Biomechanics in Restorative Dentistry

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2013

FORCES EXERTED DURING OCCLUSION / MATICATION

- Various types of forces are exerted on teeth during movement of mandible and during mastication.
- The tooth surfaces → curved or at incline - →these forces are not only vertical, but other forces →may also be exerting on these surfaces.
- Tooth →in turn, counteracts these forces with the help of periodontal & alveolar bone

FORCES EXERTED DURING OCCLUSION /MASTICATION

- If the surfaces → flat & perpendicular to the force of mastication → only vertical forces take part.
- In curved surfaces → other forces → set up & the resulting forces might not be exerted the long axis of the tooth (see fig 1)
- This phenomenon can be understood by studying the resolution of forces on inclined planes.

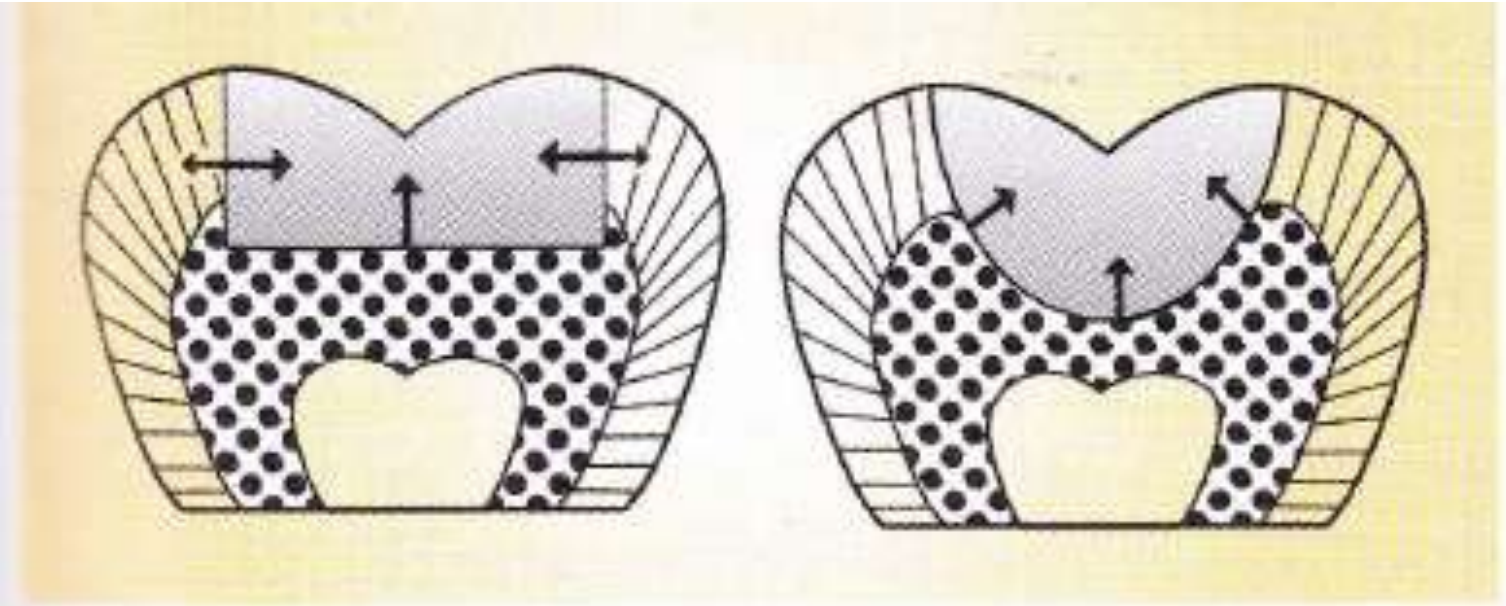

Fig. 12.18. Counteraction of occlusal forces (a) Flat floor (b) Curved floor

FORCES EXERTED DURING OCCLUSION / MASTICATON

- **The cuspal planes are taken as inclined planes**

FORCES EXERTED DURING OCCLUSION / MATICATION

- When force acts perpendicular to fixed horizontal surface → the resolving force reacts perpendicular to the surface with an equal and opposite force

- If the surface is tilted at an angle to the horizontal → is still reacts at right angle to the surface (see fig 12.19)

Forces Extended during Occlusion / Mastication

- The reaction force no longer opposes the applied force in direction nor is equal to its magnitude.

→ **the force are not in equilibrium when applied on inclined planes**

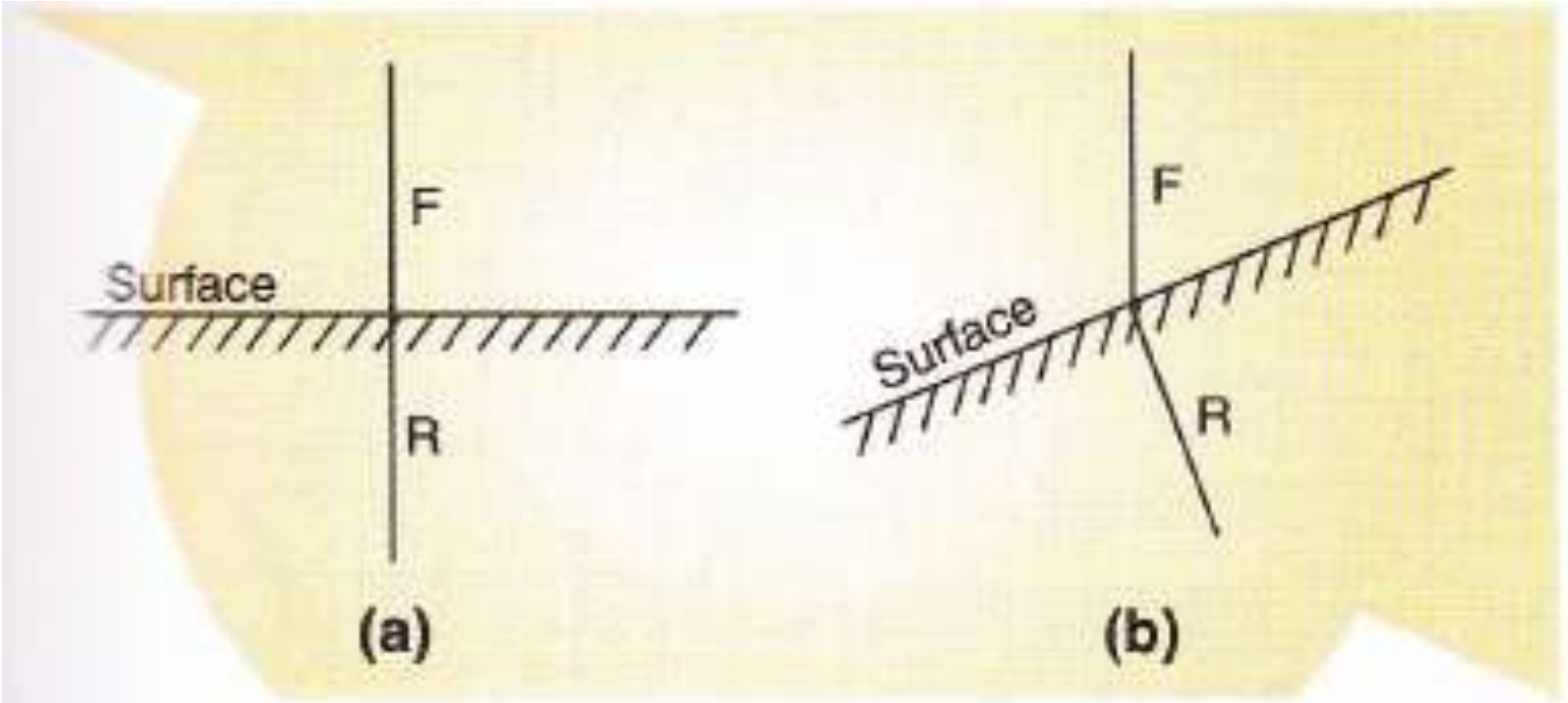

Fig. 12.19a & b. Force and its resolution on (a) horizontal and (b) inclined surfaces.

Forces Exerted During Occlusion / Mastication

The equilibrium → can be maintained if more than one force is exerted on tooth or the forces are resolved in both direction (see fig . 12.20)

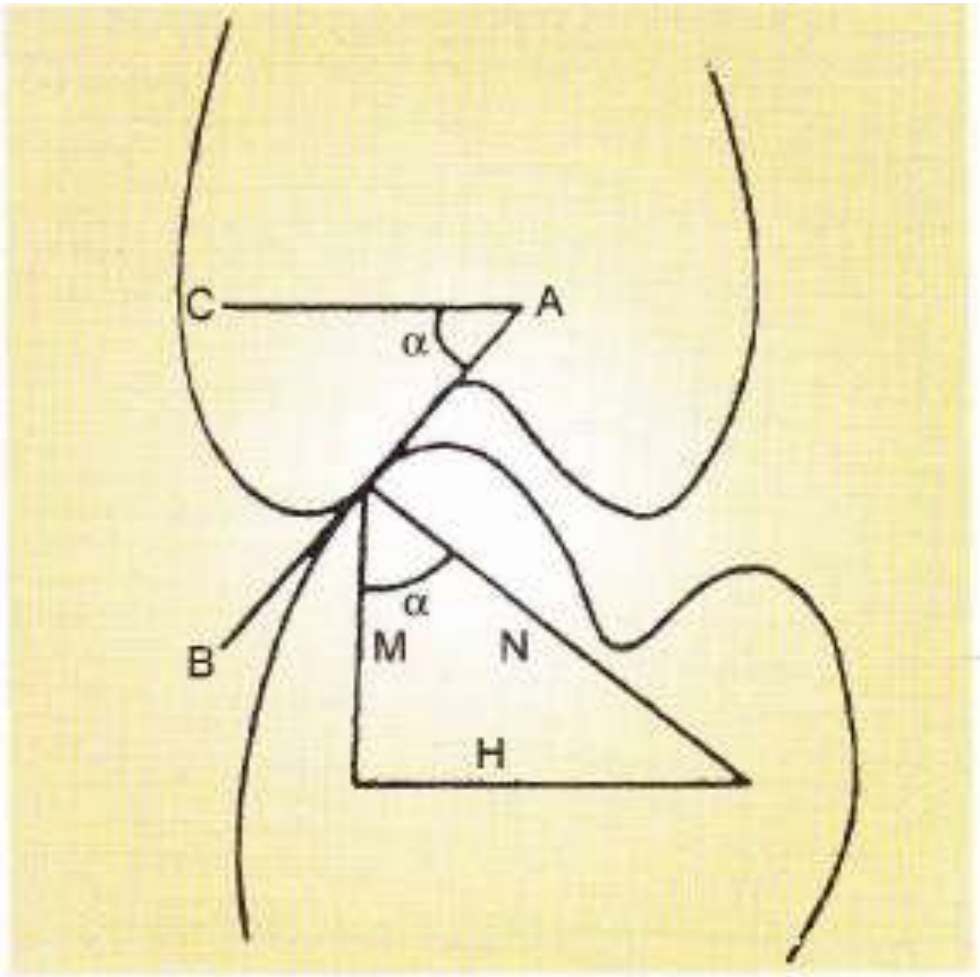

Fig. 12.20. Forces acting on cuspal inclines.

Forces Exerted During Occlusion / Mastication

- AB = tangent drawn at inclined plane or the contact between 2 cusps.
- Angle α → the angle made with the horizontal AC by tangent AB of the cuspal contact.
- M = the force of mastication → perpendicular to the horizontal AC
- N =the resolving force →perpendicular to the incline plane, tangent AB

Forces Exerted During Occlusion / mastication

- H = The horizontal component of the the resolving force → maintains the equilibrium

- As the angle α decreases (i.e.incline plane decreases) → N & H becomes shorter -→ finally merge with M (i.e equal to zerro)

Forces Exerted During Occlusion / Mastication

- The effect of friction between cusps → play an important role.

- **Friction → is the resistance to sliding motion of one body over another .**
- **The coefficient of friction → is the force of friction over normal force.**

Forces Exerted During Occlusion / Mastication

- During occlusion →Two or more inclined surfaces with slopes facing each other of one tooth contact the buccal and lingual cusps of the opposing tooth or the buccal and lingual cusps and marginal ridges.
- This condition accounts for the proper balance in occlusion.

Forced Exerted During occlusion / mastication

- **In case the contact is not normal** → it may account for **displacements of restoration or the fracture of the teeth.**
- The effect so produced → is termed as **wedging effect.**
- **The horizontal components of the normal force→ responsible for the wedging effect.**
- **Horizontal components set up by inclines are equal & opposite → tend to push and inclined surfaces apart**

Forces acting on the tooth

- In centric occlusion forces (see Fig.12.21a):
- → a , b , c, act at 3 points
- → Rab→ Resultant of forces a & b
- →Rab & c → are 2 adjacent sides of the parallelogram passing through a given point (see Fig. 12.21b) → the resultant is presented by diagonal passing through the same point(Vabc)

Forces acting on the tooth

- Hc→ is horizontal component of force c.
- Hab→ horizontal component of force a & b
- Hab and Hc→ should be equal for achieving equilibrium→ Rabc and Vabc are equal

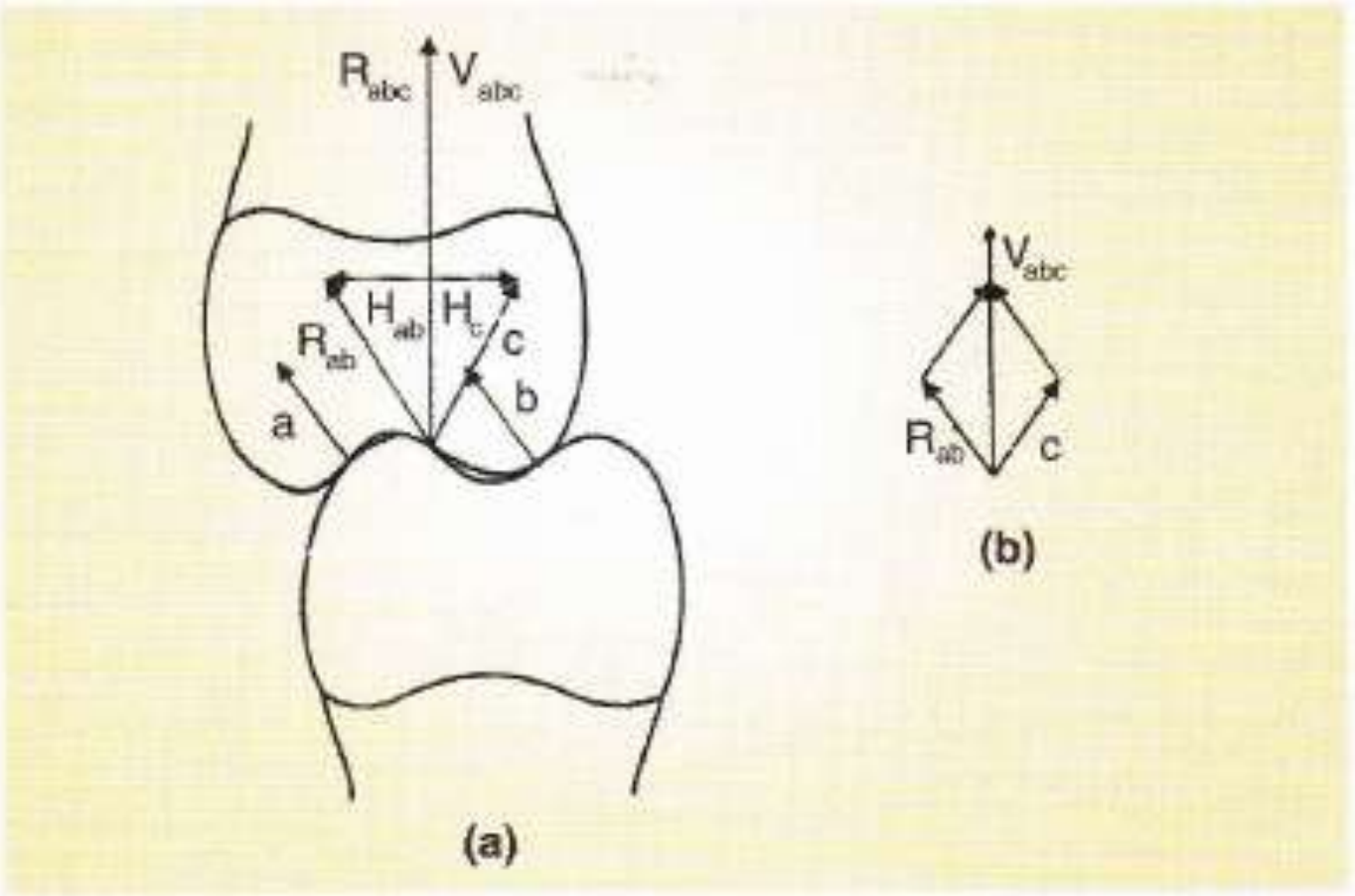

Fig. 12.21. (a) Forces acting on tooth during centric occlusion (b) R_{ab} and c are the two adjacent sides of the parallelogram.

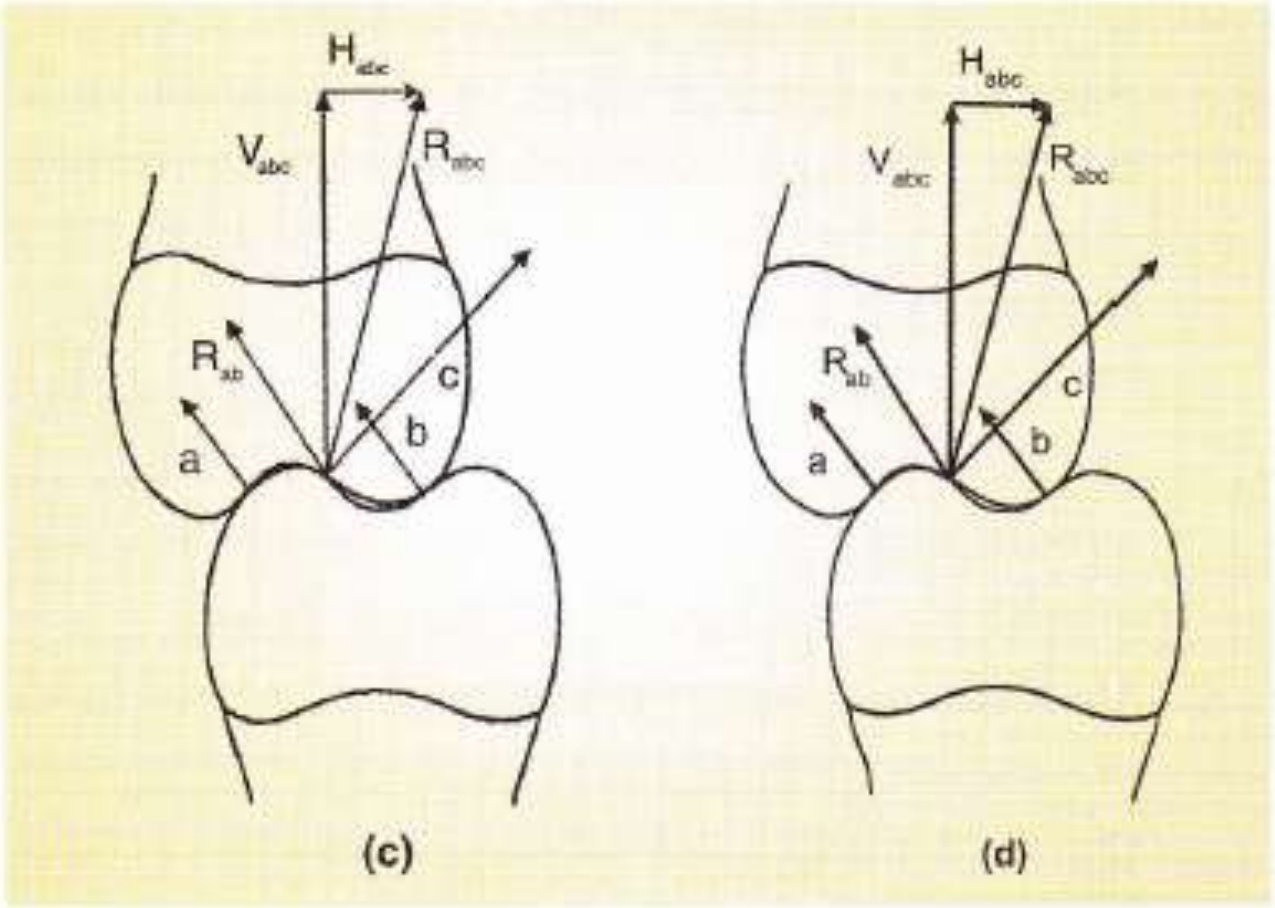

Fig. 12.21. (c) Forces acting on tooth during chewing (movement - centric occlusion to lateral) (d) Forces acting on tooth during chewing (movement - lateral to centric occlusion).

Forces acting on the tooth

During Chewing :

→ when mandible moves from centric occlusion to lateral position→ resultant of forces acting is not vertical but incline laterally (see fig. 12.21c)

During this movement→ forces A & B increased→ C is decreased with resultant changes in horizontal and vertical components

Forces acting on the tooth

C. During chewing :

→ When mandible moves from lateral to centric occlusion→ resultant of forces acting is not vertical but inclined medially (see Fig. 12.21d)

Mechanical Functions of the marginal ridge

See Fig. 12.22 - **Normal Marginal ridge**

→ forces 1 & 2 act on marginal ridges of teeth A & B

→ The horizontal component of 1, H1

→ The horizontal component of 2, H2

→ H1 & H2 counteract each other

→ The vertical component V1 & V2 → resolved normally by underlying tissues

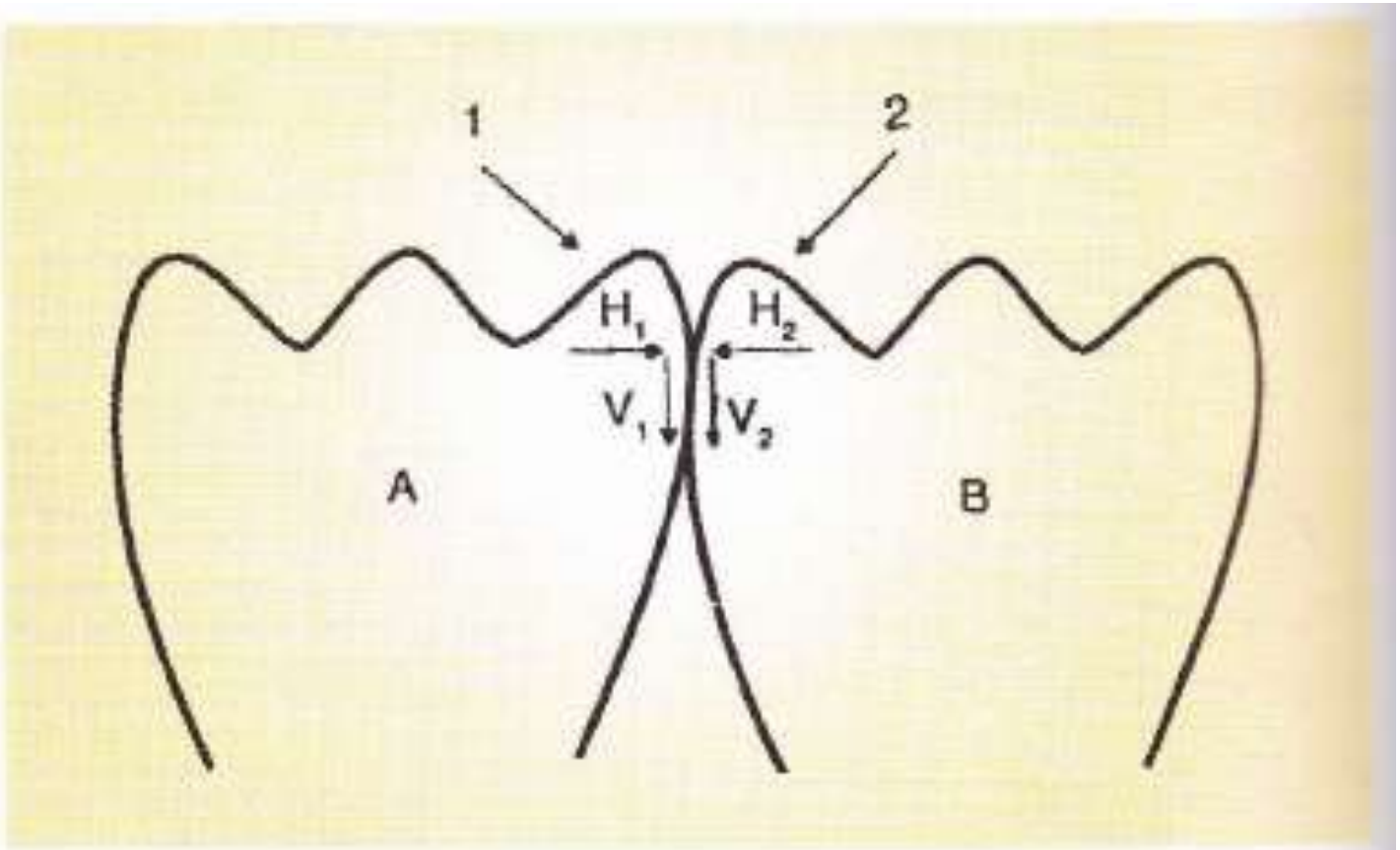

Fig. 12.22. Normal marginal ridge.

Mechanical functions of The marginal ridges

See Fig. 12. 23--- **No normal ridge**

Tooth B has no marginal ridge

→ **Force1 & 2 are acting on tooth A& B**

The horizontal component of 2—H2→ is missing in B because force 2 is mainly directly towards A

Horizontal component H2 will drift A apart.

Mechanical functions of marginal ridges

No marginal ridge (continued….)

→ The vertical component V1 & V2 of both the forces 1 & 2→ will help the food impact vertically

The vertical force V2 → will be more than required -→ there may occur slight tilting of B

→ **this will further deteriorate the resolution of forces & lead to further food impaction**

A marginal ridge with a wider occlusal embrasure

See Fig. 12.24

→ Force 1 & 2 can act on adjacent teeth

→ The force 2 will put on tooth A and force 1 will put pressure on tooth B

→ this will lead to drifting of both the teeth

→ The vertical component of forces will wedge the food in between the two teeth

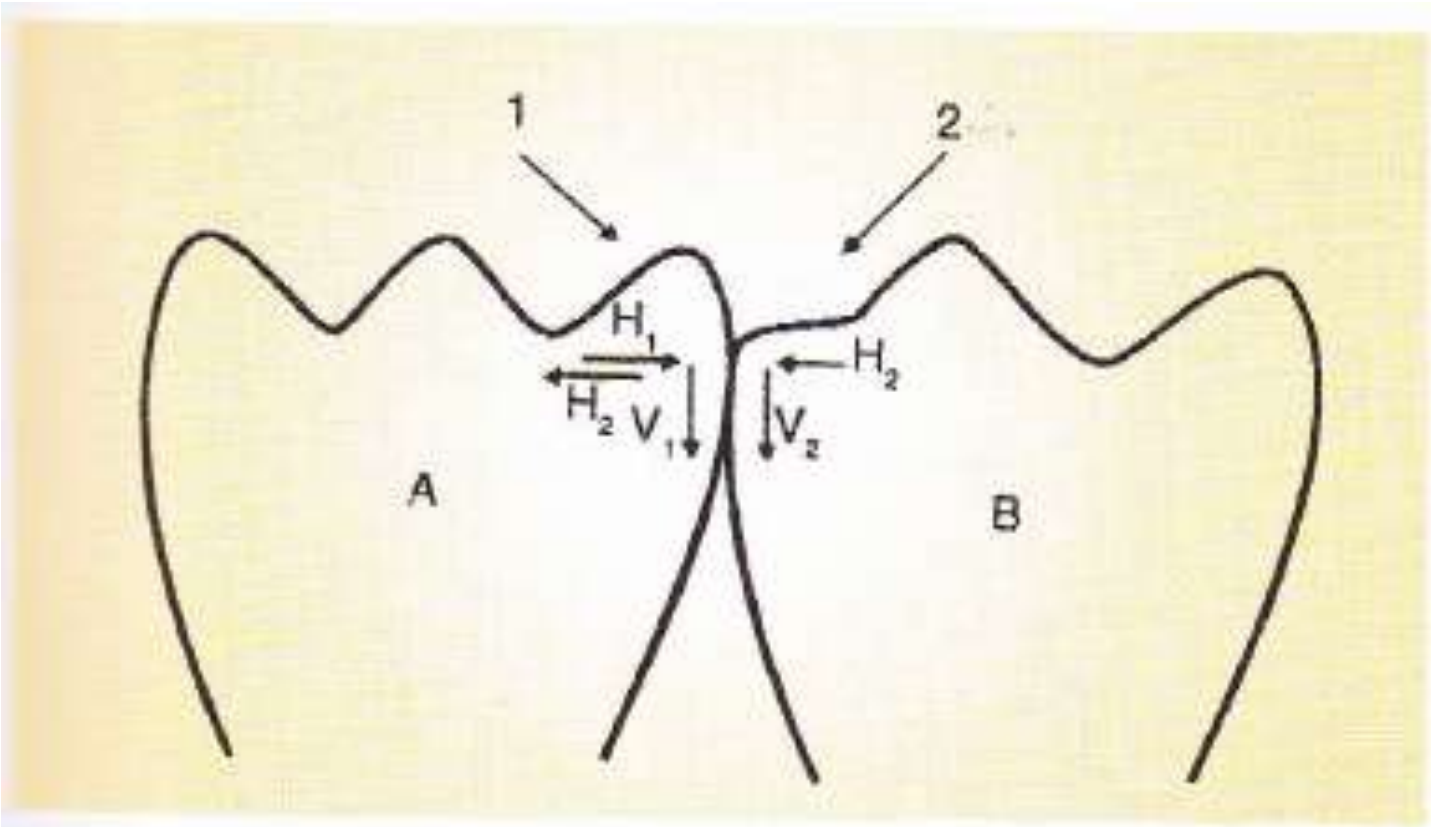

Fig. 12.23. No marginal ridge.

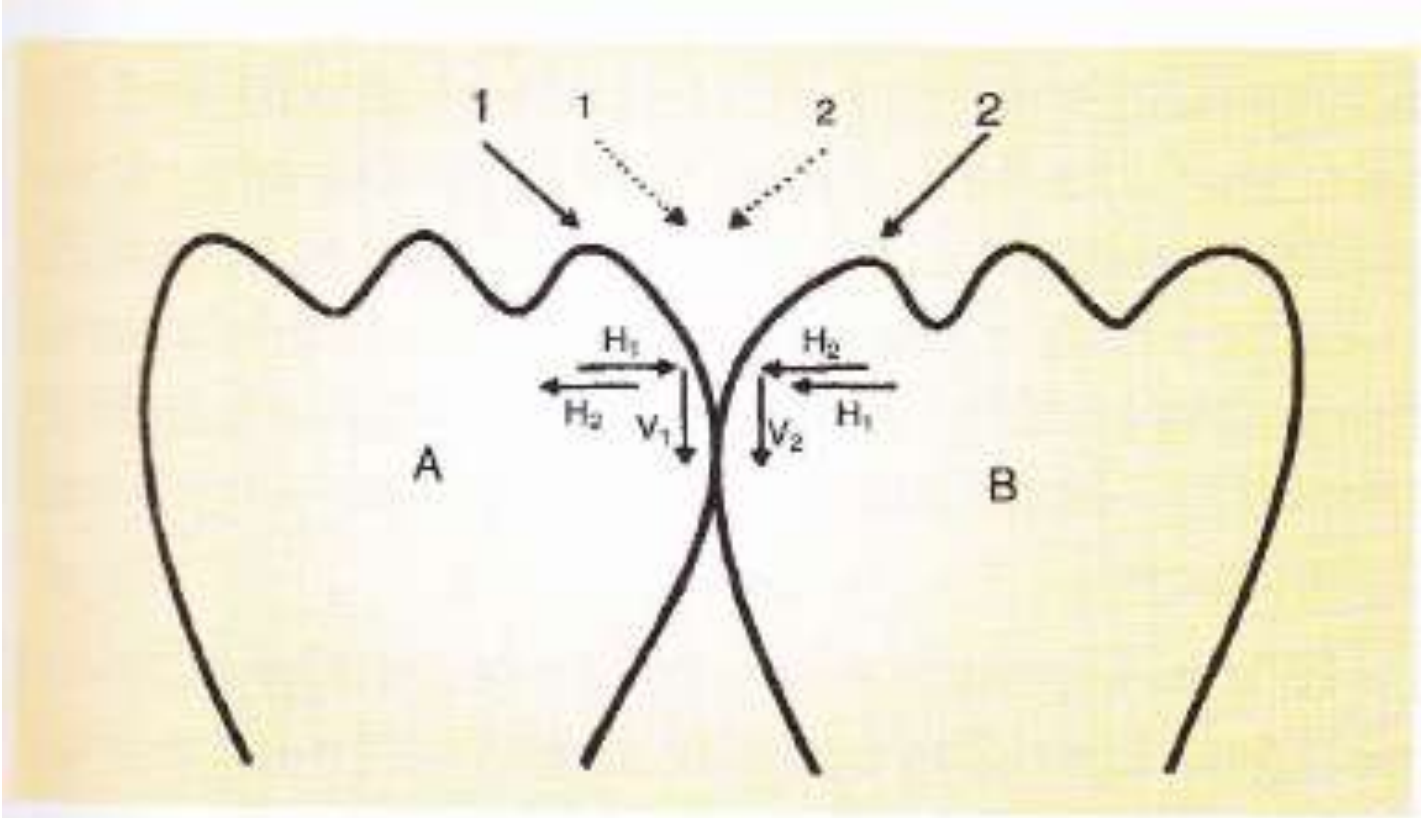

Fig. 12.24. Wide occlusal embrasure.

No occlusal embrasure

See Fig 12.25

- → The vertical component of forces 1 & 2 will be more concentrated than horizontal components
- →Though there will not be any vertical impaction of food → the continuous impact of concentration of vertical component of forces may lead to changes in alveolar bone after sometime

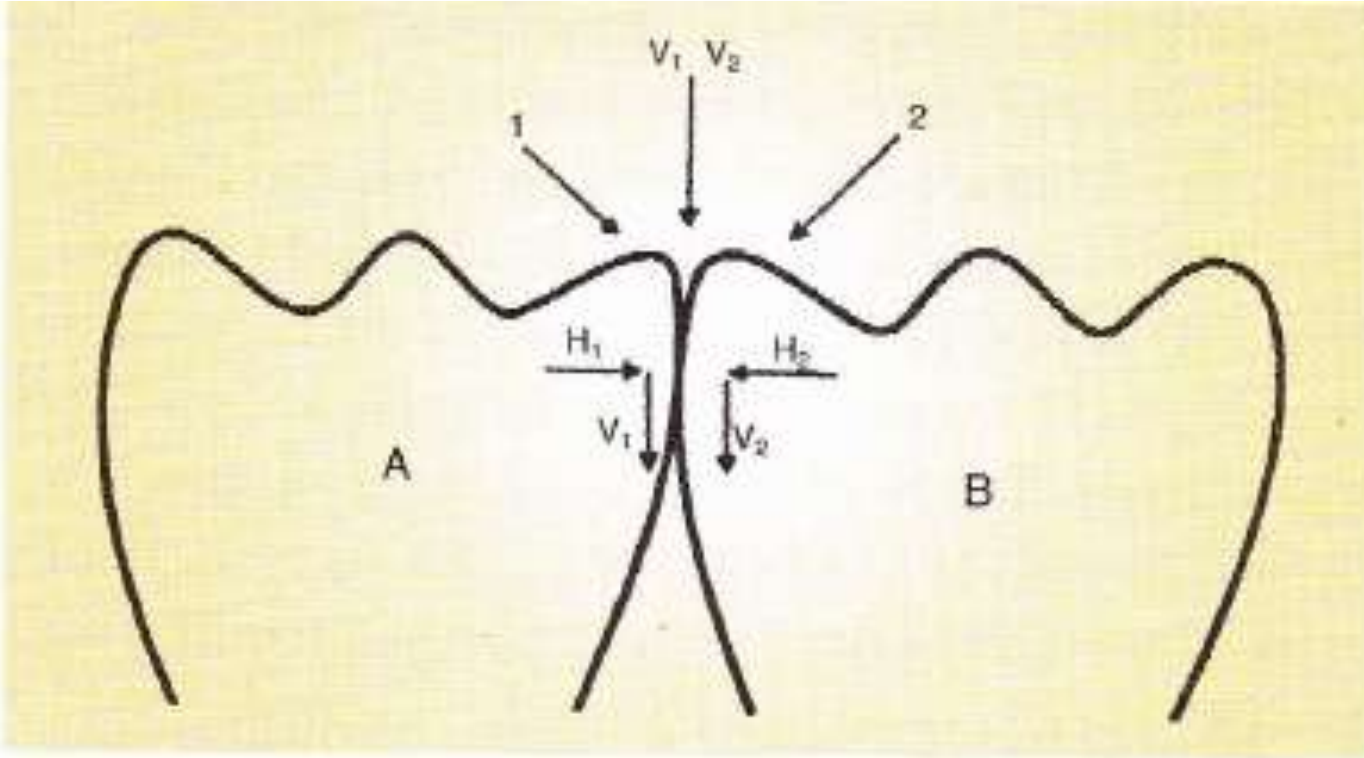

Fig. 12.25. No occlusal embrasure.

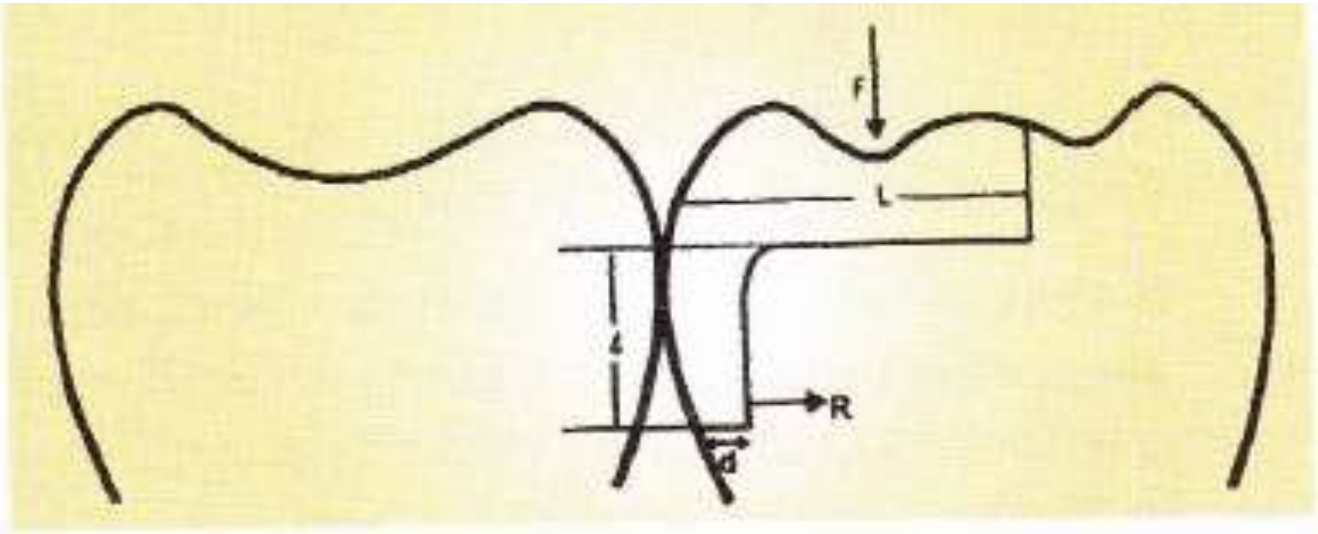

Fig. 12.26. Moment of force in MO/DO preparations.

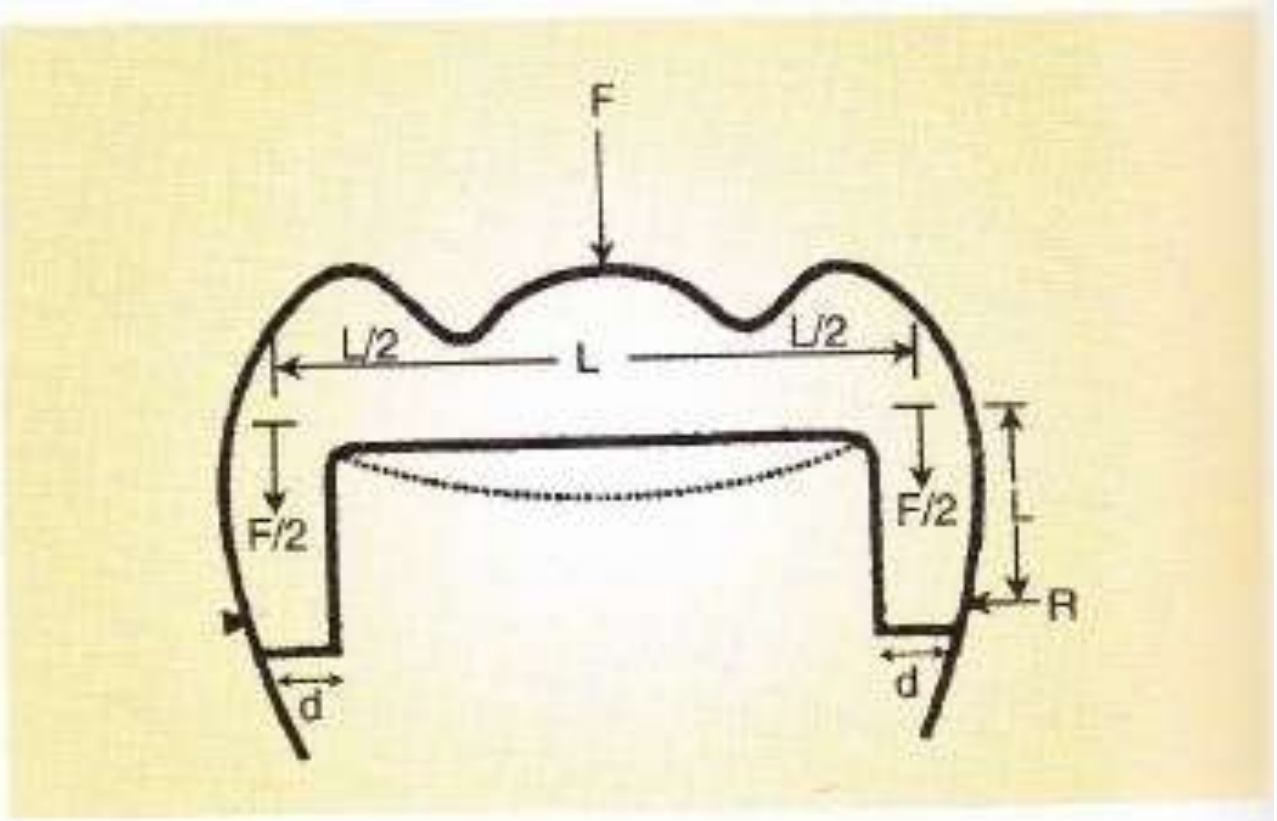

Fig. 12.27. Moment of force in MOD preparation.

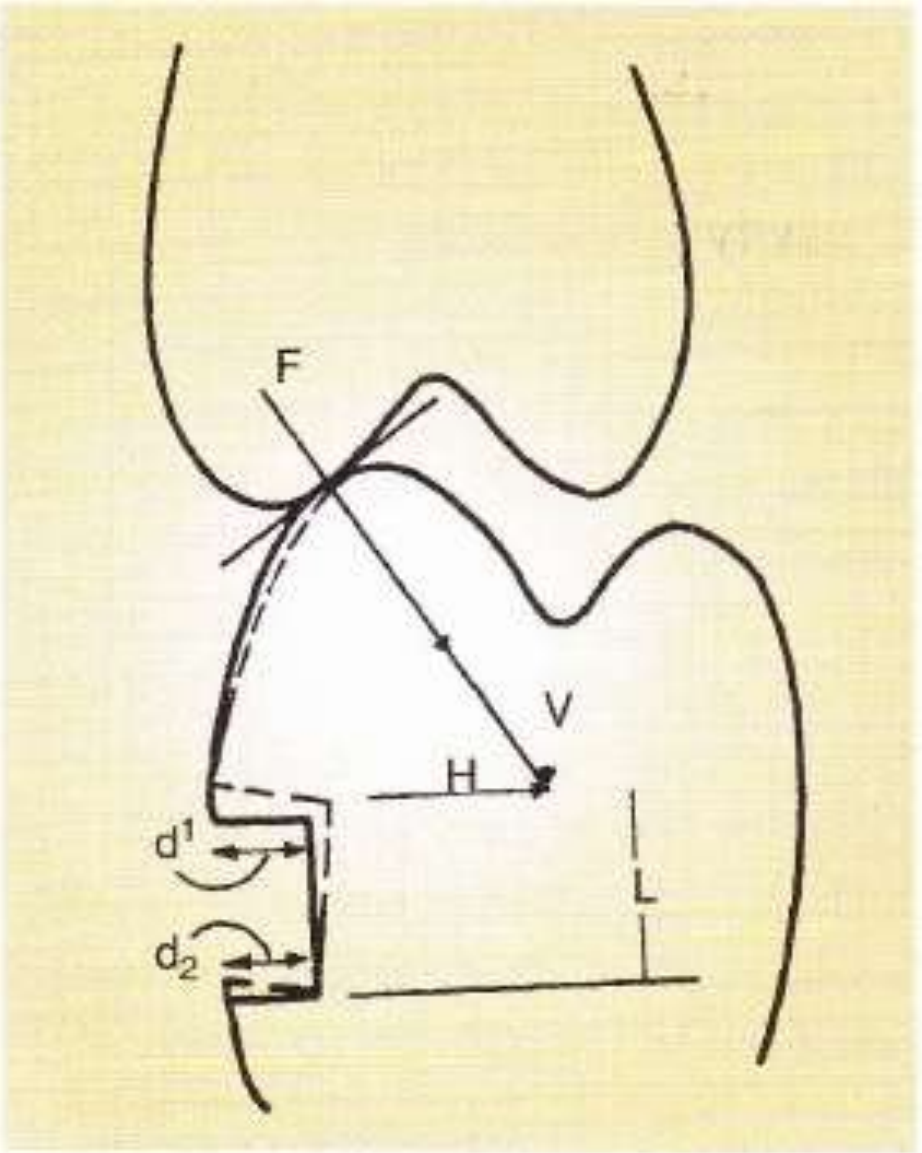

Fig. 12.28. Moment of force in cervical cavities.

THANK YOU