International Journal of Current Advanced Research
ISSN: O: 2319-6475, ISSN: P: 2319-6505, Impact Factor: 6.614
Available Online at www.journalijcar.org
Volume 11; Issue 05 (A); May 2022; Page No.864-867
DOI: http://dx.doi.org/10.24327/ijcar.2022.867.0197

Research Article

FORCES ACTING ON RESTORATION: A LITERATURE REVIEW

Shrishti Kumawat[1], Manjri Agrawal[2], Gunjan Singh[3], Manu Bansal[4], Mahesh Solanke[5] and Harsh Saini[6]

[1,3,4,5]Department of Conservative Dentistry and Endodontics, Jaipur Dental College, Rajasthan
[2]Department of Prosthodontics, Crown and Bridge, Jaipur Dental College, Rajasthan
[6]Department of Oral and Maxillofacial Surgery, Jaipur Dental College, Rajasthan

ARTICLE INFO

Article History:
Received 4th February, 2022
Received in revised form 25th March, 2022
Accepted 23rd April, 2022
Published online 28th May, 2022

Keywords:
Stomatognathic system, amalgam, inlay, stress, restoration

ABSTRACT

The basic aim of cavity preparation design should be to establish the best possible shape that can cope with the distribution of stresses in tooth structure and restoration without failure. By restoring the tooth form, we aim at maintaining the stomatognathic system. Large amalgam restorations caused a static load on the cusps of the teeth to predispose a tooth to fracture, and adequate preparation guidelines are important affecting the prognosis of restoration. For inlay restoration requires a careful balance between the requirements of retention and the stresses generated.

INTRODUCTION

Robert Ledley (1955)[1] A knowledge of the functional forces that occur in the -mouth has important application to every branch of dentistry. The physic-mechanics of the forces operating on the restoration in the oral cavity must be understood in order to assure its success.. By restoring the tooth form, we aim at maintaining the integral and continuity of dental arch which is very important as far as mastication is concerned.

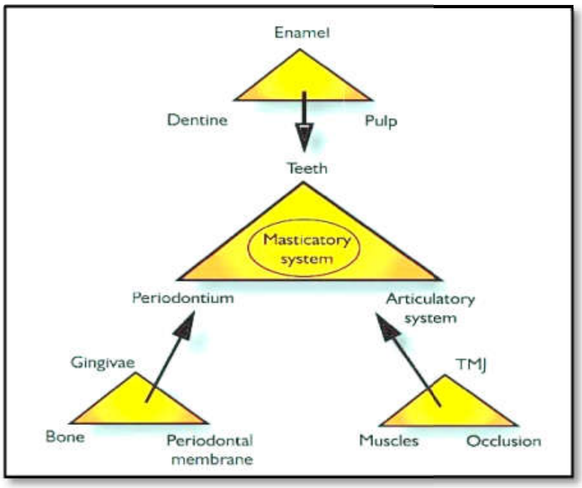


Fig 1 Stomatognathic system

Corresponding author:* **Shrishti Kumawat
Department of Conservative Dentistry and Endodontics, Jaipur Dental College, Rajasthan

As a result, the primary goal of cavity preparation design should be to create the greatest feasible form that can withstand stress distribution in tooth structure and restoration without failure.

There is a general belief among dentists that occlusion plays a significant role in para-functional activities, which may lead to temporomandibular disorder

Rationale

D. B. Mahler & A. Peyton (1955)[2] It has been indicated that the analysis of stresses in dental structures would establish valuable criteria for the design of cavity preparations and dental restorations Occlusal restorations are stressed an average of 1 million times per year, therefore a 25-year service life corresponds to 25 million mechanical stress cycles. Typically, materials fail in the 10 to 100 million cycle range during laboratory testing.[13]

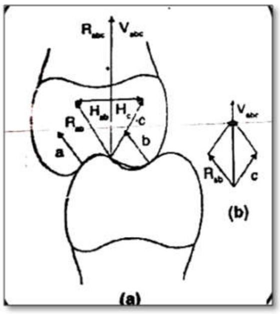
Yet, it is important to realise that patients' response to an occlusal interference and a lack of harmony between parts of thestomato-gnathic system may vary.(Fig.1) As a result, it is critical that the goal of any restorative treatment be to meet the parameters that minimise any potential negative consequences caused by occlusal interference. Thus, there should be minimum to noeffort from the masticatory system.

Studies have revealed that four patients developed biting forces on the first and second molars that varied from 390 to

800 N (88 to 198 lb), with the average being 565 N (127 lb). The average force on the bicuspids, cupids and incisors was 288, 208 and 155N (65, 47 and 35 b) respectively.

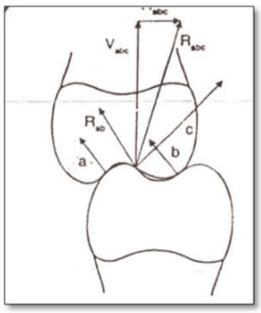
In a similar investigation of the biting forces in children, 783 boys and girls were studied. Children forms 6 to 17 years of age were included, and it was observed that there was an increase in force from 235 to 494 N (53 to 111 Ib) as age increased, with the average yearly increase being in the order of 22.2 N (5 lb).[4]

Forces During Centric Relation



Vabc = Rabc

Force During Chewing



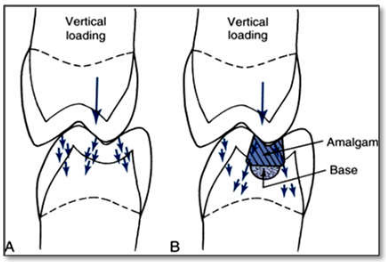
Vabc < Rabc

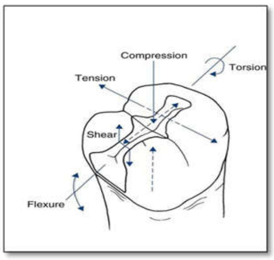
The resultant force is acting medially

The forces which act on the teeth and Cause them to move within their periodontal tissues vary with magnitude, duration, frequency and direction. As a result of these forces, a tooth can he displaced in one of six directions apically mesiodistally or buccolingually and each one producing a rotation or a translation.

The end effect will most likely be a mix of all directions, resulting in omnidirectional movement.

Stresss Transfer Into Intact Tooth VS Restored Tooth





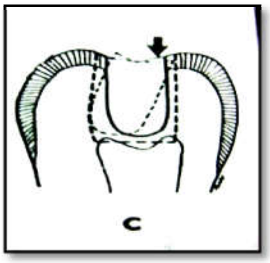
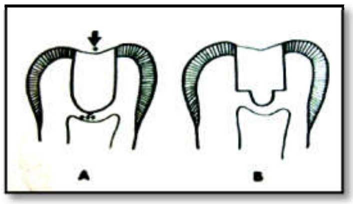
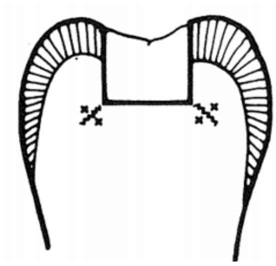
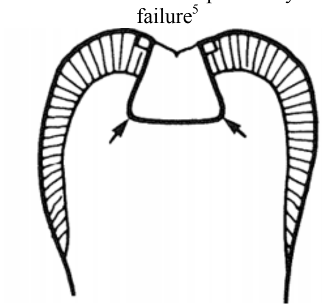
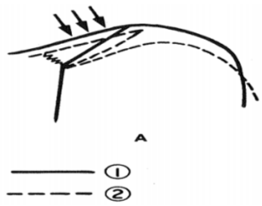
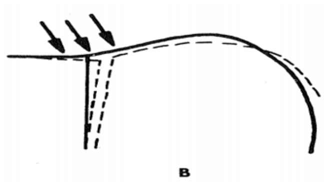
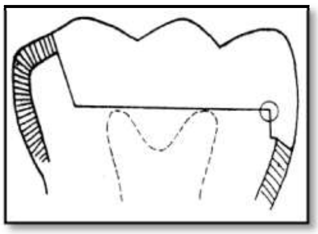
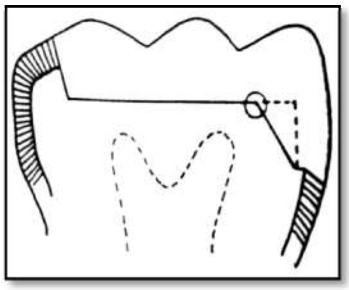
Stress transfer into (a) intact tooth & (b) restored tooth

In normal tooth Biting loads transfer from enamel into dentin as compression. Any force applied to the restoration causes compression tension or shear at the tooth restoration contact. Once enamel is no longer continuous, its resistance is much lower. Therefore, most restorations are designed to distribute stresses onto sound dentin, rather than to enamel.(Fig. 2)

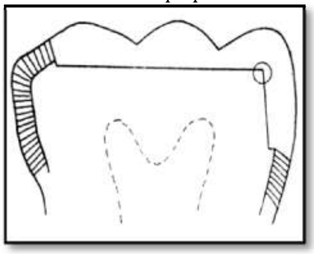
	Compressive Strength (psi)	Modulus of Resilience (inches-lbs/cubic inch.)
Enamel (supported by vital dentin)	36-42,000	60-80
Vital Dentin	40-50,000	100-140

Fig 2

Forces Acting on Amalgam Restoration

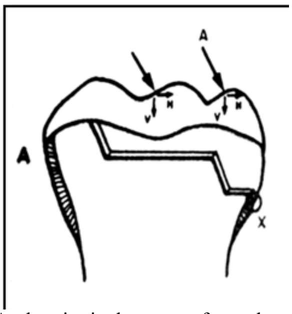
Problem	Solution
 Cone shaped is the least advantageous the restoration may act as a wedge, concentrating forces at the pulpal floor, dentin bridge cracking, increased tendency Splitting.	MORTISE SHAPE Line angles and point angles rounded but definite Adv.: marginal amalgam to withstand stresses and splitting of lateral walls THE LEDGE  When a caries is deep into dentin Ideal depth 1.5 mm All cavosurface angles should he right angled to create a butt-joint with the marginal amalgam. This configuration allows marginal amalgam to withstand stresses with the least possibility of failure[5]
	
MARGINS  Fracture due to Frail, feather edged acute angled margins	 Create but joint amalgam tooth structure at the margins. - withstand induced stresses from occlusal loading with less possibility of failure, even if the stresses arc tensile in nature. Leave no unsupported enamel at the cavo-surface margins. Remove flashes of amalgam on tooth surface adjacent to amalgam margins.[6] The interface between amalgam and tooth structure should not be at an occluding contact are with opposing teeth either in centric or excursive mandibular movements.
ISTHMUS The fulcrum of binding occurs at the axio-pulpal line angle. Stresses increase closer of the surface of a restoration, away from that fulcrum. Tensile stresses predominate at the marginal ridge area of a Class II restoration.  Increase bulk at axiopulpal line	 A combination of the two solutions i.e. increasing amalgam bulk near the marginal ridge, while bringing the axio-pulpal line angle away from the stress concentration area and closer to (lie surface, Can be achieved Simply by slanting the axial wall towards the

angle-Deepened cavity preparation close to pulp	pulpal floor

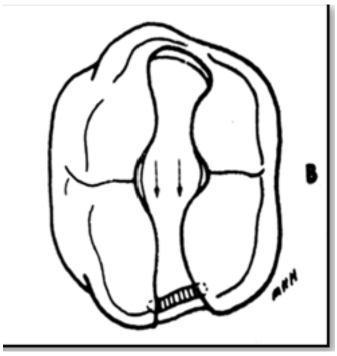


Axiopulpal line angle closer to surface – diminished bulk of amalgam

Proximal Displacment of Entire Restoration



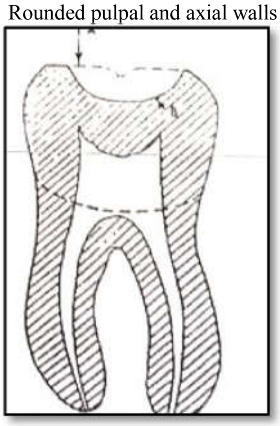
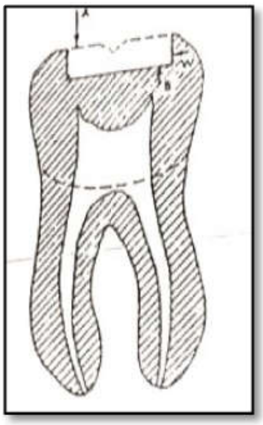
At the gingival cavo-surface edge, axis 'X' will tend to rotate the restoration proximally.

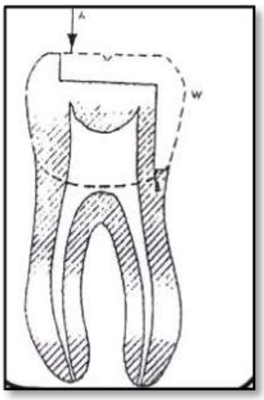


To prevent such displacement self-retaining facial and lingual grooves proximally are necessary, in addition to an occlusal dovetail.

Forces Acting On Inlay

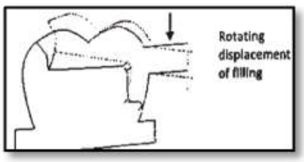
For a cast restoration to be acceptable biologically and mechanically, the tooth which it rests must be so designed that it will receive sufficient support and ate retention against displacing forces.[7]

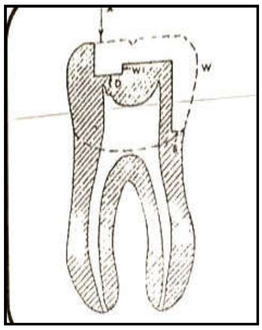
Problem	Solution
Rounded pulpal and axial walls  Elimination of one of the vertical parallel walls considerably reduces the resistance to displacement.	 Vertical force A meets maximum resistance to displacement due to vertical axial walls and perpendicular pulpal floor. a retentive groove at the pulpal floor results, creation of a small vertical well W2 and replace, a small degree of resistance to displacement which was lost when the vertical wall W was cut away.



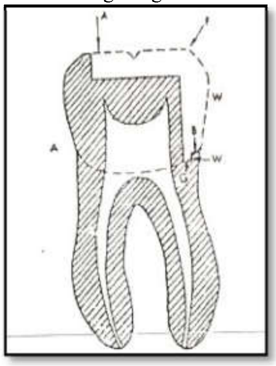
ROTATIONAL DISPLACMENT

When force is applied to the proximal extension of the restoration: The restoration has a tendency to rotate occluso-proximally out of its cavity the rotation point being the gingival marginal wall.[9]





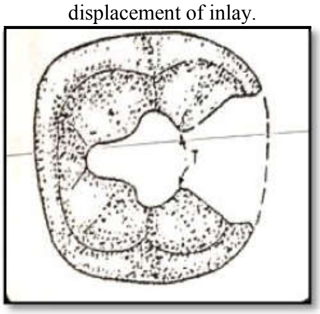
Gingival groove



Gingival groove should not be wider than half the width of its gingival wall and that the depth of the groove be equal to its width.[8]

Occlusal dovetail

The tensile stress develop by the occlusal lock of dovetails is one of the strongest means of resisting displacement of inlay.

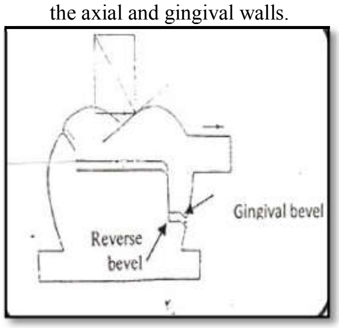


Gingival groove

It should not be wider than half the width of its gingival wall and that the depth of the groove is equal to its width.[10]

Reverse bevel

Inward beveling of gingival .wall is done forming an acute angle between the axial and gingival walls.



Now when the horizontal displacing force is applied. The lateral displacement of the restoration wall be resisted by the triangular wedge portion of the inlay which extends into the acute angle formed by axiogingival walls.[11]

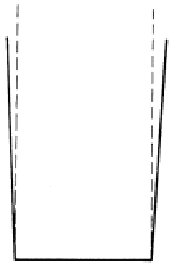
The ideal depth of bevel should be approximately 45° from the horizontal plane.[12]

Pulpal wall

The inclined planes of pulpal wall will prevent the lateral dislodgement of the inlay unit the deepest part rises above the pulpal floor level.

Preparation of lowering grooves or pinholes whole walls are parallel within2^0 resist horizontal displacement of the inlay since this portion of inlay must be raised out of the cavity before any lateral movement can take place.

Axial wall convergence of 2 to 5^o gives maximum resistance to displacement of restoration.



A

Weakest Link : Between Casting And Luting Cement

Circumferential tie

peripheral marginal anatomy of the preparation

Features:

Enamel must be supported by sound dentin; enamel rods forming the cavosurface margin should be continuous with sound dentin; enamel rods forming the cavosurface margin should be covered with the restorative material angular cavosurface angles should be trimmed.

Primary and secondary flare

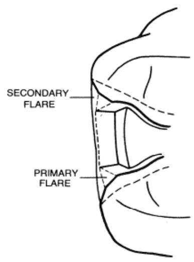


Fig. 17-6

Usually prepared solely on enamel on facial and lingual walls at 45 degree for cleansable areas

In very widely extended lesions bucco-lingually, the buccal and lingual tooth structure will be badly thinned; the primary flare will end with acute-angled marginal tooth structure, occasionally with un supported enamel. A secondary superimposed flare (Fig. 17.6) at the correct angulation can create the needed obtuse angu lation of the marginal tooth structure. This is done without any sacrifice in the preparation resistance and retention, because the wall proper and primary flare are maintained at their proper locations and angulations.

Complex Restorations

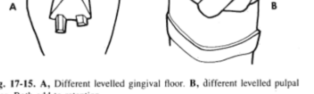


Fig. 17-15. A, Different levelled gingival floor. B, different levelled pulpal floor. Both add to retention.

The irregularity or roughness should be of adequate dimension, leaving bulky tooth structure between them to be self-resistant, especially under shear loading. Irregularities should have no. undercuts, be fairly smooth surfaced, and have no frail or undermined enamel.

Fissure burs followed by chisels are very effective in refining and/or establishing these features

CONCLUSION

Every tooth and restorative material have their own stress pattern recognizing them in vital to prior to designing a restoration without failure potential.

Building a restoration is similar to building any mechanical structure in that the stress patterns of the available foundation and contemplated structure (or the forces acting biomechanics unit" must be periodontal.

Optimal functional capacity and stability of occlusal relationships are major considerations in every phase of restorative dentistry.

References

1. Roberts. Ledley: A New Method Of Determining The Functional Forces Applied To Prosthetic Appliances And Their Supporting Tissues. J. Pros. Den.1955; volume 5 Number 4.
2. D. B. Mahler and F. A. Peyton: Photoelasticity as a Research Technique for Analyzing Stresses in Dental Structures. J. D. Res.1955,Volume 34; Number 6.
3. Maurice J. Saklad: The Disclosure of Cleavage and Fracture Lines in Porcelain Restorations. J. Pros. Den. 1958,Volume 8 Number1
4. Parker M.W: The Significance of Occlusion in Restorative Dentistry. D.C.N.A.: 37,341,1993.
5. Gillmore H.W Restorative material and tooth preparation design DENT CLIN NA 15 99 1971.
6. Hunt,P.R.: Rational Cavity Design Principle.j.esthet.dent.6,245,1994.
7. Crockett, W.D.Sheppard.E.F. Moon.P.C. and Creal. A.F.: The influence of proximal grooves on the retention and resistance of class ii preparation of amalgam. J, am. Dent assn.nov.91: 1053-1056.
8. Frates, F.E. Inlays. D.C.N.A.: 11,163,1967.
9. Woosley, G.D.Matich J.A: Effect of Grooves on the restoration form of cast restoration. J.a.d.a.97. 978.1978.
10. Rosner David: Function, placement and reproduction of bevels for gold casting. J. Prostho Dent Asso. 35,213, 1969.
11. Dow, P.R.Iroved coronal retention withminimal pulp damage:a summations of principals. J. can.dent. 8,6,1983.
12. Charbeaneau *et al* Principle &Practice of Operative Dentistry, 3rd edition. 1989.
13. Sturdevant's Art and Science of Operative Dentistry: Theodore Roberson, **Harald O. Heymann, Edward J. Swift, Jr.**