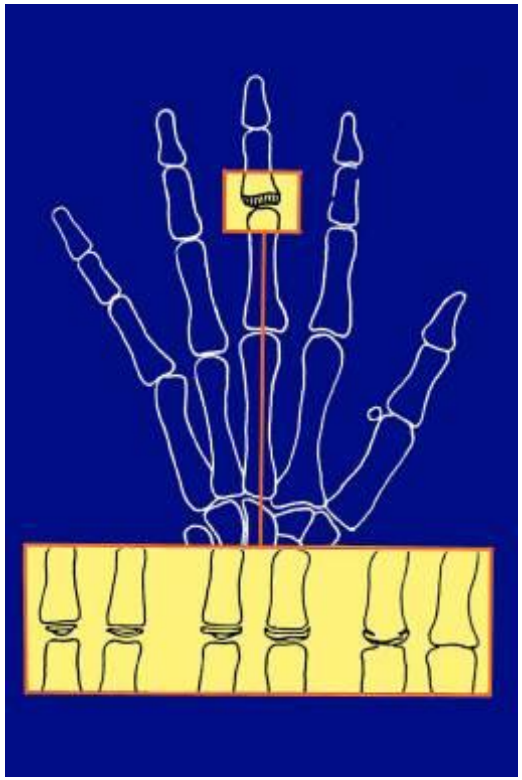
R

Região epífise-diáfise da falange média do dedo 3 (FM3)

FASE FG



HAGG e TARANGER, 1980



E F FG G H I

FG = a epífise possui a mesma largura da metáfise, e há bordas medial e lateral distintas na epífise formando um ângulo reto.

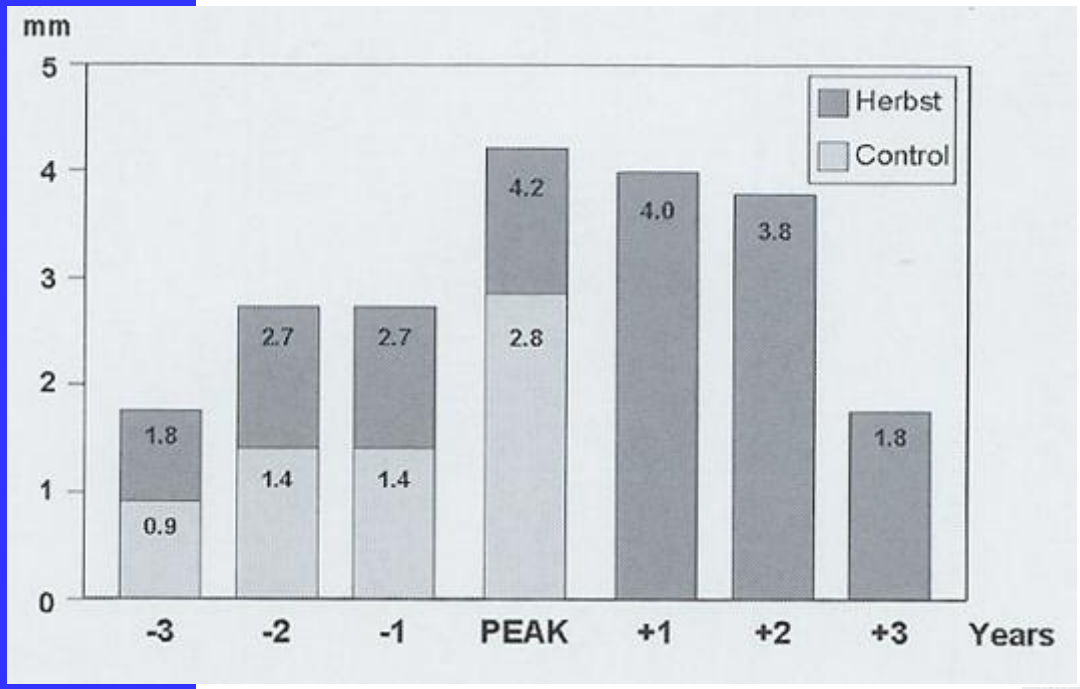
HAGG, U.; PANCHERZ, H. Dentofacial orthopaedics in relation to chronological age, growth period and skeletal development. An analysis of 72 male patients with Class II division 1 malocclusion treated with the Herbst appliance. Eur. J. Orthod., v.10, p.169-176, 1988.

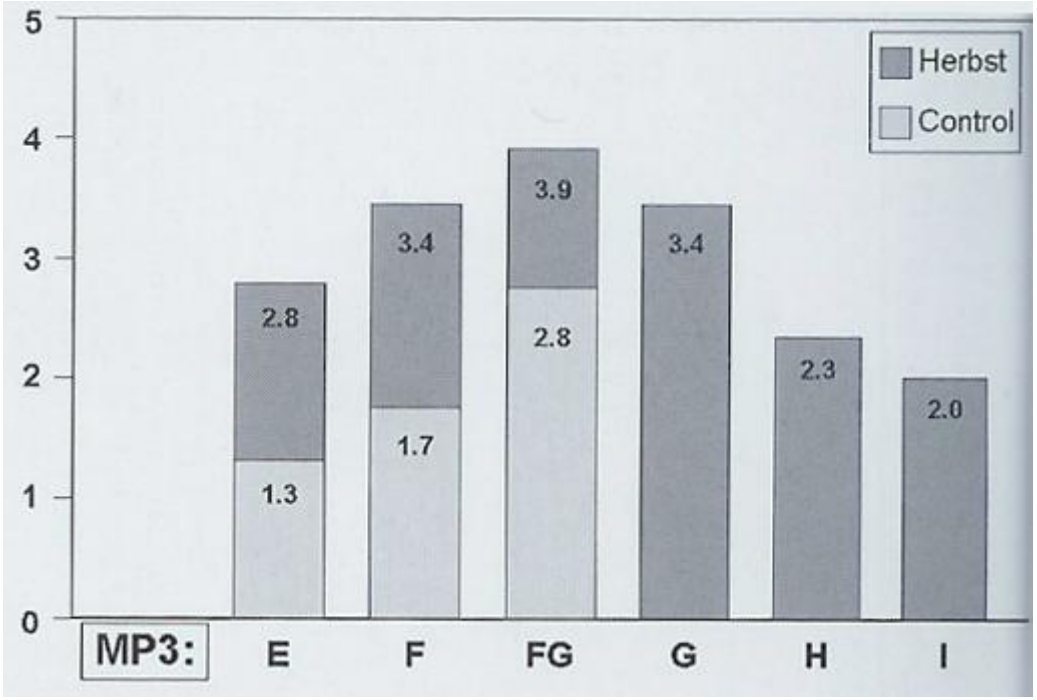
Amostra : 72 meninos com Cl II/1, com idade entre 11 a 19 anos

Tempo de tratamento: 7 meses

Resultados: o crescimento sagital do côndilo (média de 3,6 mm) nos pacientes tratados no pico foi 2 vezes maior que os tratados 3 anos antes ou 3 anos depois do pico.

Os pacientes tratados no estágio FG apresentaram o maior crescimento condilar.


mm
5
4
3
2
1
0
Herbst
Control
4.2
4.0
3.8
2.7
2.7
2.8
1.8
1.4
1.4
0.9
1.8
-3
-2
-1
PEAK
+1
+2
+3
Years


5
4
3
2
1
0
Herbst
Control
3.9
3.4
3.4
2.8
2.8
2.3
2.0
1.7
1.3
MP3:
E
F
FG
G
H
I

MORFOLGIA FACIAL E RESPOSTA AO TRATAMENTO ORTODÔNTICO

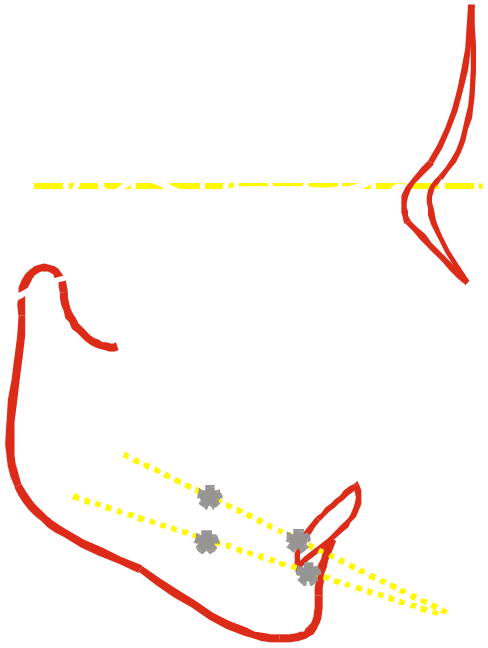
ANÁLISE DE PETROVIC/LAVERGNE

DUAS ÁREAS DE ESTUDO

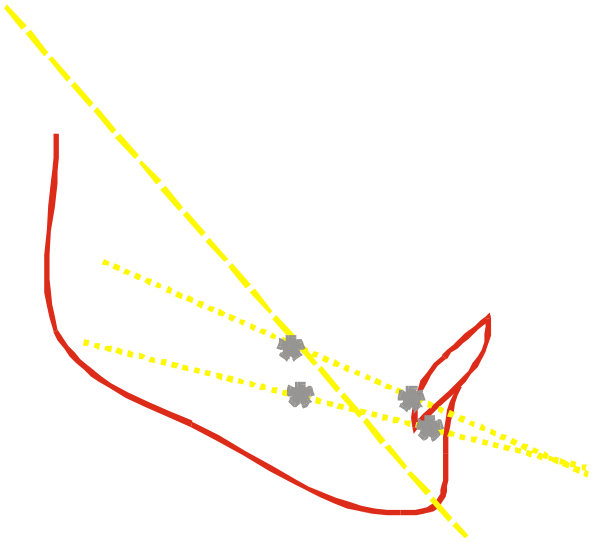
*

*

Rotações mandibulares



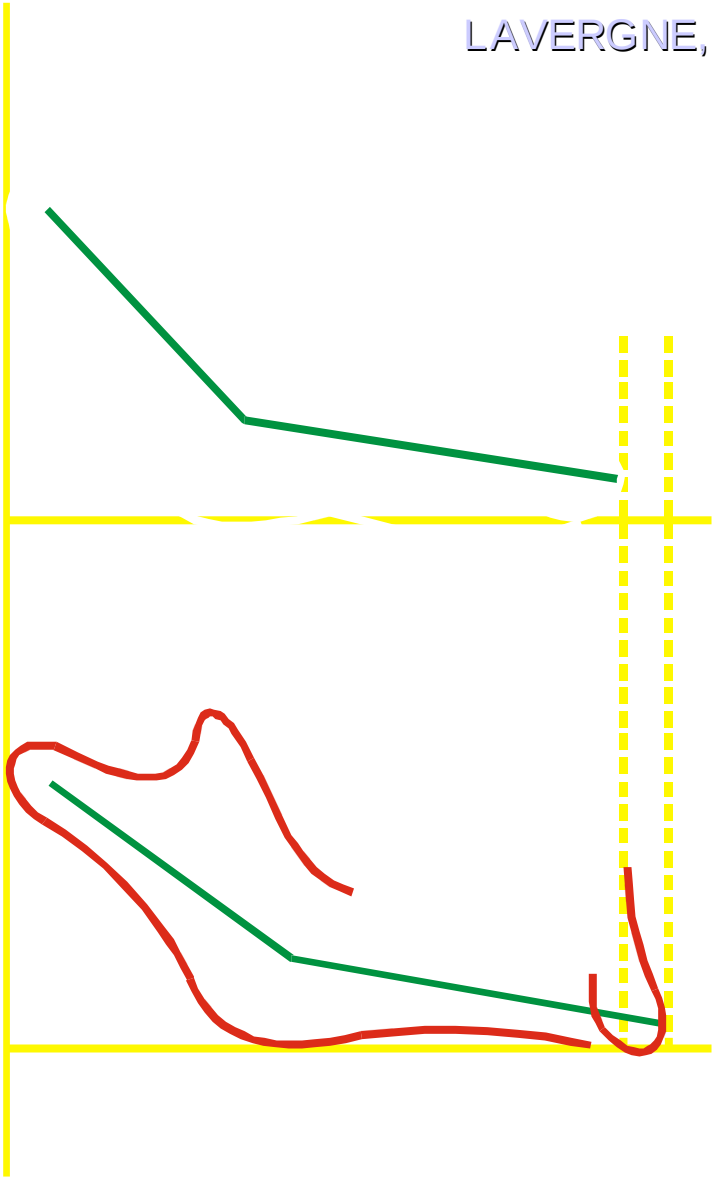
Rotação posicional



Rotação morfogenética

Influência da rotação sobre o comprimento da mandíbula

LAVERGNE, J.; GASSON, N. Scand. J. Dent. Res., 1977.



Rotação anterior

Rotação posterior

- velocidade de renovação do osso alveolar
- velocidade de ossificação subperiostal
- taxa de crescimento da cartilagem condilar

alta velocidade

rotação anterior da mandíbula

baixa velocidade

rotação posterior da mandíbula

POTENCIAL DE CRESCIMENTO A NÍVEL TECIDUAL

TIPOS ROTACIONAIS

1	P2D
2	P1N, A2D
3	R2D
4	R1N
5	R3M, A1N, A1D, P1M
	A3M, P3M

DIMENSÃO VERTICAL

mordida profunda (DB)

mordida aberta (OB)

normal (N)

33 GRUPOS ROTACIONAIS

P POSTERIOR

R NEUTRA

A ANTERIOR

---

1 MAND. = MAX.

2 MAX. MAND.

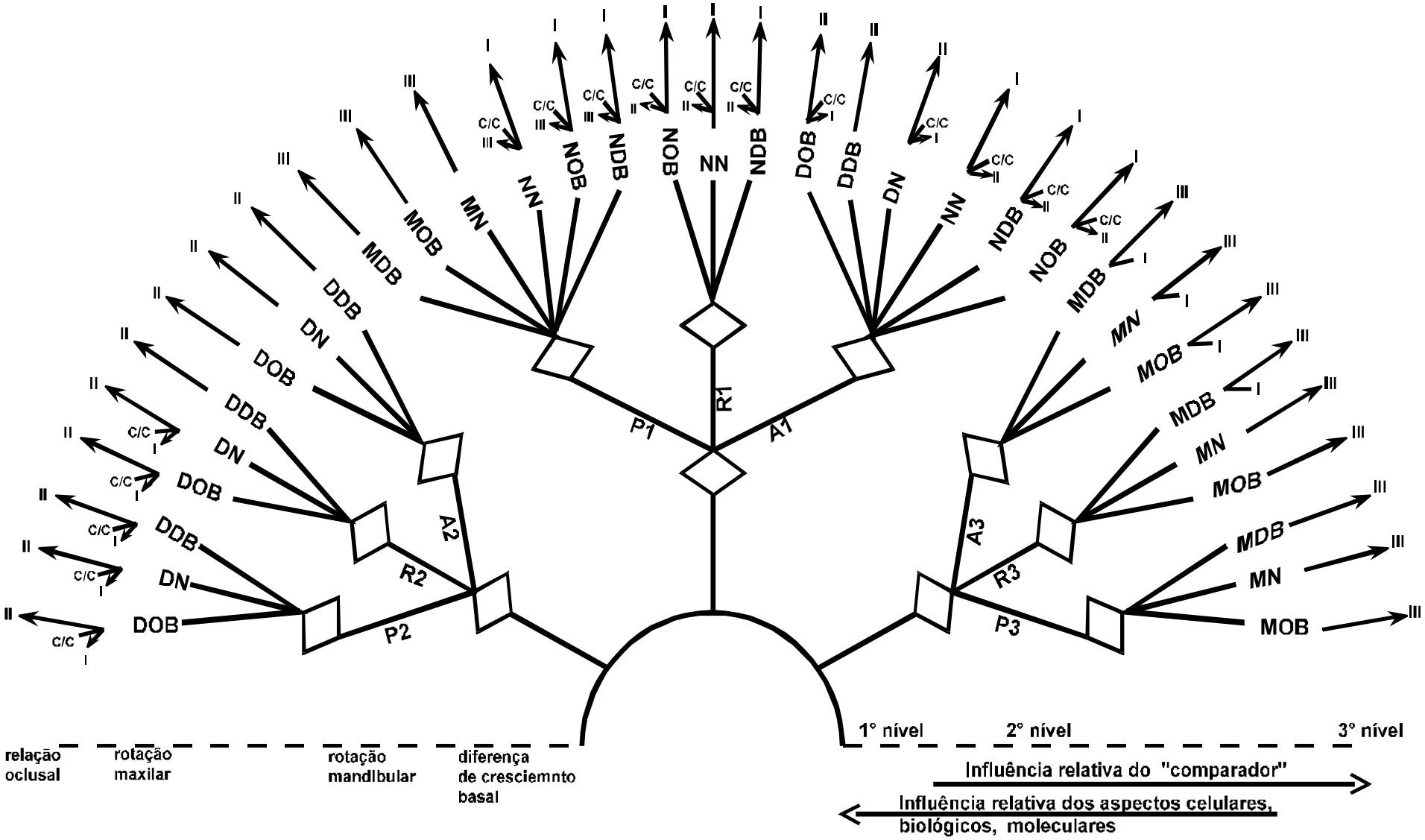
3 MAND. MAX.

D DISTAL

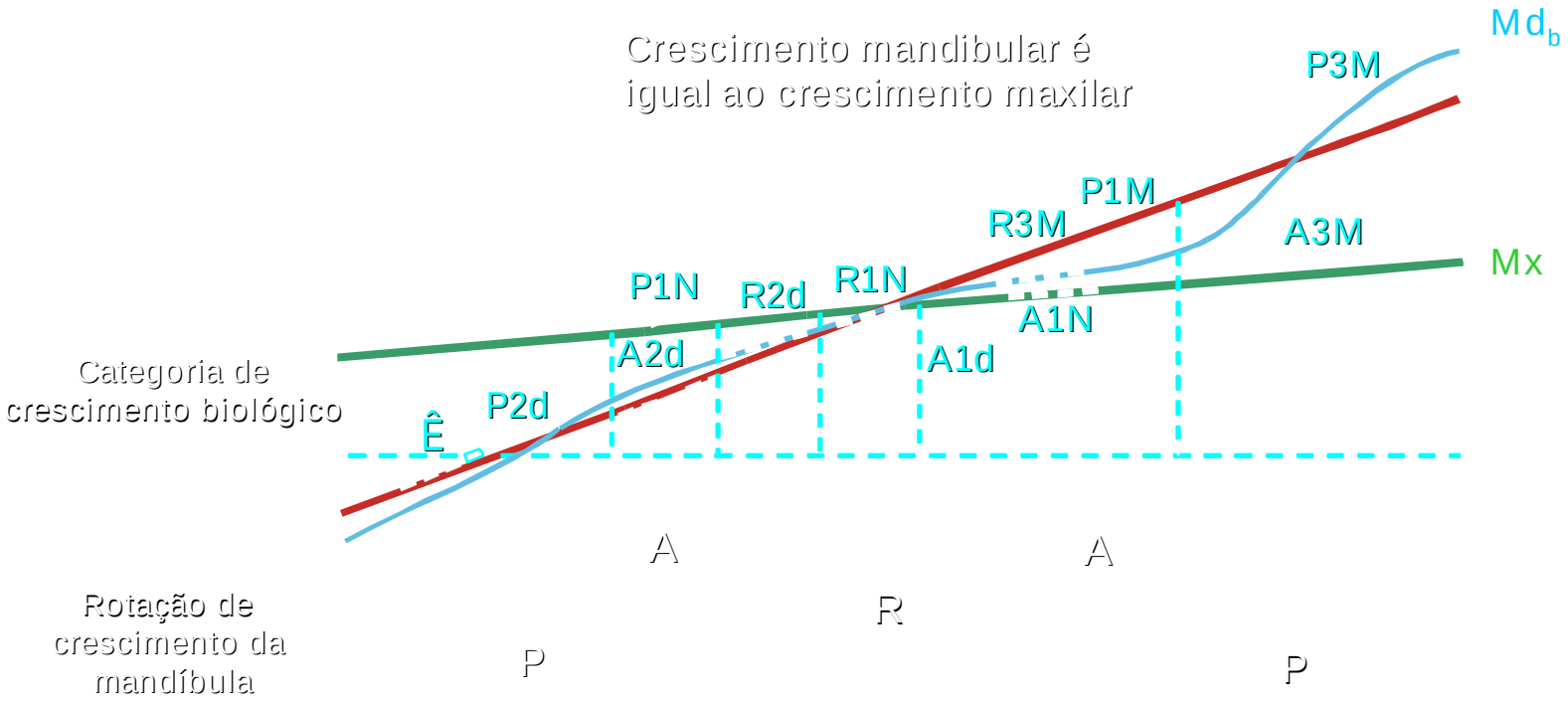
N NORMAL

M MESIAL

ARBORIZAÇÃO EM TRÊS NÍVEIS



6 categorias de crescimento da mandíbula



Mx
Md$_a$
Md$_b$:

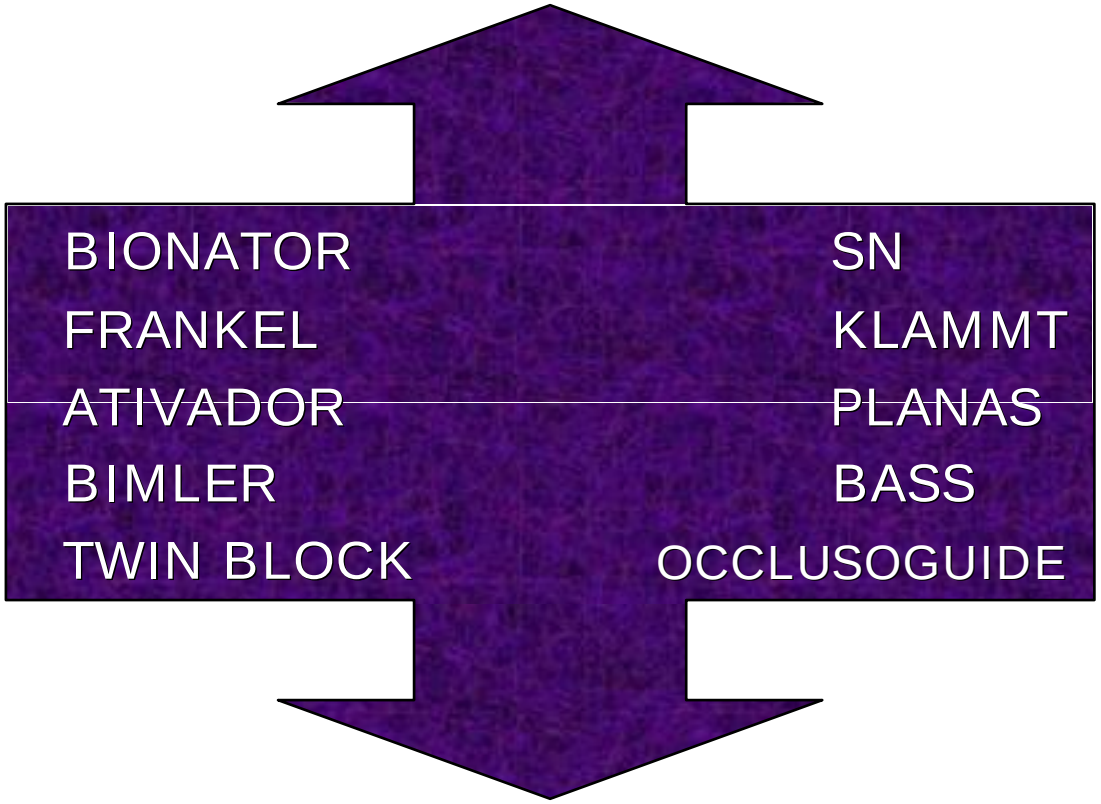
Resposta aos aparelhos funcionais

-
-
  - indistinguível
-
  - Pouca diferença
-
  - Muita diferença

EXPERIMENTOS COM DIFERENTES APARELHOS

APARELHOS ORTOPÉDICOS FUNCIONAIS

REMOVÍVEIS



DEPENDEM DA COLABORAÇÃO

Table 1. Sagittal mandibular advancement relative to cranial base (in mm).

Study	*Year*	*N*	*Appliance*	*Tx time (months)*	*Mandibular advancement*	*Rate per 6 months*
Pancherz	1982	22	Herbst	6	3.1	3.1
Pancherz	1984	30	Activator	32	4.7	0.9
Johnston	1986	47	Activator and bionator	17	4.5	1.6
Pancherz and Hansen	1986	40	Herbst	19	2.5	0.8
Valant and Sinclair	1989	32	Herbst	10	3.3	2.0
Windmiller	1993	46	Herbst	12	4.0	2.0
Livieratos and Johnston	1995	21	Bionator	24	4.7	1.2
Lai	1995	40	Herbst	12	4.1	2.0
Cura and Saraç	1997	27	Bass	6	2.5	2.5
Obijou and Pancherz	1997	40	Herbst	7	2.5	2.1
Weiland *et al.*	1997	27	Activator	7	2.0	1.7
		20	Jasper Jumper	7	2.2	1.9
		20	Headgear activator	7	1.9	1.6
Stucki and Ingervall	1998	27	Jasper Jumper	5	1.6	1.9

Mandibular changes produced by functional appliances in Class II malocclusion: A systematic review

Paola Cozza,[a] Tiziano Baccetti,[b] Lorenzo Franchi,[c] Laura De Toffol,[d] and James A. McNamara, Jr[e]
Rome and Florence, Italy, and Ann Arbor, Mich

The aim of this systematic review of the literature was to assess the scientific evidence on the efficiency of functional appliances in enhancing mandibular growth in Class II subjects. A literature survey was performed by applying the Medline database (Entrez PubMed). The survey covered the period from January 1966 to January 2005 and used the medical subject headings (MeSH). The following study types that reported data on treatment effects were included: randomized clinical trials (RCTs), and prospective and retrospective longitudinal controlled clinical trials (CCTs) with untreated Class II controls. The search strategy resulted in 704 articles. After selection according to the inclusion/exclusion criteria, 22 articles qualified for the final analysis. Four RCTs and 18 CCTs were retrieved. The quality standards of these investigations ranged from low (3 studies) to medium/high (6 studies). Two-thirds of the samples in the 22 studies reported a clinically significant supplementary elongation in total mandibular length (a change greater than 2.0 mm in the treated group compared with the untreated group) as a result of overall active treatment with functional appliances. The amount of supplementary mandibular growth appears to be significantly larger if the functional treatment is performed at the pubertal peak in skeletal maturation. None of the 4 RCTs reported a clinically significant change in mandibular length induced by functional appliances; 3 of the 4 RCTs treated subjects at a prepubertal stage of skeletal maturity. The Herbst appliance showed the highest coefficient of efficiency (0.28 mm per month) followed by the Twin-block (0.23 mm per month). (Am J Orthod Dentofacial Orthop 2006;129:599.e1-599.e12)

Table V. Descriptive analysis of reported outcomes

			Annualized changes				*Actual change*	
Articles	*Appliance*	*Active treatment duration (mo)*	*SNB*	*Co-Gn (or Co-Pg) mm*	*Co-Go mm*	*Go-Gn (or Go-Me; or Go-Pg) mm*	*Co-Gn (or Co-Pg) mm*	*Coefficient of efficiency (mm/mo)*
Jakobsson[18]	act	18	—	0.5 (NS)	—	—	0.7	0.04
Pancherz[19]	Herbst	6*	1.4‡	2.2 (S)†	—	—	***2.2***†	0.37
McNamara et al[20]	FR-2 E	24	0.3 (S)	1.2 (S)	1.0 (S)	0.0 (NS)	***2.4***	0.10
	FR-2 L	24	0.4 (S)	1.8 (S)	1.5 (S)	0.1 (NS)	***3.6***	0.15
Jakobsson and Paulin[21]	act M	32	0.6 (S)	1.2 (S)	—	—	***3.2***	0.10
	act F	30	0.1 (NS)	0.2 (NS)	—	—	0.5	0.02
McNamara et al[22]	Herbst	12	1.6 (S)	2.7 (S)	2.1 (S)	0.2 (NS)	***2.7***	0.22
	FR-2	21	0.5 (NS)	2.2 (S)	1.8 (S)	0.3 (NS)	***3.8***	0.18
Windmiller[23]	Herbst	12	1.3 (S)	3.5 (S)	2.9 (S)	0.3 (NS)	***3.5***	0.30
Nelson et al[24]	FR-2	18	0.2 (NS)	0.5 (NS)	0.0 (NS)	0.7 (NS)	0.7	0.04
	act	18	0.2 (NS)	0.9 (NS)	−0.7 (NS)	1.2 (S)	1.3	0.07
Tulloch et al[25]	bo	15	0.6 (S)	1.3 (S)	—	—	1.6	0.11
Illing et al[26]	Bass	9	1.5 (NS)	0.5 (NS)	—	—	0.4	0.04
	bio	9	1.1 (NS)	3.5 (S)	—	—	***2.6***	0.29
	TB	9	1.3 (NS)	3.2 (S)	—	—	***2.4***	0.27
Franchi et al[27]	Herbst	12	—	2.7 (S)	1.2 (S)	1.1 (NS)	***2.7***	0.22
Tümer and Gültan[28]	act	10	2.2 (S)	1.8 (S)	—	0.2 (NS)	1.5	0.15
	TB	7*	1.5 (S)	1.4 (S)	—	–0.5 (NS)	1.4	0.20
Toth and McNamara[29]	TB	16	1.0 (S)	2.2 (S)	1.3 (S)	0.7 (S)	***3.0***	0.19
	FR-2	24	0.3 (NS)	1.4 (S)	1.0 (S)	0.1 (NS)	***2.8***	0.12
Mills and McCulloch[30]	TB	14	1.9 (S)	3.6 (S)	2.5 (S)	1.1 (S)	***4.2***	0.30
Baccetti et al[31]	TB E	14	—	1.9 (S)	0.3 (NS)	1.0 (NS)	***2.2***	0.16
	TB L	17	—	4.7 (S)	2.7 (S)	1.7 (S)	***6.7***	0.39
Chadwick et al[32]	FR-2	20	0.4 (S)	0.3 (NS)	—	—	0.6	0.03
de Almeida et al[33]	bio	16	1.3 (S)	1.7 (S)	—	1.1 (S)	***2.3***	0.14
	FR-2	17	0.4 (NS)	0.8 (S)	—	0.8 (S)	1.2	0.07
Basciftci et al[34]	act	16	0.7 (NS)	3.9 (S)	—	2.2 (S)	***5.2***	0.32
Pangrazio-Kulbersh et al[35]	MARA	11	1.0 (S)	2.7 (S)	2.7 (S)	0.1 (NS)	***2.7***	0.23
Faltin et al[36]	bio	22	—	0.4 (NS)	0.0 (NS)	0.2 (NS)	1.9	0.09
	bio	28	—	2.1 (S)	2.1 (S)	0.0 (NS)	***4.3***	0.15
Janson et al[37]	FR-2	28	1.4 (NS)	0.0 (NS)	0.1 (NS)	0.7 (S)	0.5	0.02
O'Brien et al[38]	TB	15	—	1.2†,‡	—	—	1.5	0.10
Cozza et al[39]	act	21	0.8 (S)	1.5 (NS)	—	0.1 (NS)	***2.7***	0.13

Act, Activator; *Bass,* Bass appliance; *bio,* bionator appliance; *FR-2,* function regulator of Fränkel; *MARA,* mandibular anterior repositioning appliance; *TB,* Twin-block appliance; *contr,* controls; *ECG,* early control group; *LCG,* late control group; *M,* male; *F,* female; *S,* statistically significant; *NS,* not significant as reported by authors.

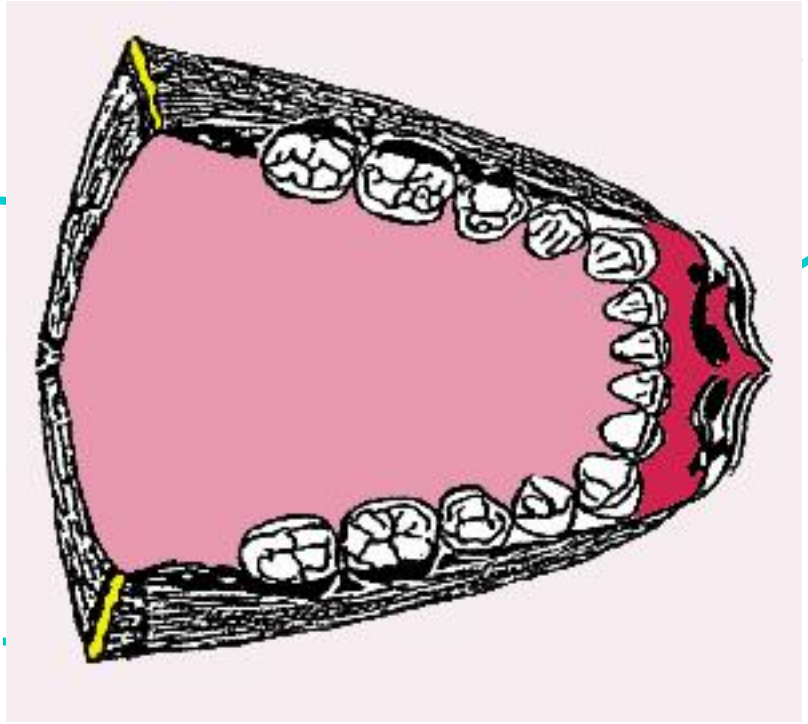
Statistically and clinically significant differences (at least 2 mm) shown in bold and italics.

*Outcomes were not annualized.

FRANKEL
FR2

M. Constritor
superior da faringe

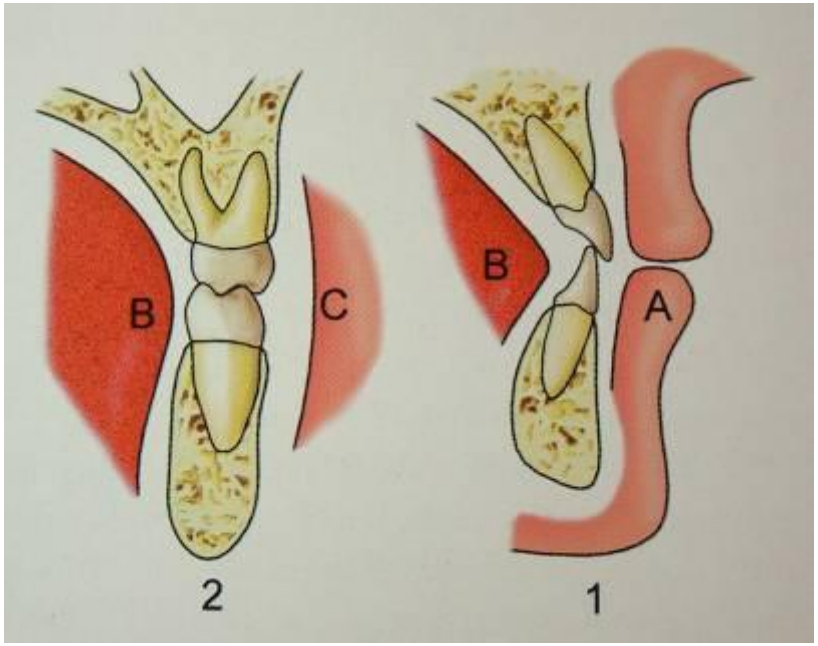
Rafe pterigomandibular

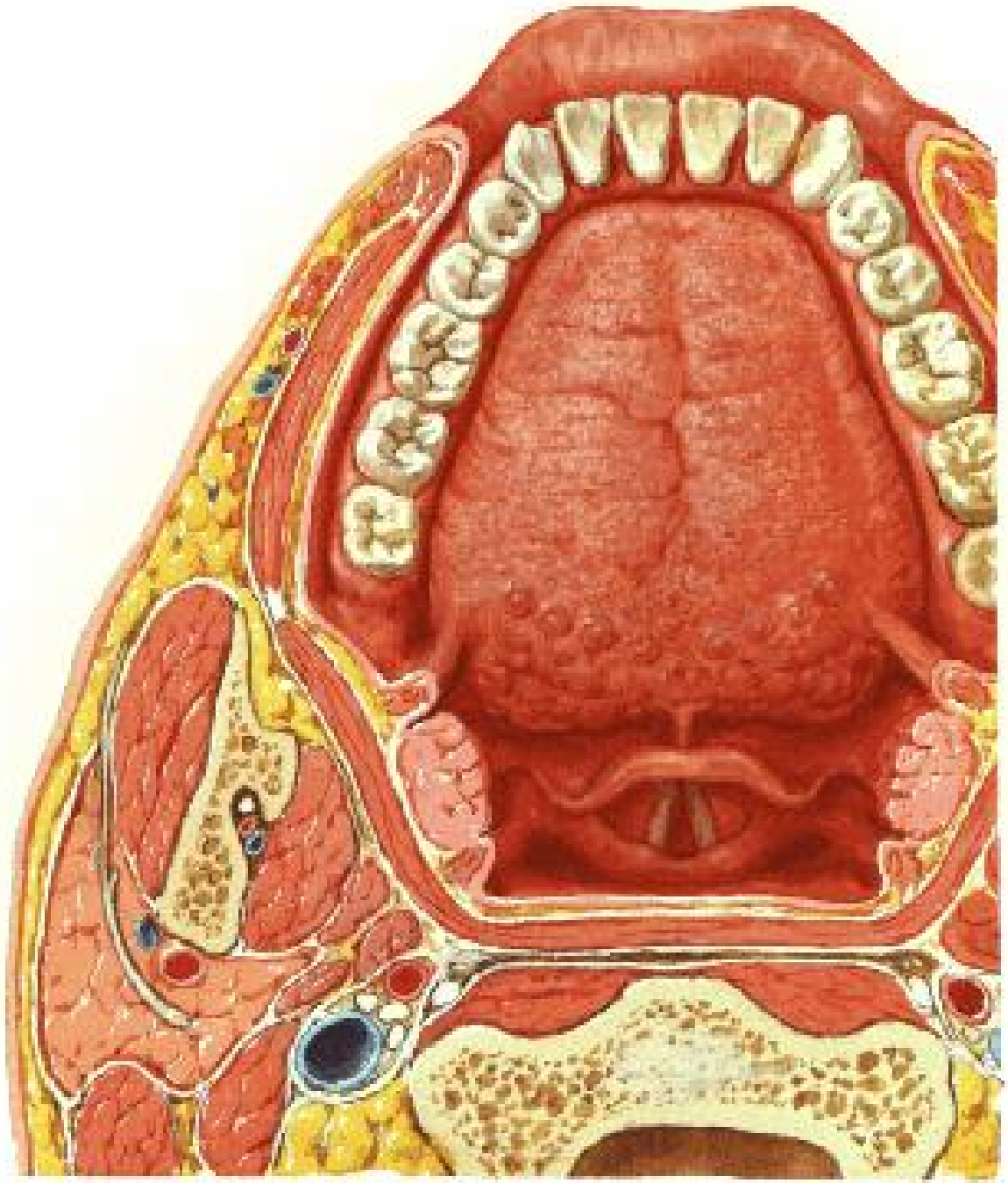


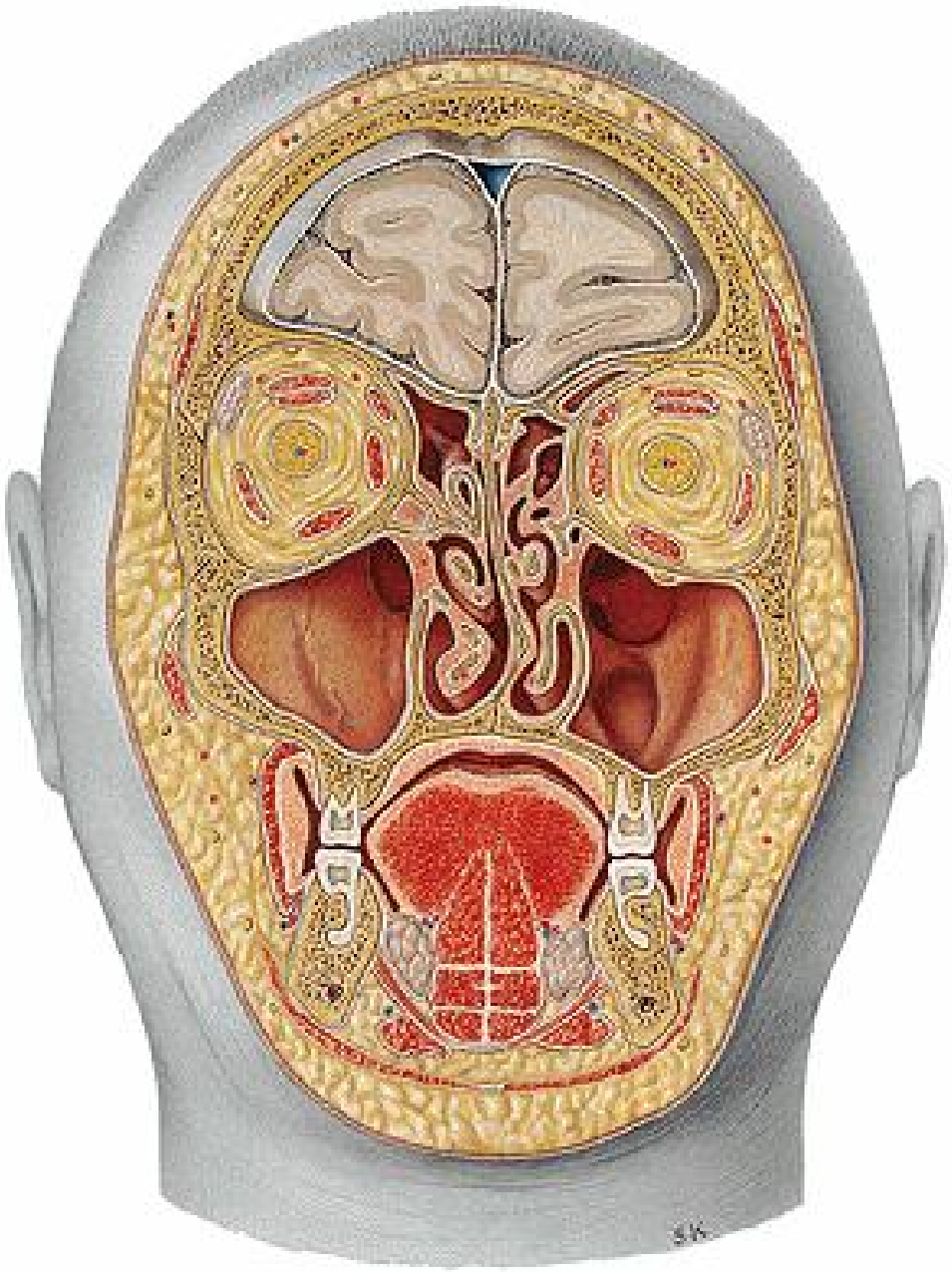
M. Orbicular da boca

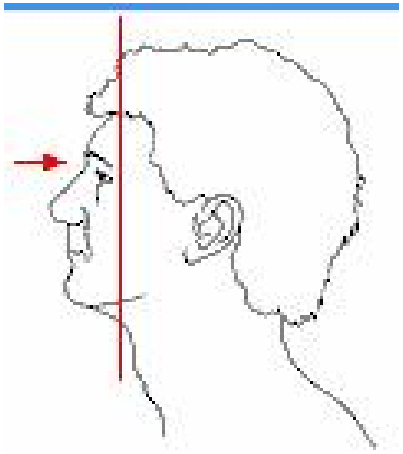
Mecanismo Bucinador

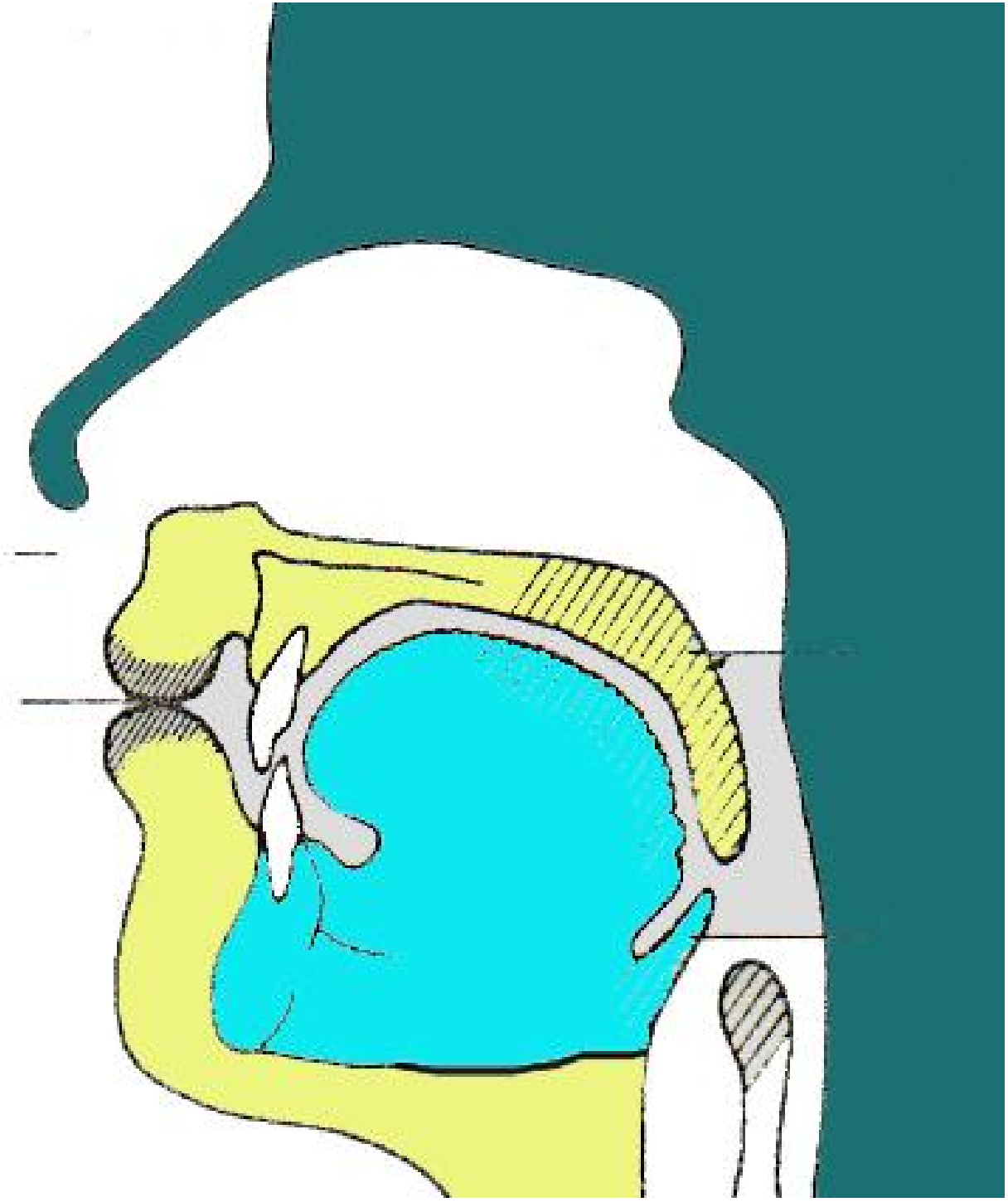
Graber,T.

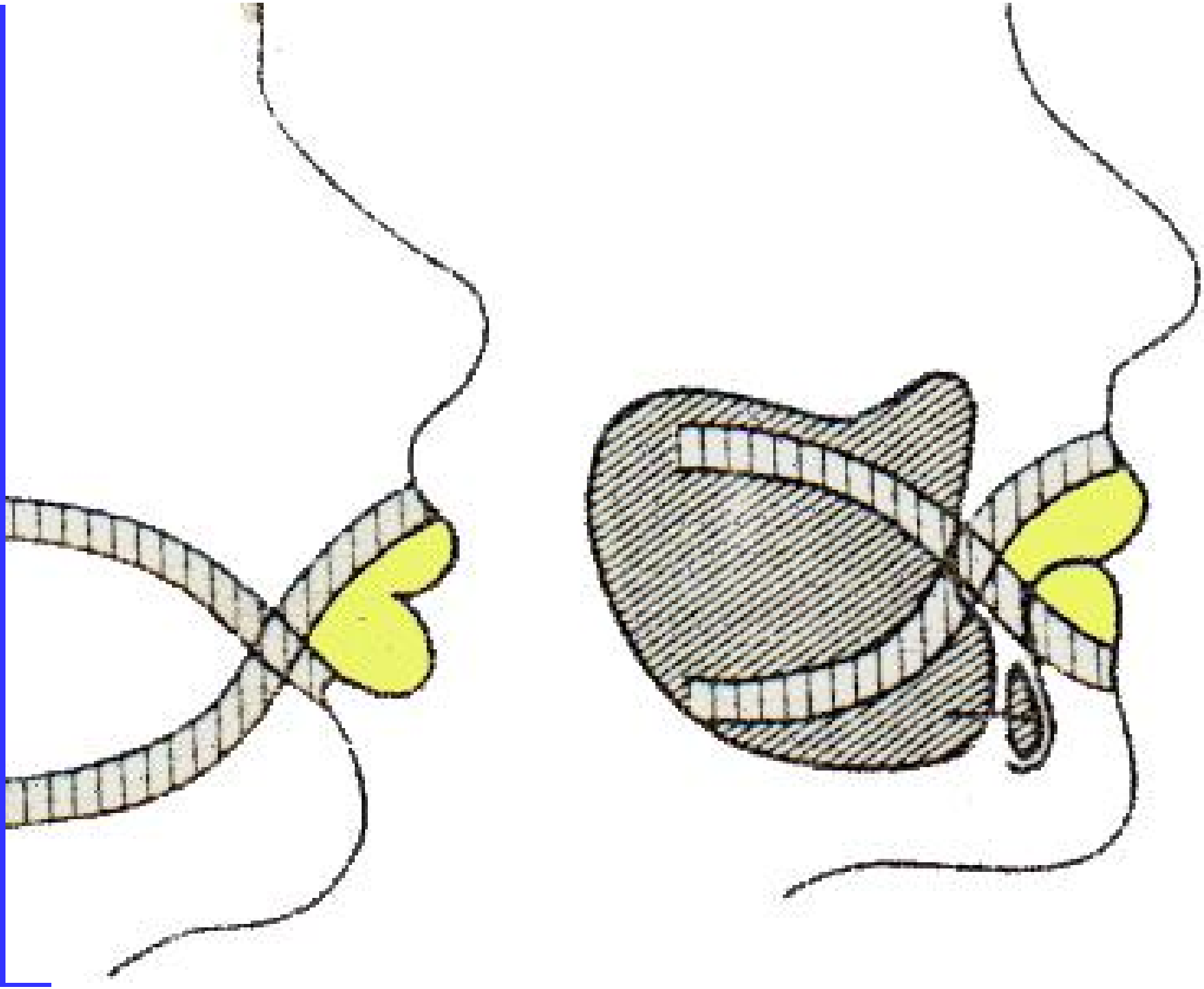


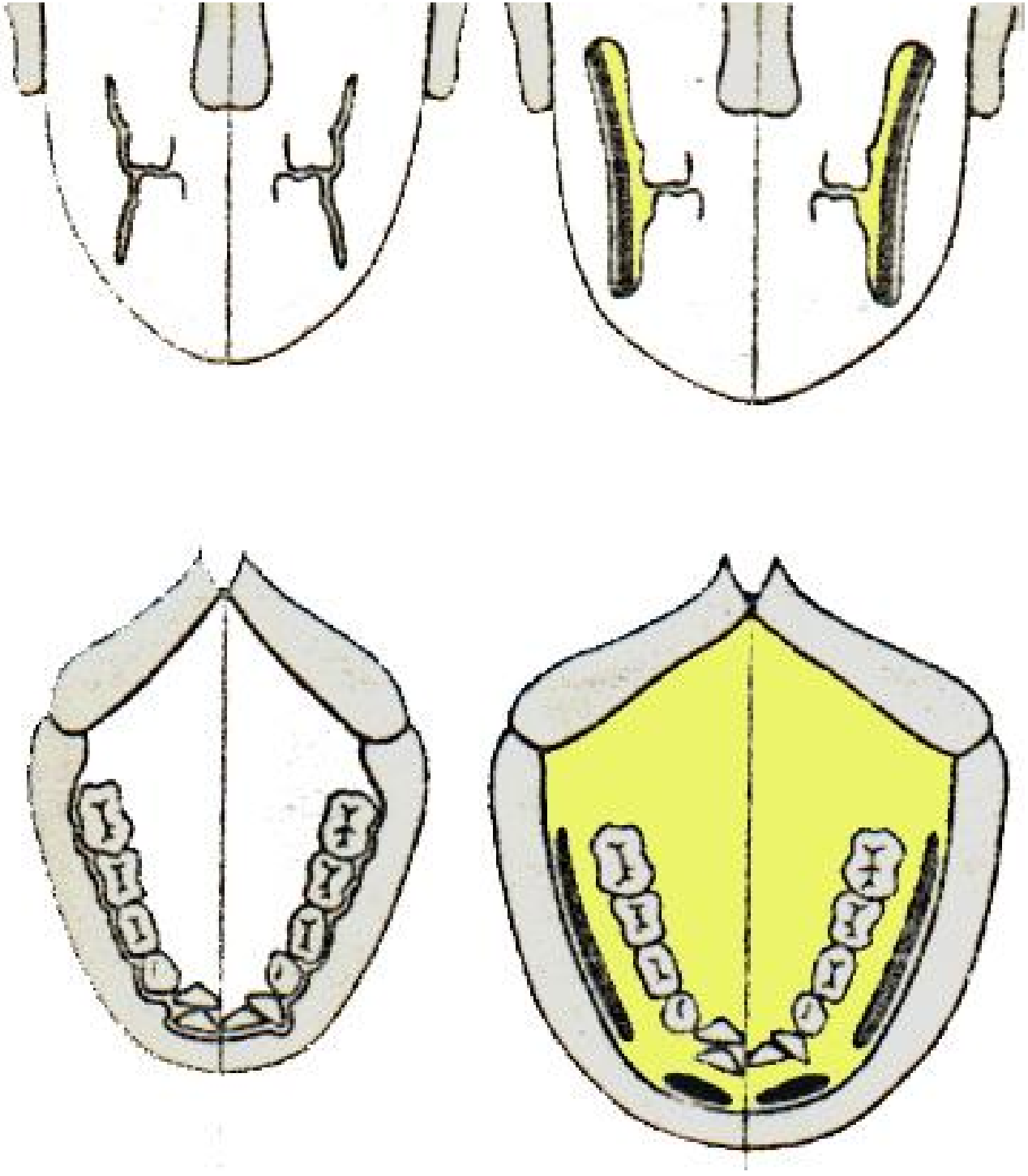


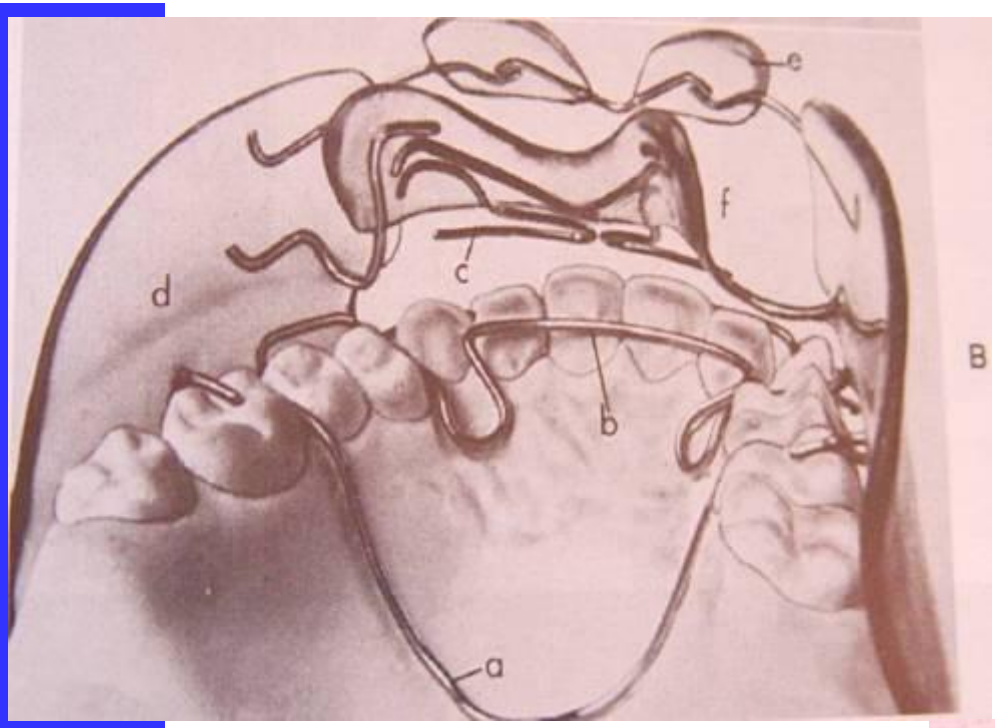


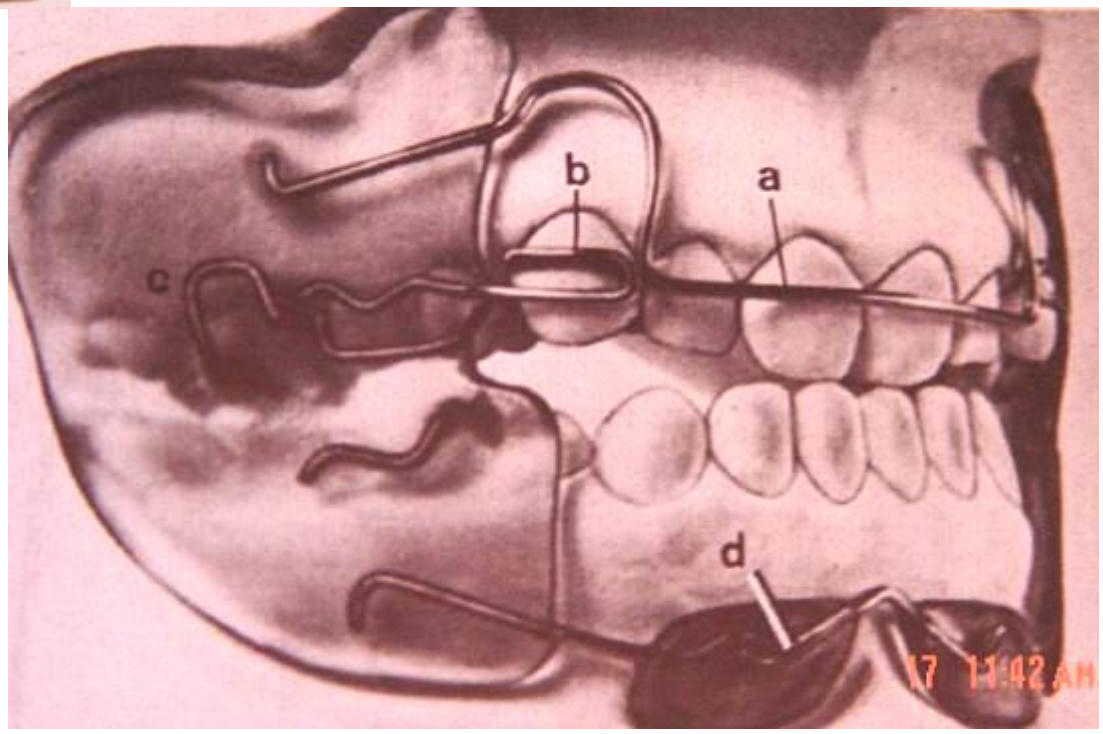




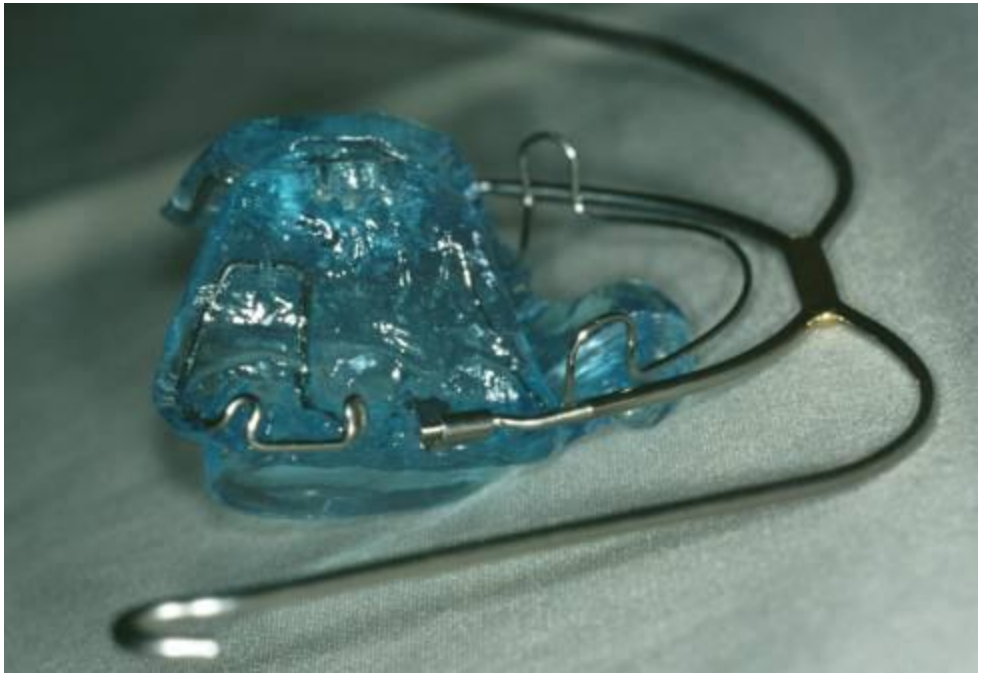


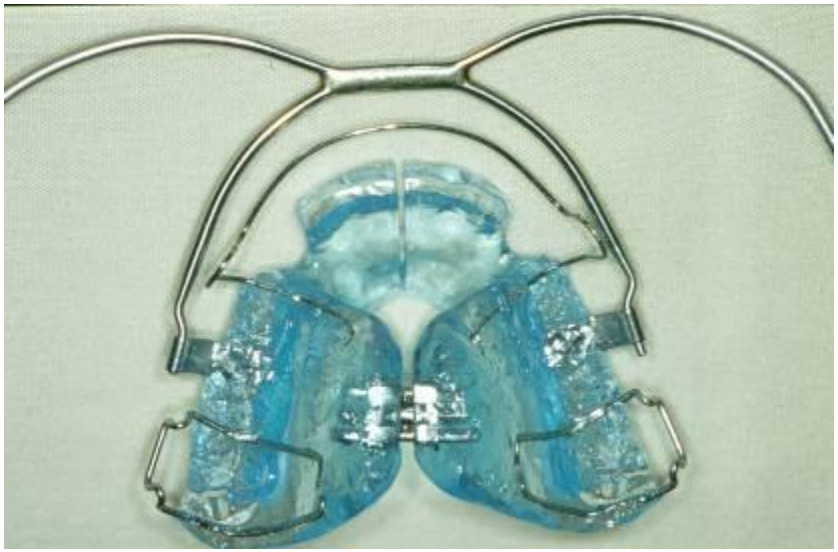



e
f
c
d
b
B
a


b
a
c
d

AEB CONJUGADO COM ATIVADOR





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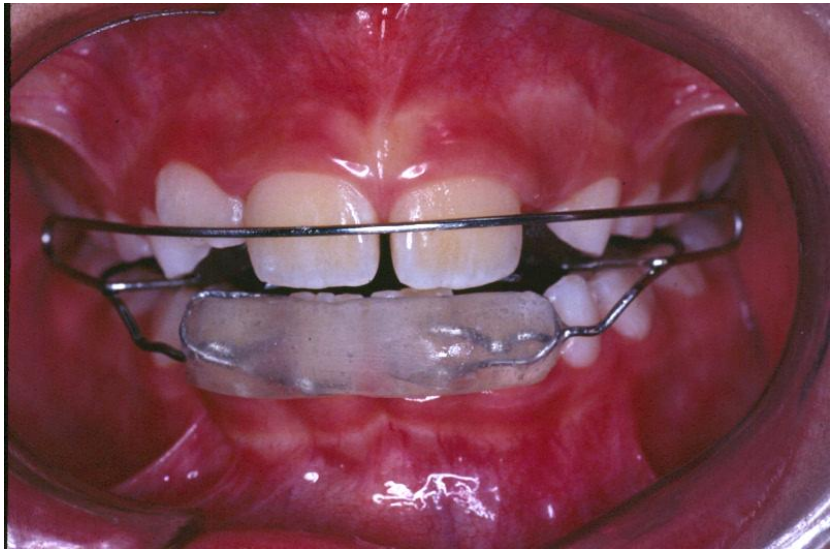
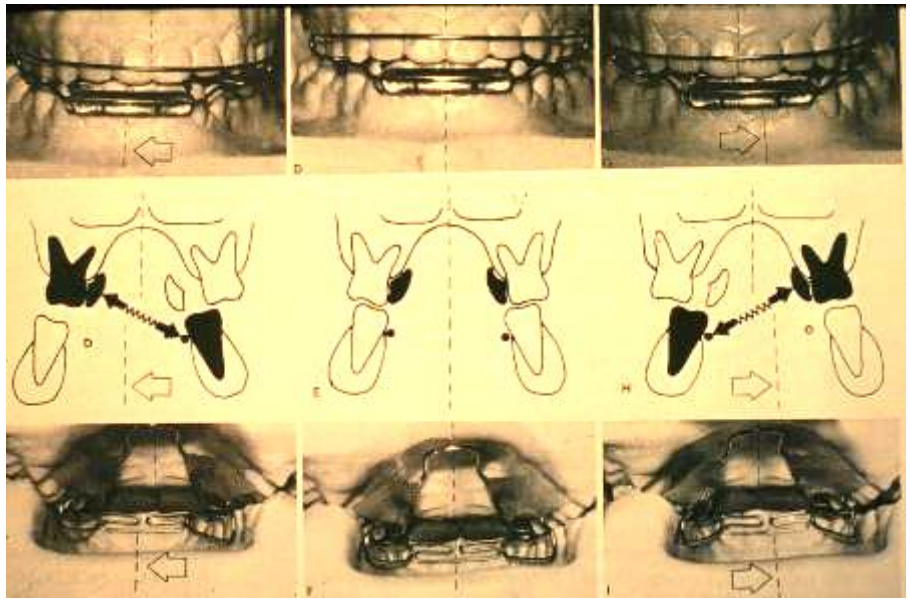
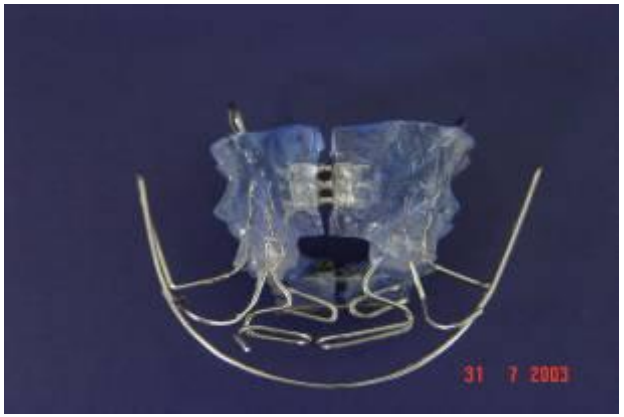
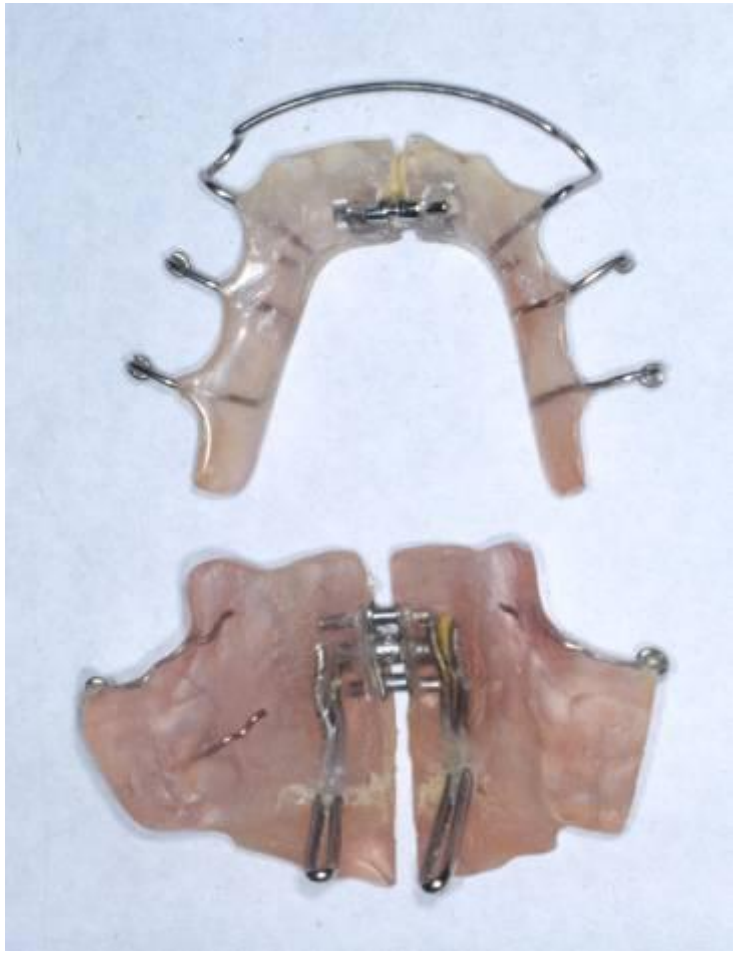




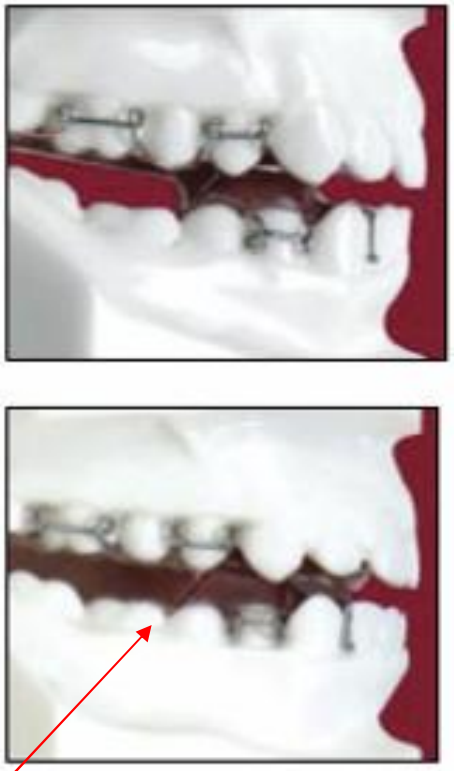
SN1



PLACA DUPLA DE SANDERS



TWIN BLOCK



TWIN BLOCK X HERBST

Fig 1. Design of Twin-block used in study.

Fig 2. Design of Herbst appliance used in study.

Correção da Classe II
Cenário mais provável

- 6 a 7 mm:

1- crescimento condilar	1 a 3 mm
2- crescimento normal da fossa	0,5 a 1 mm
3- modificação da fossa	1,5 a 2 mm
4- eliminação da retrusão funcional	0,5 a 1,5 mm
5- restrição da mesialização dos 1MS	1 a 2 mm
6- mesialização dos 1MI	1 a 2 mm
7-alteração na diração de cresc. cond.	0,5 a 1mm

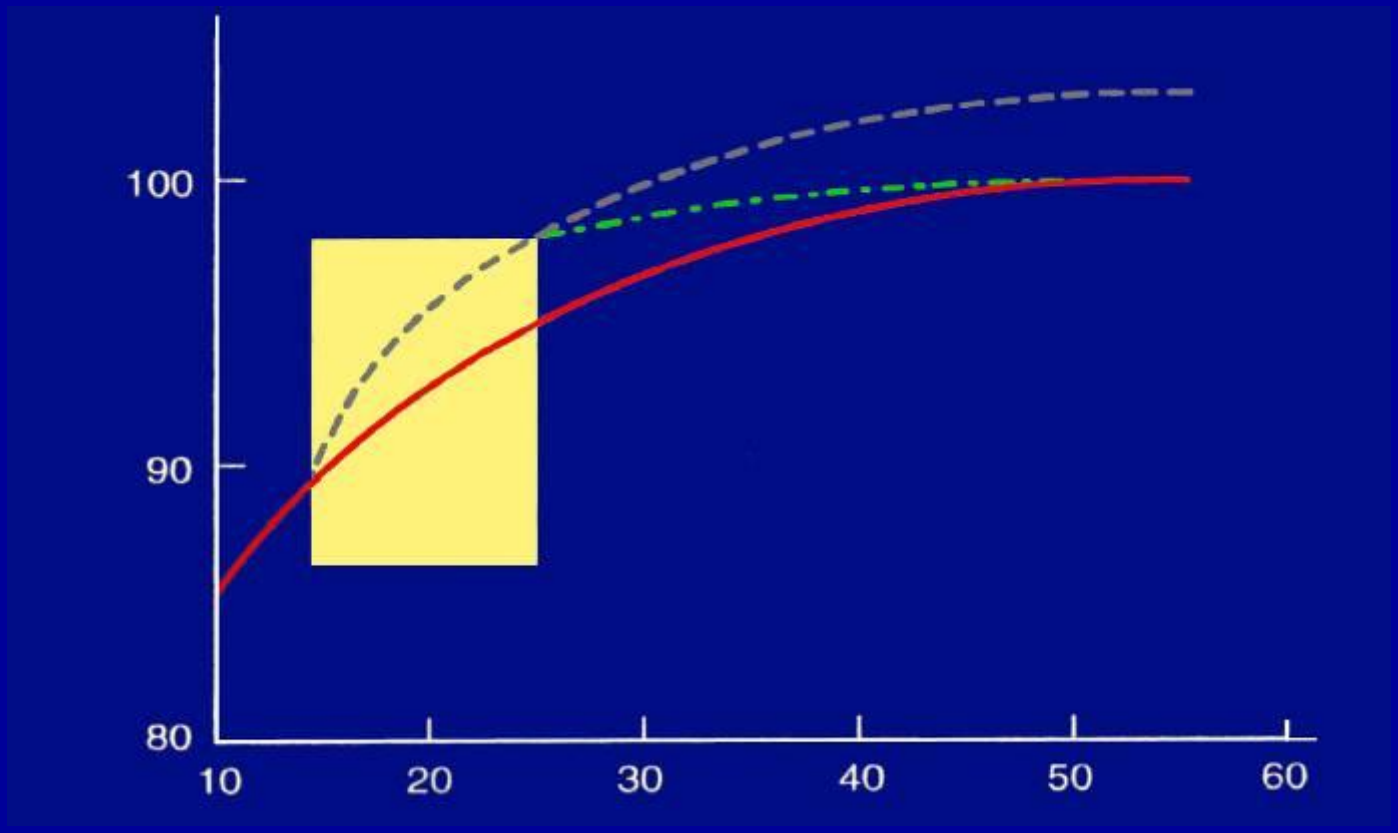
DEPENDE DE :

-
-
-
-
-
-

CONCLUSÕES

CONCLUSÕES

% do tamanho mandibular adulto



MORDIDA CONSTRUTIVA

Mordida construtiva

Mordida construtiva

Montagem do articulador