SPACE MANAGEMENT

CONTENTS

Definition

- **Preventive Orthodontics:** "Actions taken to preserve the integrity of what appears to be normal occlusion at a specific time"(Graber- 1966)

- **Interceptive Orthodontics**: "that phase of science and art of orthodontics employed to recognize and eliminate the potential irregularities and malpositions in the developing dentofacial complex"(AAO – 1969)

INTRODUCTION

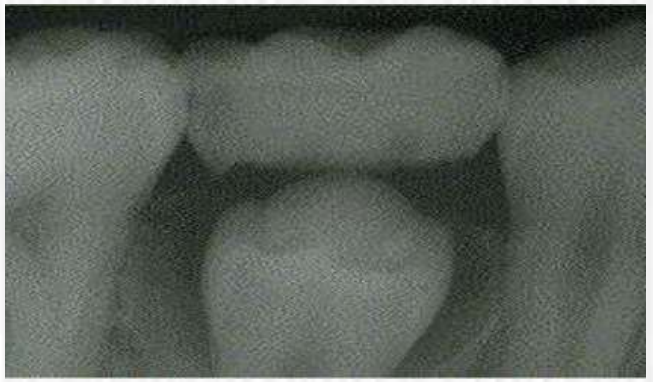
- Premature loss of primary teeth → undesirable tooth movements → ↓ arch length

Loss of arch-length results in a loss of structural balance and functional efficiency

Norman P. Martinez, Henry G. Elsbach. Functional maintenance of arch-length. J Dent Child, May-June 1980; 190-193.

- Primary tooth with proper mesiodistal width --- best

- Space management --- space maintenance / space regaining / space supervision / serial extraction



Space management (control)

careful supervision of developing dentition -- reflects an understanding of dynamic nature of occlusal development. *(Gainsforth, 1955)*

Space Maintenance

Concerned with control of space loss -- without taking into consideration measures to supervise development of dentition

Space Maintainer

Maintain space / regain minor amount of space lost --- to guide Unerupted tooth into a proper position in arch

Space Regainer

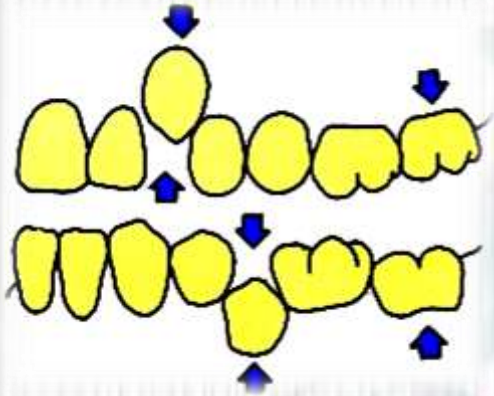
Fixed or removable appliance capable of moving a displaced permanent tooth into its proper position in the dental arch. *(Boucher)*

OBJECTIVES OF SPACE MANAGEMENT

- Prevent loss of arch length, width & perimeter
- Preservation of primate space
- Preservation of integrity of dental arches
- Preservation of normal occlusal plane
- Esthetics and Phonetics (in case of anteriors)

Causes for space loss

- Primary teeth with interproximal caries
- Ectopically erupting teeth
- Alteration in sequence of eruption
- Ankylosis of primary teeth
- Dental impaction
- Transposition of teeth
- Loss of primary molars without proper space management
- Congenitally missing teeth
- Abnormal resorption of primary molar roots
- Delayed eruption of permanent successor
- Abnormal dental morphology



FACTORS CONTRIBUTING FOR SPACE CLOSURE

- Inclination of long axis of permanent molars — tendency of molar to shift mesially because their long axis is mesially inclined.
- Premature loss of deciduous teeth
- Influence of buccal musculature — buccinators exerts forces that can derange occlusion.
- Path of least resistance — this is created following loss of support because of extraction or missing tooth.
- Effect of position of center of rotation of mandible: Smyd pointed out that more the axis of mandibular rotation is lowered in respect to occlusal plane less is the amount of horizontal thrust transmitted to teeth in occlusion.

William Tunison, Carlos Flores, Hossam, Usama and Tarex. Dental Arch Space Changes following Premature Loss of Primary First Molars: A Systematic Review. *Pediatr Dent 2008; 30: 297 – 302.*

Lin & Chang (1998), Kumari & Kumari (2006), Lin & Lin (2007)

- unilateral premature loss of primary 1st molar
- Impression made immediate post extraction and 8 months post extraction
- D+E space, arch width (intermolar), arch length, arch perimeter were measured
- Initial D+E space on extraction side showed no sig. difference from control side
- After 8 months, D+E space on extraction side sig. shorter than control side & less than initial D+E space
- No sig. diff in arch width, arch length, arch perimeter between initial and follow-up 6 months
- early space changes are primarily distal drift of the primary canines toward the extraction space

Indication of space closure / retaining space in case of absence of permanent teeth

Moyers table	
Retain space and artificial replacement	Let space close
• Skeletal / dental class I • No crowding • Unilateral • Good inter-arch relationship	✓ Crowded arch ✓ Protrusive incisors / lips ✓ Bilateral missing

Premature Loss Of Teeth

Loss of maxillary deciduous 1st molar	• The deciduous cuspid shifts distally in the first year only, if at all • The 1st permanent molar and second deciduous molar shift mesially, with the amount depending on the duration of absence and age at loss • An erupting first bicuspid is guided along the mesial surface of the mesially migrating second deciduous molars, eventually lying close to the lateral incisor
Loss of maxillary deciduous 2nd molar	• If the maxillary second deciduous molar is lost early, the second bicuspid is generally impacted • The permanent molar shifts mesially • The cuspid and first deciduous molar shift distally • As the first bicuspid generally has an eruption timing advantage over the second bicuspid, will erupt earlier into the site, maintained by the first deciduous molar, often with distal drift • The resultant lack of space between the permanent molar and first bicuspid causes impaction of the second bicuspid
Loss of mandibular deciduous molar	• The effect of mandibular extractions tends to be similar for all three situations, i.e. loss of primary 1st molar, 2nd molar or both • Timing differentials between the cuspid, first bicuspid and second bicuspid in the mandible appear to account most for the similarity among groups • In case of loss of first primary mandibular molar, the permanent molar and second primary molar both tips forward • In case of loss of second primary mandibular molar, the permanent molar tips forward • In case of loss of first and second primary mandibular molars, the permanent molar will tip forward and primary canine will tip distally leading to impaction of bicuspids and also causing midline shift

SPACE MAINTAINERS

IDEAL REQUIREMENTS

- Maintain desired MD dimension of space (intra-arch space maintenance)
- Not interfere with vertical eruption of adjacent teeth (interarch space maintenance)
- Not interfere with eruption of permanent teeth
- Provide MD space opening when it is required
- Restore function
- Prevent supraeruption of opposing tooth
- Compatibility with soft tissues
- Effective hindrance of torque forces on abutment teeth
- Simple / easy to construct
- Strong enough to withstand occlusal forces
- Permit maintenance of oral hygiene
- Not restrict the growth of jaws
- Cost effective / durable

INDICATIONS

- Signs of space closure after premature loss of deciduous teeth
- Aid / reduce future orthodontic treatment need

CONTRAINDICATIONS

- Space available > space required
- Succedaneous teeth absent
- No bone observed radiographically overlying erupting permanent tooth suggesting sooner eruption of tooth

DETERMINANTS OF APPLIANCE SELECTION

(According to DCNA 1978)

1. Patient cooperation
2. Integrity of the appliance (long-term wear / frequency at which appliance breaks or lost)
3. Maintenance
4. Modifiability
5. Time required for construction

FACTORS INFLUENCING SPACE MANAGEMENT

Time elapsed since tooth loss -- first 6 months after extraction

Dental age of patient

- Emergence of tooth when 3/4th of root completion *(Gron, 1962)*
- As age ↑ → tendency of space closure ↓ *(Linder & Aronson, 1960)*
- Loss before 7 years of age → delayed eruption of successor
- Loss after 7 years of age → early emergence

Amount of bone covering unerupted tooth

- 4 to 5 months to erupt through1mm of bone *(Mc Donald)*
- 6 months to erupt through 1mm of bone *(Pinkham)*

Amount of space loss

- Greater loss occurs in mandible owing to a mesial axial orientation of 1st molar *(Olsen, 1995)*

	Maxilla		*Mandible*	
	D	E	D	E
First year	1.3 mm	2.8 mm	1.8 mm	2.4 mm
Second year	1.8 mm	4.5 mm	2.7 mm	3.1 mm
Third year	3.2 mm	8.0 mm	3.3 mm	4.5 mm

Before eruption of permanent molar = 6.1 mm

After eruption of permanent molar = 3.7 mm

- Younger the patient, more is the space loss
- Maximum space lost within first 6 months
- Most immediate loss within 76 hours

Direction of Space Closure

- Maxilla -- closed by mesial migration of teeth distal to extraction space
- Mandible -- space losses >2 mm mainly by distal movement of teeth mesial to space *(Stewart FS,1965)*
- space closure -- forward migration / rotation of teeth distal to site of extraction. *(Rose JS,1966)*

Eruption Status of Adjacent / Succedaneous Tooth

Sequence of Eruption

- Loss of primary 1M during eruption of permanent LI → distal movement of primary cuspid & "falling in" of anterior segment
- Mandible : primary 2M prematurely lost and permanent 2M is erupting before 2PM → arch length loss

Delayed eruption of permanent teeth

- Over-retained / ankylosed primary teeth
- Impacted permanent teeth

Congenital absence of permanent tooth

- Hold space until fixed replacement / allow space to close

- ✓ **Favorable space analysis**
- ✓ **Patient's health status**
- ✓ **Patient's cooperative ability**
- ✓ **Active oral habits**
- ✓ **Oral hygiene**

- Longitudinal study among 40 children in the age group of 6 - 9 years
- Evaluate the space changes, dental arch width, arch length and arch perimeter, after unilateral extraction of lower 1st primary molar in the mixed dentition period
- Study models made from before extraction and after extraction at periodical intervals of 2, 4, 6, 8 months
- Statistically significant space loss in extraction side and no significant space loss in control side
- Rate of loss was greatest in 1st four months

Padma Kumari, Retna Kumari. Loss of space and changes in the dental arch after premature loss of the lower primary molar: A longitudinal study. J Indian Soc Pedod Prev Dent 2006;24:90-6

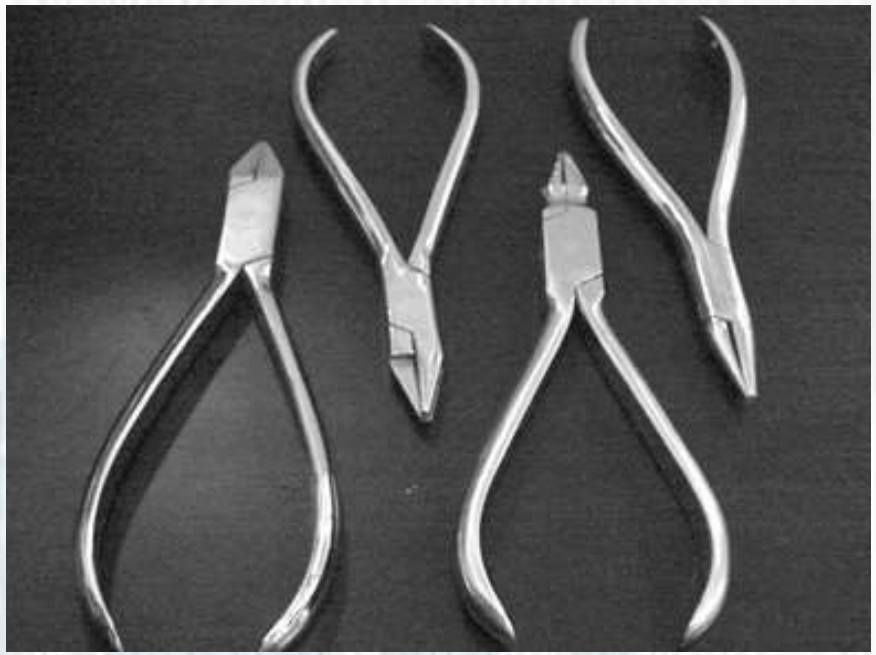
CLASSIFICATION

Hinrichsen (1962)	Hitchcock (1973)	Raymond (1978)
Fixed Class I a) Non-functional type (bar type / loop type) b) Functional type (pontic type / lingual arch type) Class II – Cantilever type (distal shoe / band and loop)	1. Removable / fixed / semi-fixed 2. With / without bands 3. Functional / nonfunctional 4. Active / passive 5. Certain combination of above	1. Removable 2. Complete arch (lingual arch / extraoral anchorage) 3. Individual arch

Fixed Space Maintainers

Fabrication

1. Band construction
2. Taking impression and cast preparation
3. Loop fabrication
4. Soldering
5. Polishing
6. Cementation



According to Fabrication

Loop bands

- Precious metal (first introduced by Johnson)
- Chrome alloy bands.

Tailored bands

- Precious metal
- Chrome alloy.

Preformed seamless bands

Chrome alloy or precious metal, which are adapted, festooned and stretched to fit. A range of preformed bands from 1 to 32 depending on the mesiodistal width of the tooth for the maxillary and mandibular arch are available commercially.

According to Band Material

- *Anterior teeth*: 0.003 × 0.125 × 2 inches
- *Bicuspids*: 0.004 × 0.150 × 2 inches
- *Primary molars*: 0.005 × 0.180 × 2 inches
- *Permanent molars*: 0.006 × 0.180 × 2 inches.

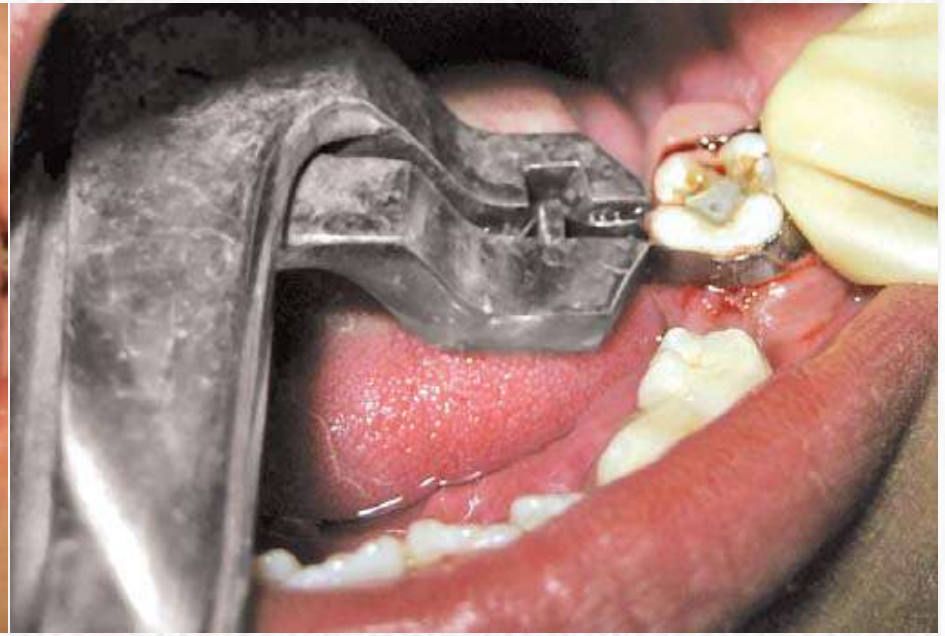
2 contrasting sides

- Dull side goes next to tooth – hold cement in place
- Shiny side faces outward --- lets food slide off

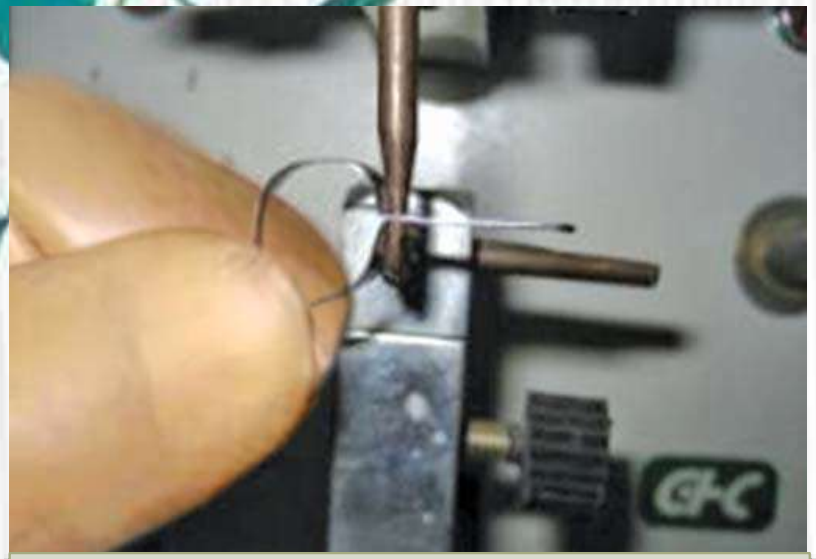
Initial spot weld

Rounding off margins

Buccal grove adaptation



Pinching



Spot welding after final adaptation

Infolding of seam

- Seam placed opposite cusp
- Groove – more thickness required

Final spot welding of band seam

- Occlusal surface of band – just below crest of marginal ridge and just above contact area

Loop Fabrication

Band and Loop

- Premature loss of primary 2M after eruption of permanent 1M
- B/L loss single primary molar prior to eruption of permanent incisors
- Premature loss of primary canine (sometimes)

Middle of band

- Occlusal clearance
- Adequate strength of soldered joints

At contact area

Approx. 8 mm – allow PM to erupt freely

contour --- similar and as close as possible to gingival contour

Appliance is impinging on soft tissues

Succedaneous tooth has erupted

Appliance is not functioning as intended

Periodic Recall (every 6 months)

Lack of proper occlusion due to interference of band & loop

Reverse band & loop

- premature loss of primary 2M & permanent molars not erupted fully to support a band
- Touches just below marginal ridge of permanent molars

Crown & loop

Abutment requires a crown

Prevents eruption of premolar

- prevent gingival as well as buccal movements of loop
- May hamper proper eruption of tooth to its occlusal plane (Wright + Kennedy, 1978)

Inhibition of disto-lateral movement of primary canine due to fixed space maintainer leaded to rotation of permanent LIs during their eruption.

Preoperative, immediate postoperative, and one-year postoperative occlusal views of mandibular arch with functional band and loop space maintainer in the tooth 74 region

Direct visualization of the eruption of the successor is not possible

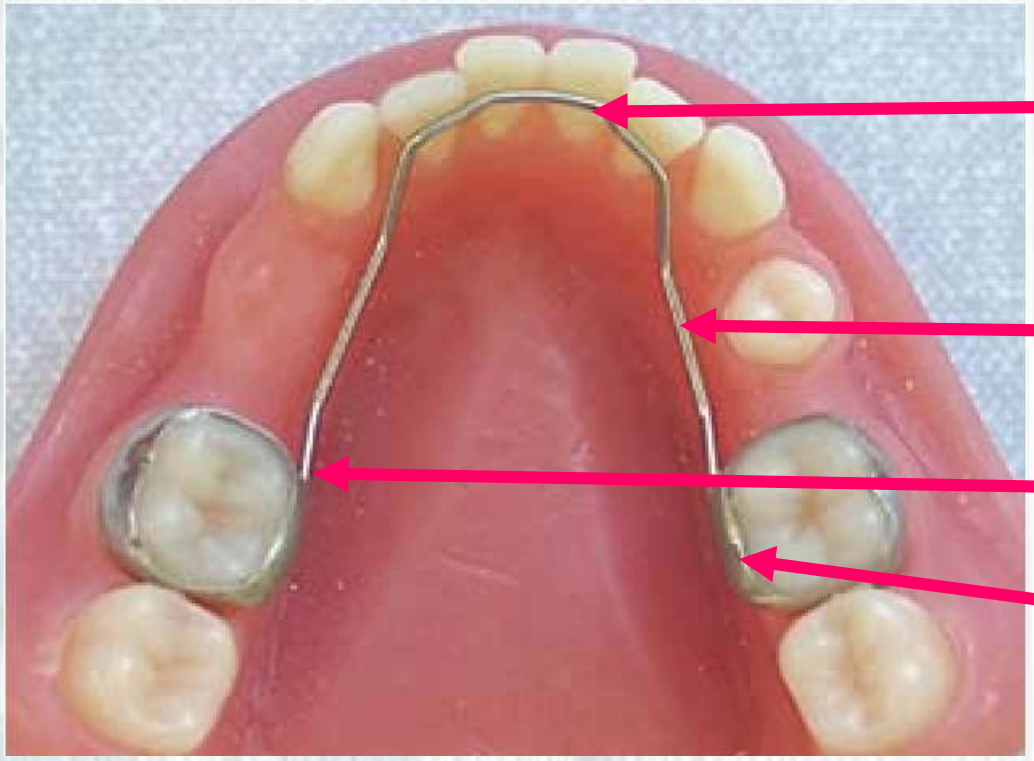
Functional Band and Loop Space Maintainers in Children

Preoperative, immediate postoperative, and one-year postoperative occlusal views of the maxillary arch with the conventional band and loop space maintainer in the tooth 54 region and functional band and loop space maintainer in the tooth 64 region

Lingual Arch

- Multiple loss of primary molars with no space loss
- Erupted mandibular permanent incisors
- As ‘holding arch’ for mild anterior crowding
- Excellent source of anchorage
- Allows individual tooth movement

Konstantinos et al (1998)
Omega bends —canine region to prevent interference b/w ach wire & cuspids which migrate distally into primate spaces



Cingulum of erupted permanent incisors

1 – 2 mm lingual to posterior teeth
–-- permit normal eruption

Arch wire meet band at ML cusp

3 – 4 mm contact of wire with band

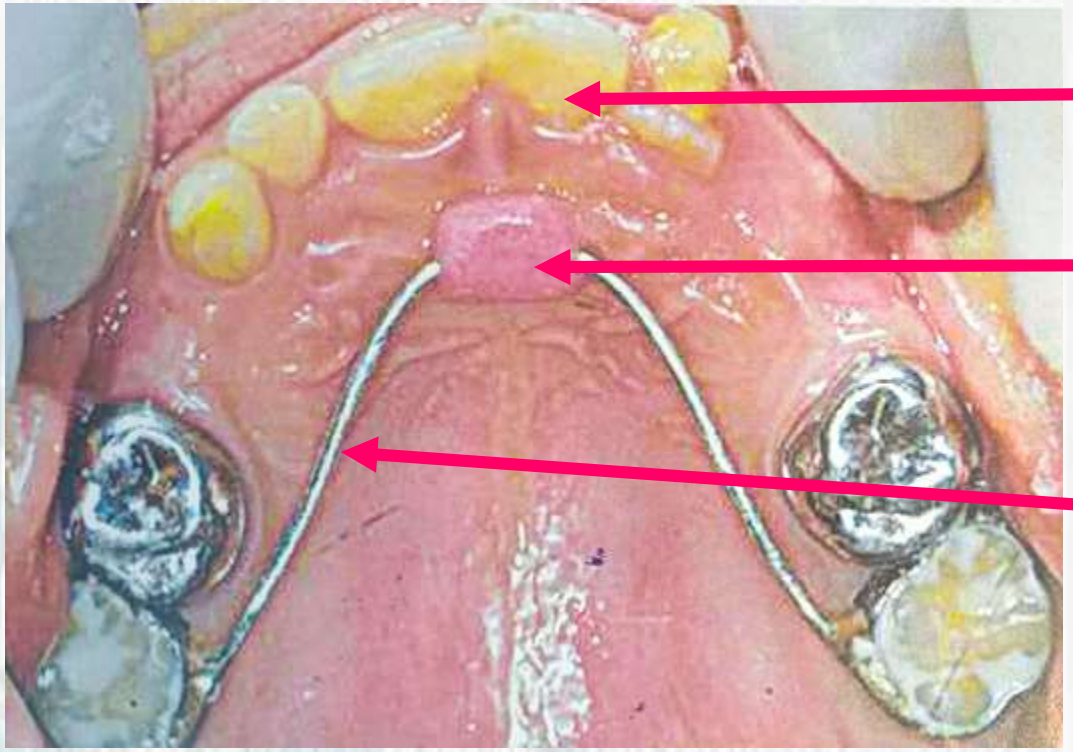
Looped lingual arch

Limited tooth movt.

Modification for erupting permanent incisor

Nance Palatal Arch

- B/L premature loss of primary molars
- Primary dentition
- Tongue thrusting – spurs in acrylic button



Not contact anterior teeth --- approximates anterior palate

Acrylic button

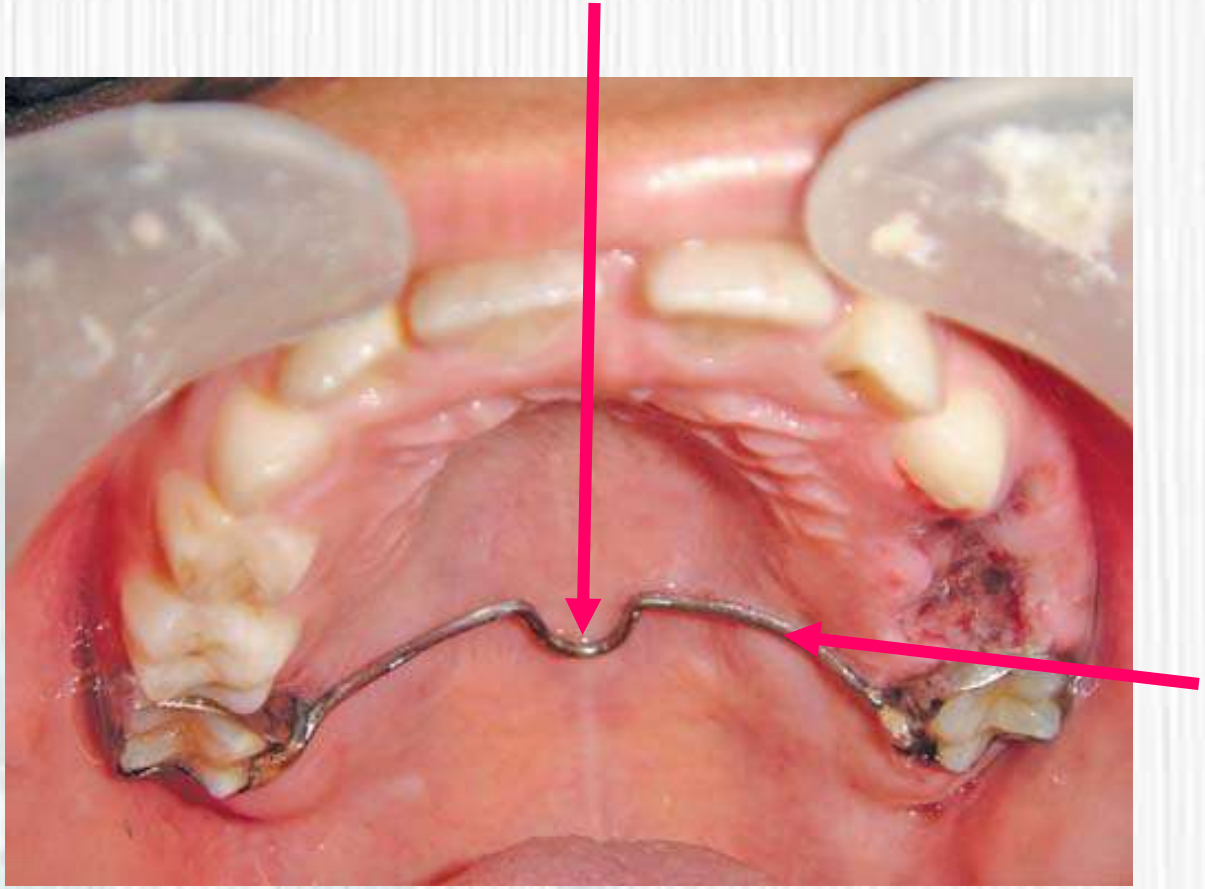
- On descending portion of palatal vault – 1 - 2 mm below incisive papilla
- Rest against palatal issue ---- 0.5 inch (dia.)
- Provides resistance to anterior movement of posterior teeth

Position coincident with deepest + most anterior point in middle of hard palate

Transpalatal Arch

- One side of arch is intact and several primary teeth on the other side are missing
- B/L loss of primary molars
- Arch expansion
- Prevent rotation of molars

U-shaped bend -- if any manipulation required



Across palatal vault avoiding contact with soft tissues

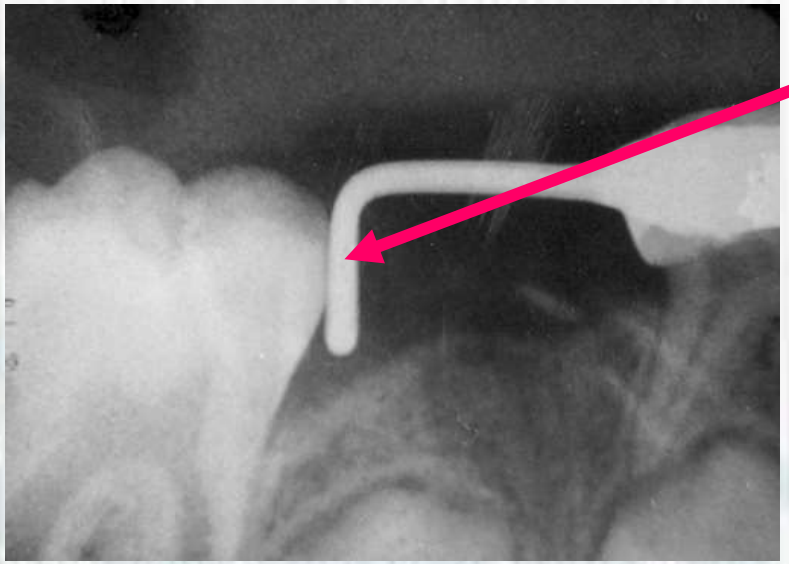
Distal Shoe Space Maintainer

- Intraalveolar appliance
- Willet's distal shoe
- Roche's distal shoe

Primary 2M extracted or lost before eruption of permanent 1M

Roche's appliance --- V-shaped end --- broader surface

- helps prevent rotations
- holds a greater chance of success if unerupted tooth is positioned buccally or lingually in dental arch



Contact area of distal extension

- Lower arch -- have a slight lingual position over the crest of alveolar ridge --- to engage mesial contact area of permanent 1M as it begins its mesial and lingual movements
- Upper arch --- slightly facial to crest of alveolar ridge

Prevent erupting permanent molar from slipping contact with appliance

Width

- closely approximate normal contact area of distal surface of the 2nd primary molar being replaced.

Length of distal extension (horizontal bar)

- 2nd primary molar present --- serve as guide on working model
- If already missing ---- distal surface of1st primary molar and mesial surface of unerupted permanent 1M

Depth of the gingival extension (vertical bar)

- If too long --- possible harm to the developing 2nd molar may result
- If too short ---1st permanent molar could erupt underneath appliance
- A good preoperative radiograph that is slightly under exposed to show the thickness of overlying soft tissue --- aid in determining the depth of groove to be cut in working model for constructing gingival extension.

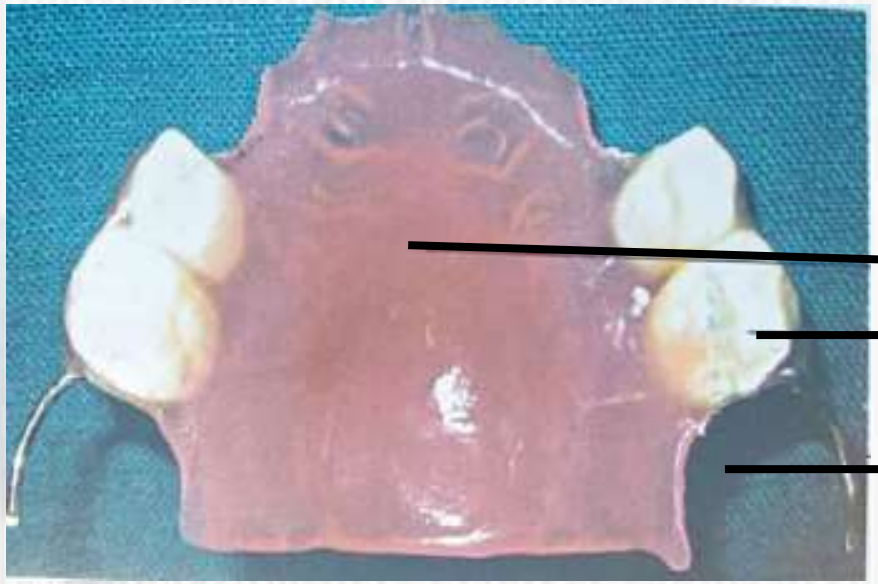
Gingival extension should extend about 1 mm below the mesial marginal of the 1st permanent molar or just sufficient to capture its mesial surface

Removable Space Maintainers

Classification --- Brauer

Class 1: Unilateral maxillary posterior.
Class 2: Unilateral mandibular posterior.
Class 3: Bilateral maxillary posterior.
Class 4: Bilateral mandibular posterior.
Class 5: Bilateral maxillary anterior posterior.
Class 6: Bilateral mandibular anterior posterior.
Class 7: One or more primary of permanent anterior.
Class 8: Complete primary.

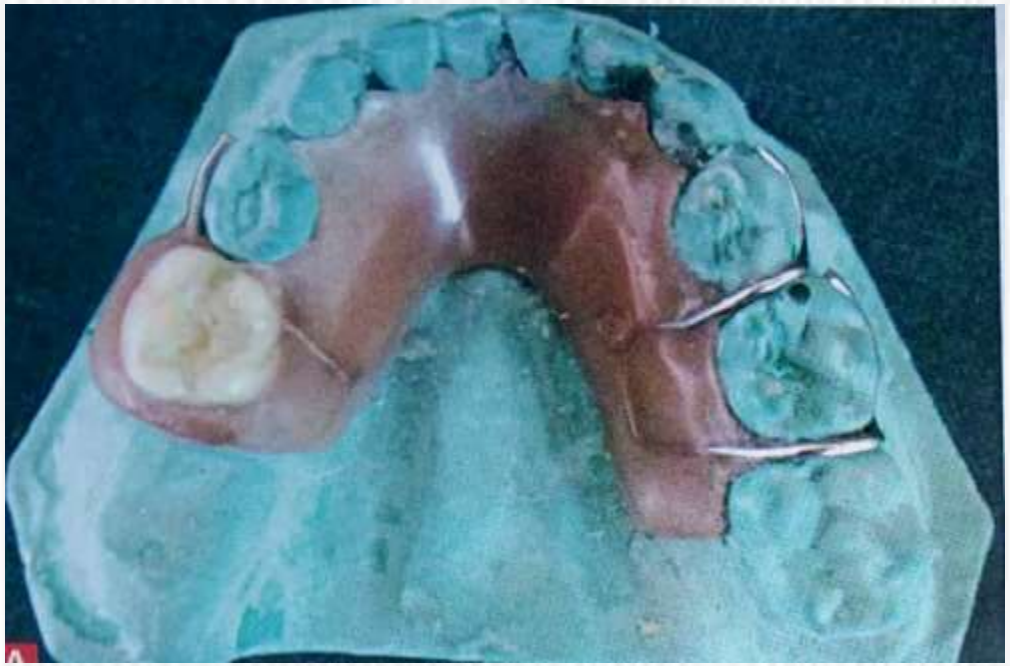
- Esthetics -- importance
- Abutment teeth cannot support a fixed appliance
- Cleft palate patient.
- Child has reached a mental age of 2½ years.
- Permanent teeth not fully erupted for adaptation of bands.
- Multiple loss of deciduous tooth
- High risk caries children



Denture base = 2-3 mm thick

Acrylic teeth --- replacement

Clasp --- retention



Space maintenance in primary dentition

Missing primary tooth	*Suggested treatment*	*Reason*
Maxillary incisor	No space maintenance required	No consequence. Exception: If incisor(s) is (are) lost prior to primary canine eruption, space closure may be observed
Maxillary canine	Band and loop space maintainer	Decrease possibility of midline shift
Maxillary 1st molar	Band/crown loop space maintainer	Prevents loss in arch dimension
Maxillary 2nd molar	Distal shoe space maintainer*	• Guides 1st permanent molar into proper position • Prevents loss in arch dimension
Mandibular incisor	No space maintenance required	No consequence. Exceptions: • If incisor(s) is (are) lost prior to primary canine eruption, space closure may be observed • Pre-existing incisor crowding (tendency of incisors to tip linqually)
Mandibular canine	Band and loop space maintainer	Decreases possibility of midline shift
Mandibular 1st molar	Band/crown loop space maintainer	Prevents loss in arch dimension
Mandibular 2nd molar	Distal shoe space maintainer*	• Guides 1st permanent molar into proper position • Prevents loss in arch dimension

If primary 2M extraction site has healed, space maintenance may be deferred until bony eruption of permanent 1M. At that time, reverse band and loop space maintainer / space-regaining procedure can be employed to guide or reposition permanent 1M into proper position

Space maintenance in mixed dentition

Missing primary tooth	*Suggested treatment*	*Reason*
Maxillary lateral incisor Maxillary canine	Extract antimere Prior to eruption of permanent lateral incisor (s): removable space maintainer After eruption of permanent lateral incisor(s): extract antimere	Decrease possibility of midline shift • Guides permanent lateral incisor into proper position • Decreases possibility of midline shift
Maxillary 1st molar	Prior to eruption of permanent lateral incisor(s): Nance appliance	• Prevents loss in arch dimension • Does not interfere with eruption of permanent laterals
	After eruption of permanent lateral incisor(s): band/crown loop space maintainer	Prevents loss in arch dimension
Maxillary 2nd molar Mandibular lateral incisor Mandibular canine	Nance appliance Extract antimere Prior to eruption of permanent lateral incisor(s): removable space maintainer	Prevents loss in arch dimension Decreases possibility of midline shift • Requires only minor adjustment to afford normal positioning of permanent incisors. • Decreases possibility of midline shift
	After eruption of permanent lateral incisor(s): stopped lingual arch space maintainer	• Decreases possibility of midline shift • Prevents lingual tipping of permanent incisors
Mandibular 1st molar	Prior to eruption of permanent lateral incisor(s): band/crown loop space maintainer	• Prevents loss in arch dimension • Does not interfere with eruption of permanent incisors
	After eruption of permanent lateral incisor(s): lingual arch space maintainer	• Prevents loss in arch dimension • Permits distolateral repositioning of primary canine
Mandibular 2nd molar	Prior to eruption of permanent lateral incisor(s): band/crown loop space maintainer	• Prevents loss in arch dimension • Does not interfere with eruption of permanent incisors
	After eruption of permanent lateral incisor(s): lingual arch space maintainer	• Prevents mesial tipping of 1st permanent molar • Prevents loss in arch dimension

SPACE REGAINERS

Space regainers

Fixed space regainers

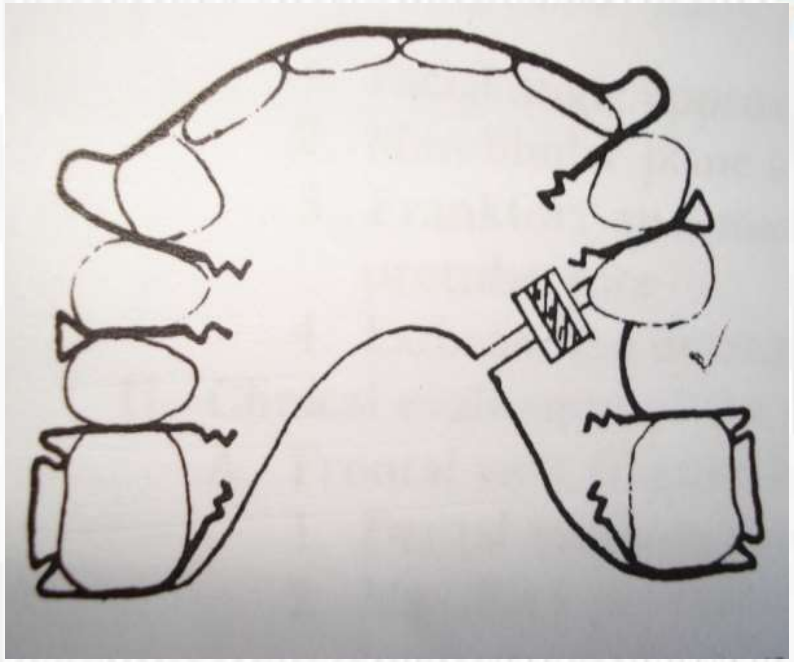
a) Open coil regainer
b) Gerber space regainer
c) Fixed lip bumper
d) Anterior space regainers

Removable space regainers

a) With helical coils
b) With jack screw
c) Split saddle design
d) Sling shot design

- light continuous forces
- Double helical loop -- rotation + tipping
- Single helical loop --- only tipping

With jack screws



- Expansion screw in the edentulous space
- Offers best control of any removable appliance when correction of rotation is not needed
- Open jackscrew one-quarter turn (0.25 mm) twice a day
- Change to one-quarter turns every second or third day
- Space is opened by expanding plates AP

Sling shot space regainer

- durability and light continuous forces
- Chair time required to supervise appropriate size of elastic to continue light forces as the tooth moves into position
- Sling shot wire consisted of an "S" bend
- Top curve of the "S" bend is used as the elastic hook

- When the hook is placed too far distally, it will impinge on soft tissue
- Acrylic in the saddle area has been relieved so that it is 1 mm away from permanent molar
- Distalizing force is produced by the elastic stretched on the molar to be moved
- elastic can be changed once each day

Fixed lip bumper

- split saddle design is most successful for regaining 1 or 2 mm space without alteration of the distal portion of appliance
- Sturdy and durable
- active patient has only a small amount of space to regain
- Appliance is activated by periodic spreading of the loops

- space regaining procedures in which bilateral movement is desired
- can also be used unilaterally

- Pressure to distalize by:

1. Incorporating loops in the arch wire just before it enters the buccal tube
2. Utilizing a coil spring

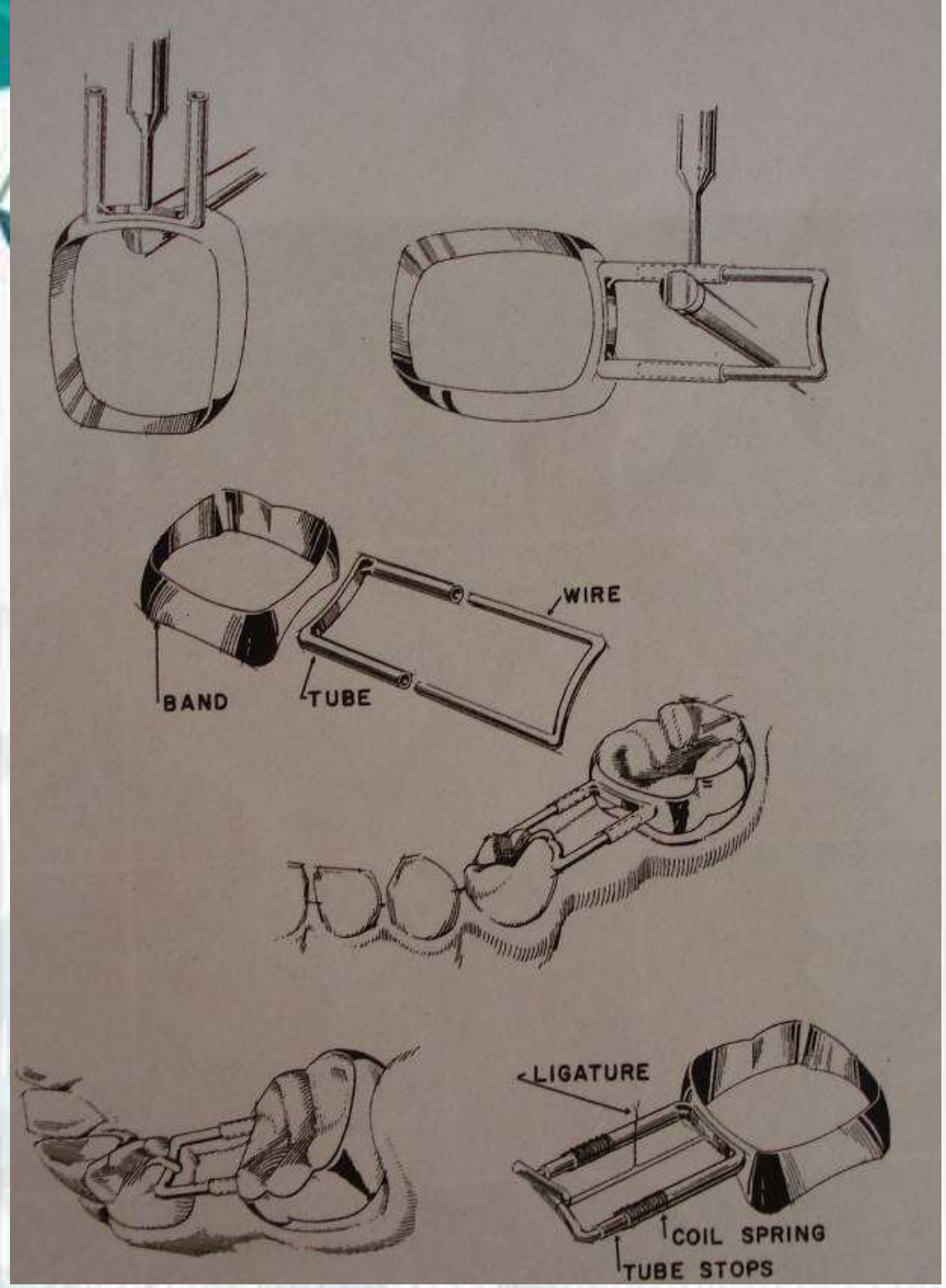
Open coil spring

- Active fixed regainer
- When first premolar has erupted into the oral cavity

- Base of the 'U' should contain a reverse bend to contact the distal surface of 1PM
- Wire should aim toward the first premolar at a point just below the greatest distal convexity of 1PM

- Band cemented with the coil springs compressed

Gerber appliance



- fabricated directly in mouth during short appointment
- requires no lab work
- A "U" assembly, is fitted in tube, appliance placed and wire section extended to contact the tooth mesial to the edentulous area
- Length of push coil springs is established placing the band-tube-wire assembly in mouth
- Cut springs to length 1 to 2 mm more to ensure spring activation
- Springs are compressed enough to allow assembly to fit the edentulous area

Chandwani M, Mittal R, Pimpale J, Kumar S. Space Management Appliance in Mixed Dentition: A New Concept. Int J Prev Clin Dent Res 2016;3(4):303-305.

- 6.5 yrs
- IOPAR -- severe early childhood caries
- 55, 65, 85 --- Deep occlusal caries
- 53, 63, 73, 83 --- smooth surface caries
- 51, 52, 61, 62, 54, 64, 84 -- root stumps
- 74, 75 --- missing

canine stopper

Arch Perimeter and Hixon and Oldfather

- space deficiency of 4 mm on left side of mandibular arch

✓ Modified Space Management Appliance -- purpose of space maintainer on the right side and space regainer on the left side of the mandibular arch

✓ Exhibited strong gag reflex -- removable space maintainer contraindicated

Follow-up visit after 4 months, demonstrating space of 3 mm regained in the mandibular arch on the left side due to distalization of left mandibular first permanent molar

CONCLUSION

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Thank You