CHAPTER 9

DIRECT RETAINERS

DEFINITIONS

RETENTION is resistance to movement of a denture away from the teeth and/or tissues along the path of placement of the prosthesis.

Most retention of RPDs is provided by DIRECT RETAINERS which are clasp assemblies or attachments applied to an abutment tooth to retain an RPD in position.[1] Some retention of tooth-tissue supported RPDs may be obtained from those factors which provide retention in complete dentures. This will be called DENTURE-TYPE RETENTION, in these lecture notes

A CLASP ASSEMBLY is the part of an RPD that acts as a direct retainer and/or stabilizer for the prosthesis by partially encompassing or contacting an abutment tooth.[1]

The CLASP is the component of the clasp assembly that engages a portion of the tooth surface and either enters an undercut for retention or remains entirely above the height of contour to act as a reciprocating element.[1]

The part of the clasp assembly that enters an undercut for retention is frequently called the RETENTIVE CLASP ARM.

An ATTACHMENT is a mechanical device for the fixation, retention, and stabilization of a prosthesis (Fig. 9-2).[1]

Most RPDs utilize clasp assemblies as direct retainers.[2] Attachments and the use of attachments in RPDs are advanced topics which will be discussed in other courses.

REQUIREMENTS OF A DIRECT RETAINER

All direct retainers, clasp assemblies or attachments, must provide the following functions in order to be effective and not do harm to the abutment teeth or tissues of the denture foundation area: (1) support, (2) retention, (3) cross-tooth reciprocation, (4) fixation and (5) passivity.

Support

Support of a clasp assembly is provided by positive contact of the rest of the clasp assembly with the rest preparation of the abutment tooth (Fig. 9-1).

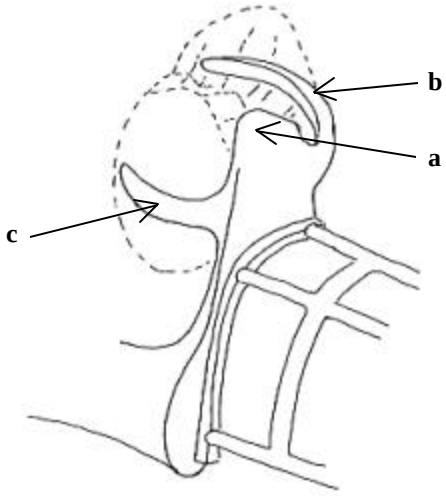


Fig. 9-1 A clasp. A) support (rest), b) retention (retentive clasp arm). The clasp arms and minor connector surrounding the tooth by 180^{o} provide fixation. Passivity occurs when the clasp is completely seated and the retention clasp arm is not active.

Support of an attachment is provided by contact of a rigid element on the denture with a rigid element on the abutment tooth (Fig. 9-2).

Retention

RETENTION of a clasp assembly is provided by the resistance to flexure of the

retentive clasp arm as it engages the height of contour of the tooth as the RPD moves occlusally/incisally. Some retention of a clasp assembly may also be provided by frictional contact of rigid portions of the clasp assembly, such as the proximal minor connector and reciprocal component, with surfaces of the tooth which are parallel to the path of placement of the RPD (Fig. 9-1).

Retention of an attachment may be provided by frictional contact of the long parallel walls of the attachment, mechanical locking devices, resistance to deformation of resilient locking materials, and other such imaginative systems (Fig. 9-2). Retention of attachments is frequently provided, or supplemented, by a retentive clasp arm on the lingual surface of the abutment.

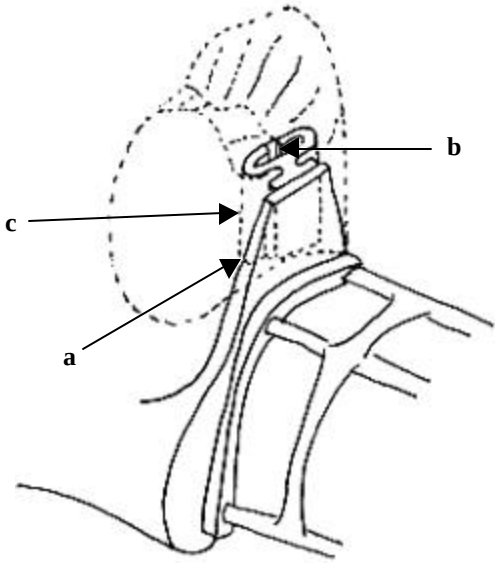


Fig. 9-2 An internal attachment, a) support (bottom of the attachment component in the crown), b) retention and c) reciprocation (provided by long parallel walls). There may be spring or mechanical retention in the attachment as well. Passivity occurs when the attachment is completely seated.

Cross-Tooth Reciprocation

RECIPROCATION is the mechanism by which lateral forces generated by a retentive clasp passing over a height of contour are counterbalanced, counteracted or negated by a reciprocal component passing along reciprocal guiding plane.

Cross-tooth reciprocation of a clasp assembly is provided by the RECIPROCAL COMPONENT which may be a clasp arm, plate or minor connector (Fig. 9-1). The reciprocal component contacts the tooth on the side opposite the retentive clasp arm as the retentive clasp arm flexes over the height of contour of the tooth. The reciprocal component stabilizes the tooth and counterbalances, counteracts, negates or "reciprocates" the force applied by the retentive component.

Cross-tooth reciprocation of an attachment is provided by the precise fit of the long parallel walls of the component parts, or by supplemental reciprocal components on the framework (Fig. 9-3).

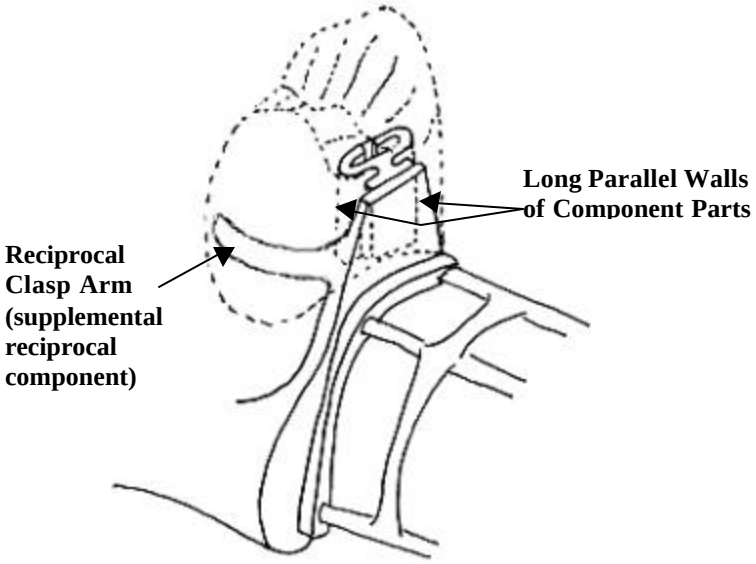


Fig. 9-3 Cross-tooth reciprocation of an attachment

Fixation

FIXATION is resistance to movement of the abutment tooth away from the prosthesis and resistance to movement of

the prosthesis away from the abutment tooth[2].

Fixation of a clasp assembly is provided by having the components of the clasp assembly encompass or encircle at least 180 degrees of the abutment tooth's circumference, or by having the components of the clasp assembly contact the tooth surface in three places approximately 120 degrees apart (Fig. 9-1). Fixation of a clasp assembly is frequently call ENCIRCLEMENT.

Fixation of an attachment is provided by the dovetail, or circular design of the component parts, or by supplemental clasp arms on the lingual of the abutment tooth (Fig. 9-2).

Passivity

Direct retainers should not exert forces on the abutment teeth when the RPD is seated. They should be PASSIVE when the RPD is seated. Forces should occur only when the denture is being seated or removed.

AMOUNT OF RETENTION

Research has shown that it should take 300-750 grams of force to remove a distal extension RPD from a model of a partially edentulous arch.[3] This amount of retention is probably adequate for all direct retainers.

Although the amount of retention a direct retainer provides is not readily measured objectively, it does not take much experience to subjectively determine when a direct retainer has too little or too much retention. You simply attempt to dislodge the direct retainer from the tooth occlusally with your finger or a dental instrument.

Direct retainers should have immediate retention, meaning that resistance to dislodgement should be felt immediately, not after the direct retainer has moved occlusally/incisally a small amount.

Various factors determine the amount of retention that a clasp assembly or attachment will provide. These factors will be discussed in the chapters on clasps and attachments.

All direct retainers of an RPD should have the same amount of retention.

CROSS-ARCH RECIPROCATION

In the design of an RPD the force exerted by a direct retainer on one side of the arch should be counterbalanced, counteracted, negated or "reciprocated" by an equal but oppositely directed force on an abutment tooth on the opposite side of the arch (Fig. 9-4). This is termed CROSS-ARCH RECIPROCATION. Cross-arch reciprocation probably does not occur in RPDs using attachments unless the retention is provided by retentive clasp arms.

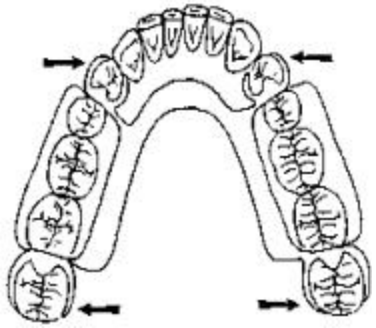


Fig. 9-4 Cross-arch reciprocation of a clasp-type RPD

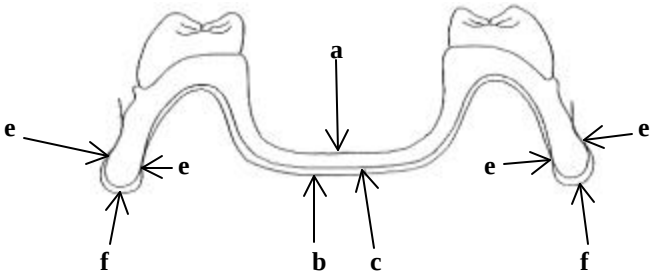
DENTURE-TYPE RETENTION

The factors, which produce retention of complete dentures, may provide some retention of RPDs; particularly tooth-tissue supported RPDs with large denture bases.

The denture-type retention factors considered important in the retention of RPDs will be only briefly discussed. The reader is referred to the Suggested Reading references at the end of the chapter for a more complete discussion of the retentive factors of complete dentures.

Interfacial Surface Tension

The primary factor providing retention of maxillary a complete denture is a physical phenomenon related to the close adaptation of the denture base to the denture foundation area with an interposed layer of saliva (Fig. 9-5). The molecules of saliva adhere to the denture surface and the tissues and cohere with one another. This adhesion and cohesion of the saliva create a force which helps retain the denture. This force is called INTERFACIAL SURFACE TENSION and is defined as the tension or resistance to separation possessed by the film of liquid between two well-adapted surfaces.[1]



$$F = \frac{2 \tilde{a} A \cos \grave{e}}{d g}$$

Fig. 9-5 Retention due to interfacial surface tension, a) denture, b) denture foundation tissue, c) saliva, e) border seal, f) resting vestibular height. A-area of denture base perpendicular to the direction of removal of the denture, è-the receding contact angle of saliva on the denture base material, d-the space between the denture base and the tissues, g-the gravitational constant, ã-the surface tension of the saliva.

Retention provided by interfacial surface tension is directly related to the area of the denture bearing foundation covered by the base, the space between the base and the tissues, and the ability of the saliva to cover these surfaces. Therefore, the bigger the denture base, the better the fit of the denture to the tissues, and the better the saliva covers the surfaces, the more retention of the denture will be provided by interfacial surface tension.

Applying this information clinically it is easy to see why interfacial surface tension is not very operant in the retention of mandibular complete dentures (not much base area), why the fit of a maxillary denture base is so important to retention (closer adaptation means more retention) and why xerostomia (no fluid film) and thick ropy saliva are detriments to denture retention (doesn't wet the tissues or denture and increases the space between the denture and the ridge).

Border Seal

In complete dentures the facial and lingual denture borders are formed to fit the moderately active vestibular tissues (Fig. 9-5). The denture base contacts the mucosa of the vertical slope of the ridge, and the cheek, tongue or lips contact the polished surfaces of the denture base. These contacts provide a BORDER SEAL which helps retain the saliva under the denture to maintain interfacial surface tension. The posterior palatal seal at the distal border of maxillary dentures does the same thing. The border seal also prevents food from getting under the denture.

Applying this information clinically is it is easy to see that if the denture borders are too long they will interfere with the movement of the muscles creating the vestibule causing either soreness of the tissues or movement of the denture. If the denture moves, the border seal will be broken and the retention provided by

interfacial surface tension will be lost. If the borders are too short or not shaped properly, the border seal will be ineffective and maintenance of the salivary film and interfacial surface tension will be inadequate.

The border seal of metal major connectors and the anterior edge of a distal-extension denture base is not very effective. This limits the retention obtained by interfacial surface tension in RPDs.

Suction

SUCTION is the act or process of exerting a force upon a solid, liquid or gaseous body by reason of reduced air pressure over part of its surface.[4] Suction only occurs under dentures from the time they begin to move away from the tissues until the border seal is broken. It is only in this brief interval that any air trapped in spaces under a denture is expanded into a larger space which reduces its pressure causing suction
(Fig. 9-6).

It is easy to see from this information that suction is not a very important factor in the retention of dentures.

Neuromuscular Retention

The contact of the lips, cheeks and tongue with properly contoured polished surfaces of the denture base is an important factor in the retention of dentures, particularly mandibular complete dentures (Fig. 9-7). Not only does this contact provide a border seal as previously discussed, but it also provides retention from the tissueward force of the muscles on the polished surface of the denture.

The impression for the denture borders, contour of the polished surface and the patient's neuromuscular coordination are all-important factors in neuromuscular retention of dentures.

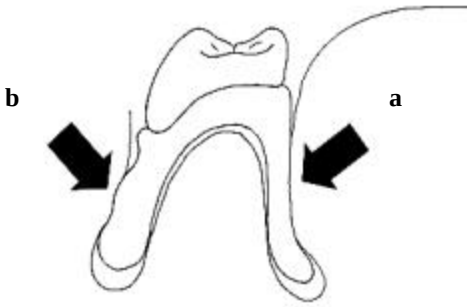


Fig. 9-7 Neuromuscular retention is produced by contact of the muscles of the tongue, check, and lips with the polished surface of the denture base, a) tongue, b) check.

REFERENCES

1. The glossary of prosthodontic terms. 6th ed. St. Louis, C V Mosby, 1994

2. Burns D, Ward, JE: A review of attachments for removable partial denture design: Part 1. Classification and section. Int J Prosthodont 1990;3:98-102

3. Frank RP, Nicholls JI: An investigation of the effectiveness of indirect retainers. J. Prosthet Dent 1977;38:44

4. Webster's new collegiate dictionary. Springfield: Merriam-Webster, 1979.

SUGGESTED READING

1. Craig RG, Berry GC and Peyton FA: Physical factors related to denture retention. J Prosthet Dent 1960;10:459

2. Fish EW: An analysis of the stabilizing factors in full denture construction. Brit Dent J 1931;52:1

3. Brill N, Tryde G and Schubeler S: The role of the exteroceptors in denture retention J Prosthet Dent 1959;9:761

4. Lott F, Levin B: Flange technic: an anatomic and physiologic approach to increased retention, comfort and appearance of dentures. J Prosthet Dent 1966; 16:394

1. Ostlund SG: Saliva and denture retention. J Prosthet Dent 1960;10:658

6. Swartz WH: Retention forces with different denture base materials. J Prosthet Dent 1956;5:427

7. Levin B: Current concepts of obtaining stability and retention for complete dentures. J Acad of Gen Dent. 1976;24:27

8. Lott FM: A stabilization technic for lower dentures. Oral Health 1934;24:22

9. Campbell RL: Some clinical observations regarding the role of the fluid film in the retention of dentures. J Amer Dent Assoc 1954;48:58

10. Tyson KW: Physical factors in retention of complete upper dentures. J Prosthet Dent 1967;18:90

11. Hardy IR, Kapur KK: Posterior border seal - its rationale and importance J Prosthet Dent 1958;8:386

12. Snyde, FC, Kimball HD, Bunch WB, Beaton JH: Effect of reduced atmospheric pressure upon retention of dentures. JADA 1945;32:445

13. Oslund SG: Some physical principles in the retention of dentures. Northwest Univ Bull 1948;49:11

14. Skinner EW, Chung P: The effect of surface contact in the retention of a denture. J Prosthet Dent 1951;1:229

15. Skinner EW, Campbell RL ,Chung P: A clinical study of the forces required to dislodge maxillary denture base of various designs. JADA 1953;47:671

16. Campbell RL: Effects of water sorption on retention of acrylic resin denture bases. JADA 1956;52:448

17. Lammie GA: The retention of complete dentures. JADA 1957;55:58

18. Cox AM: A consideration of the fundamental physical principles involved in the retention of artificial dentures. Brit Dent J 1926;47:1058

19. Stanitz JD: An analysis of the part played by the fluid film in denture retention. JADA 1948;37:168

20. Stromberg WR, Hickey JC: Comparison of physiologically and manually formed denture bases. J. Prosthet Dent 1965;15:213

21. Tallgren A: A longitudinal study on retention. Odont Tidsk 1959;67:314

22. Tryde G, Schubeler S, Brill N: Muscle activity in denture retention. Dent Abst 1960;5:25

23. Hamrick JE: A comparison of the retention of various denture base materials J Prosthet Dent 1962;12:666

24. Raxbin NH: The polished surface of complete dentures. J Prosthet Dent 1963; 13:236

25. Wright CR: Evaluation of the factors necessary to develop stability in

mandibular dentures. J Prosthet Dent 1966;16:414

26. Avant WE: A study of some factors associated with denture retention. J Prosthet Dent 1973;29:383

27. O'Brien WJ, Ryge G: Wettability of poly (methyl methacrylate) treated with silicon tetrachloride. J Prosthet Dent 1965;15:304

28. Roydhouse RH: The retention of dentures. JADA 1960;60:159

29. Lawson WA: Retention of full dentures Dent Pract 1965;15:199

Figure 9-1

A clasp, a) support (rest), b) retention (retentive clasp arm), c) reciprocation (reciprocal clasp arm). Fixation is provided by the clasp arms and minor connector surrounding the tooth by 180^{o}. Passivity occurs when the clasp is completely seated and the retention clasp arm is not active.

Figure 9-2

An internal attachment, a) support (bottom of an attachment component in the denture contacts the bottom of the attachment component in the crown), b) retention, and c) reciprocation (provided by long parallel walls). There may be spring or mechanical retention in the attachment as well. Fixation is provided by the dovetail design of the component parts. Passivity occurs when the attachment is completely seated.

Figure 9-3
Cross-arch reciprocation of a clasp-type RPD

Figure 9-4
Retention due to interfacial surface tension, a) denture, b) denture foundation tissue, c) saliva, e) border seal, f) resting vestibular height. A-area of denture base perpendicular to the direction of removal of the denture, the receding contact angle of saliva on the denture base material, d-the space between the denture base and the tissues, g-the gravitational constant, -the surface tension of the saliva.

Figure 9-5
Retention due to suction, a) air trapped under a denture at a pressure of 14 lbs./in.^{2}, b) suction created because air under a denture is at less than 14 lbs./in.^{2} since the space has expanded as the denture moves away from the tissues.

Figure 9-6
Neuromuscular retention is produced by contact of the muscles of the tongue, check, and lips with the polished surface of the denture base, a) tongue, b) check.