

Raw Data

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Stress Distribution in Restored Primary Molar Using Finite Element Analysis

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1. Materials

Equipments and instruments used in this study

- High speed hand piece (Being, China)
- Round bur no. 330
- Long-tapered diamond bur
- Matrix and band
- Aplicap Applier (3M, ESPETM, St. Paul, MN, USA)
- Amalgamator (De Gotzen, Italy)
- Planmeca Promax 3D Mid cone beam computed tomography (CBCT)

Materials used in this study

- GIC capsule (GC Fuji I) (Fig1)
- Intermediate Restorative Material(IRM) (DENTSPLY™) (Fig2)
- Amalgam (SDI), Victoria, Australia (Fig3)
- SSC (3M™ ESPE™) (Fig 4)
- Zirconia crown (Nu smile™).(Fig 5)
- Six initial caries human primary mandibular second molar, recently extracted for therapeutic purposes either about to shed or retained were selected (Fig 6)



Figure 1: GIC capsule (GC Fuji I).



Figure 2: Intermediate Restorative Material (DENTSPLY™)



Figure 3: Amalgam (SDI), Victoria, Australia.



Figure 4: SSC (3M™ ESPET™).



Figure 5: Zirconia crown (Nu smile™).



Figure 6: Extracted teeth used in this study

2. Database (tables and charts)

Table 1: The number of nodes and elements

		Model IA	Model IB	Model IIA	Model IIB	Model IIIA	Model IIIB
Enamel	Elements	53731	42022	—	—	—	—
	Nodes	16191	11707	—	—	—	—
Dentin	Elements	74033	20220	66331	97077	66331	97077
	Nodes	20105	5377	18492	26817	18492	26817
Amalgam	Elements	18272	8825	12050	5571	12050	5571
	Nodes	5466	2622	3660	1757	3660	1757
SSC	Elements	—	—	93177	102709	—	—
	Nodes	—	—	26238	28630	—	—
zirconia crown	Elements	—	—	—	—	93177	102709
	Nodes	—	—	—	—	26238	28630
IRM	Elements	—	3087	—	16010	—	16010
	Nodes	—	1018	—	4629	—	4629

Table 2: Isotropic material properties.

Material	Elastic modulus in Megapascal unit (MPa)	Poisson's ratio
Enamel	80,000	0.33
Dentin	20,000	0.31
SSC	200,000	0.33
zirconia Crown	240,000	0.26
Amalgam	48,000	0.35
IRM	2,500	0.32
pulp	2,000	0.45
Glass Ionomer cement	12,000	0.3

Table 3: The maximum von-Mises stress values of model I-A

	Enamel	Dentin	Amalgam
Vertical load	49.504	31.231	64.842
Type I lateral load	116.93	56.264	34.081
Type II lateral load	86.193	52.556	20.422
Type III lateral load	94.875	54.938	97.184
Type IV lateral load	103.26	32.726	84.055

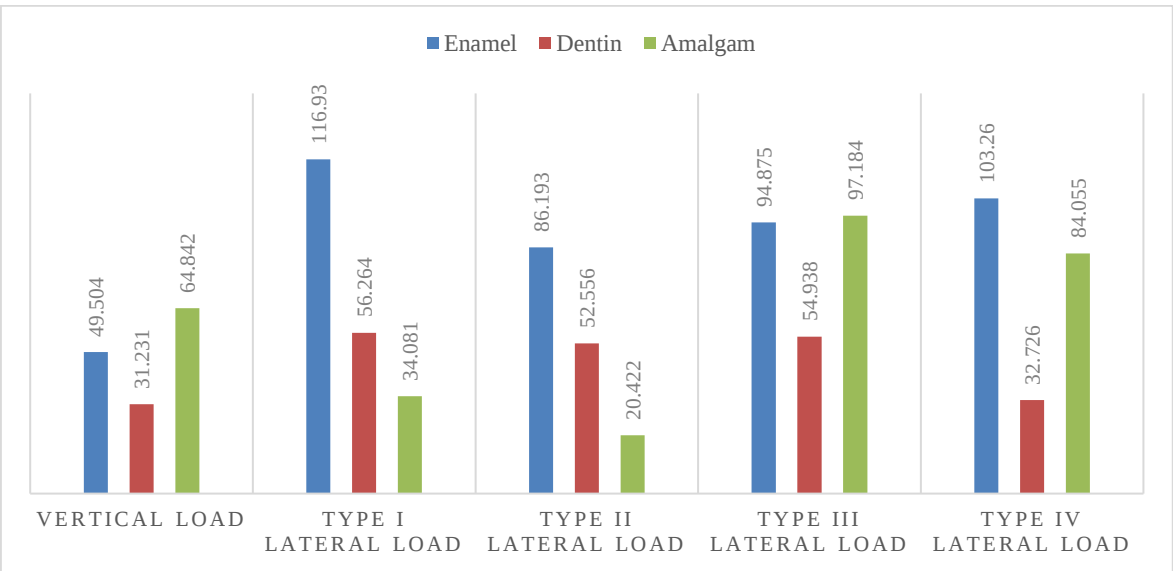


Chart 1: The maximum von-Mises stress values of model I-A

Table 4: The maximum von-Mises stress values of model I-B

	Enamel	Dentin	Amalgam	IRM
Vertical load	65.762	44.656	77.117	24.465
Type I lateral load	155.46	51.342	40.281	13.068
Type II lateral load	119.32	50.55	27.093	11.606
Type III lateral load	146.39	59.493	141.6	38.621
Type IV lateral load	130.51	46.625	54.526	17.632

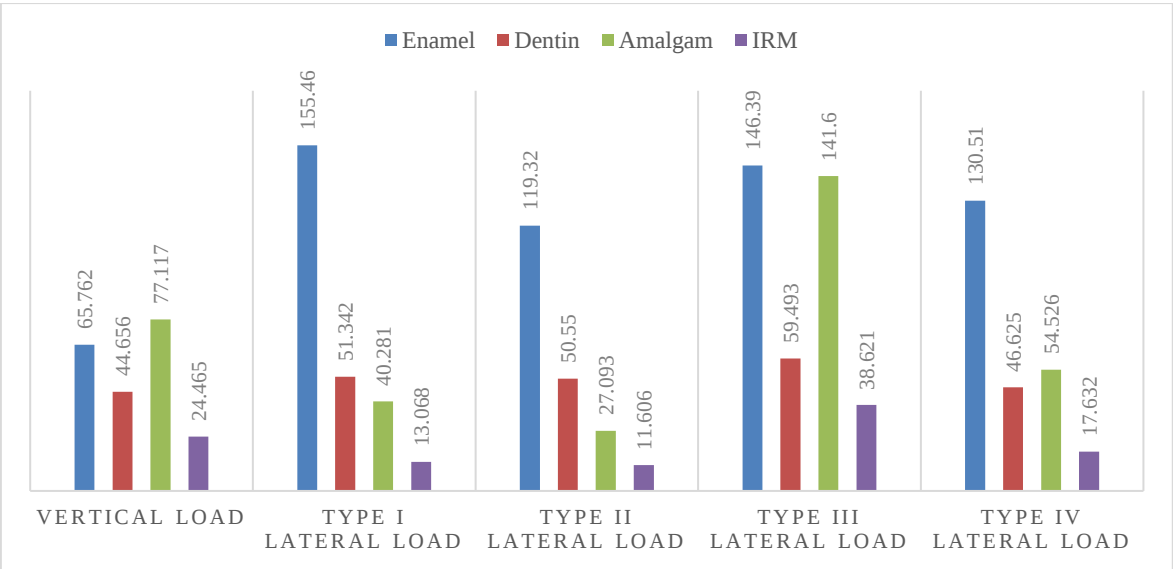


Chart 2: The maximum von-Mises stress values of model I-B

Table 5: The maximum von-Mises stress values of model II-A

	SSC	Dentin	Amalgam
Vertical load	86.284	23.93	21.639
Type I lateral load	274.61	46.061	26.584
Type II lateral load	273.99	39.613	15.94
Type III lateral load	245.58	42.028	66.656
Type IV lateral load	196.96	31.206	16.194

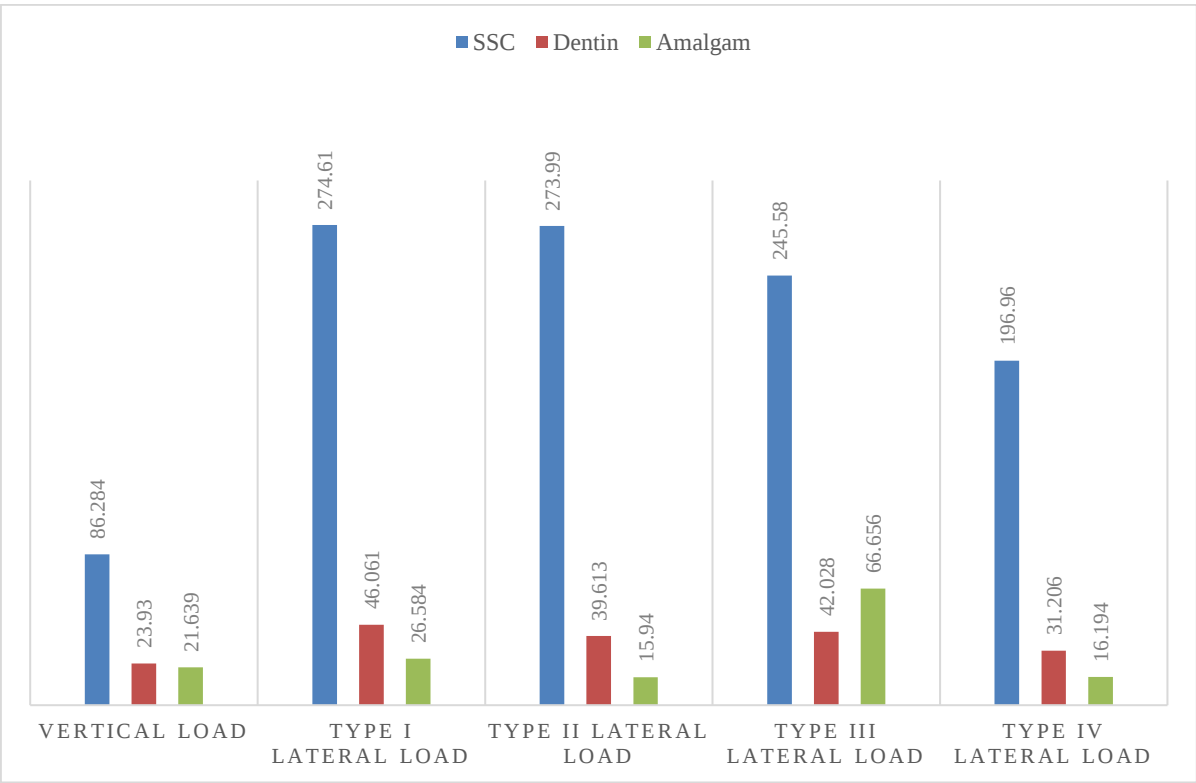


Chart 3: The maximum von-Mises stress values of model II-A

Table 6: The maximum von-Mises stress values of model II-B

	SSC	Dentin	Amalgam	IRM
Vertical load	183.95	31.13	0.4727	0.3437
Type I lateral load	327	49.787	1.8718	1.3895
Type II lateral load	281.82	44.394	0.5901	0.4882
Type III lateral load	203.37	52.716	1.9819	1.4712
Type IV lateral load	191.84	37.664	1.7301	1.1968

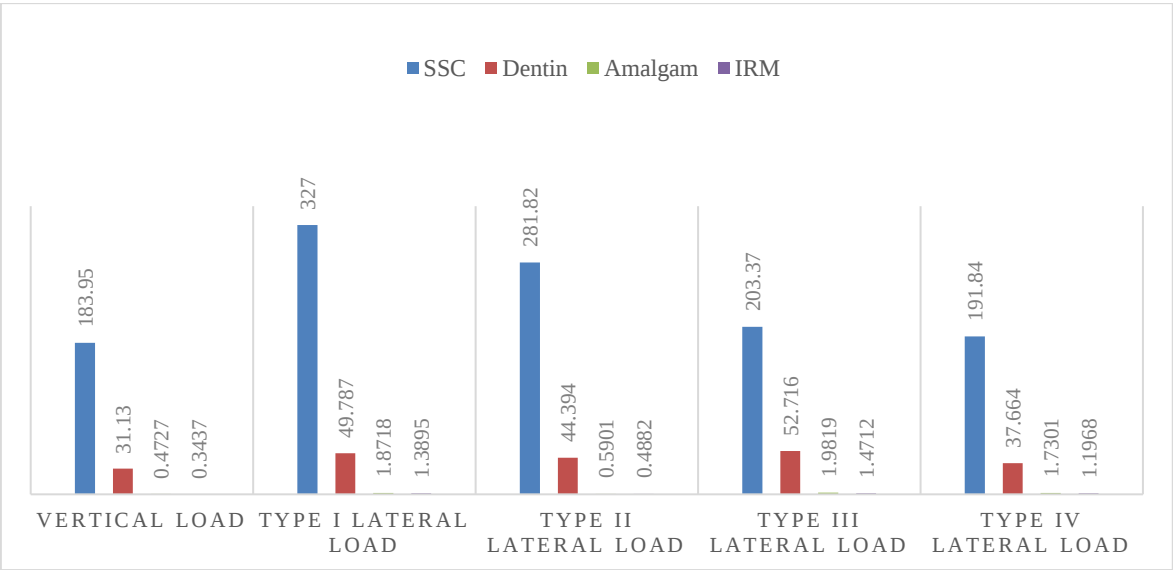


Chart 4: The maximum von-Mises stress values of model II-B

Table 7: The maximum von-Mises stress values of model III-A

	Zirconia Crown	Dentin	Amalgam
Vertical load	81.189	21.67	20.637
Type I lateral load	272.09	46.584	25.238
Type II lateral load	271.58	38.526	15.259
Type III lateral load	224.59	41.776	62.833
Type IV lateral load	174.51	31.274	14.063

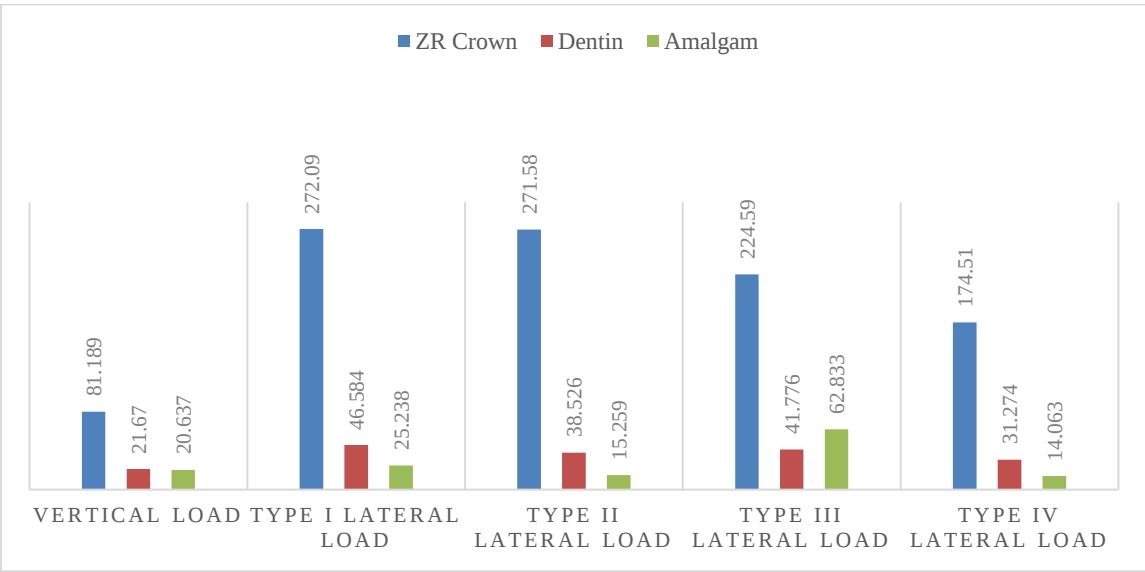


Chart 5: The maximum von-Mises stress values of model III-A

Table 8: The maximum von-Mises stress values of model III-B

	Zirconia Crown	Dentin	Amalgam	IRM
Vertical load	173.42	28.133	0.4313	0.3137
Type I lateral load	294.48	48.323	1.8168	0.4254
Type II lateral load	245.26	41.064	0.5458	0.4516
Type III lateral load	198.82	49.892	1.6174	1.1942
Type IV lateral load	185.79	34.368	0.7892	0.657

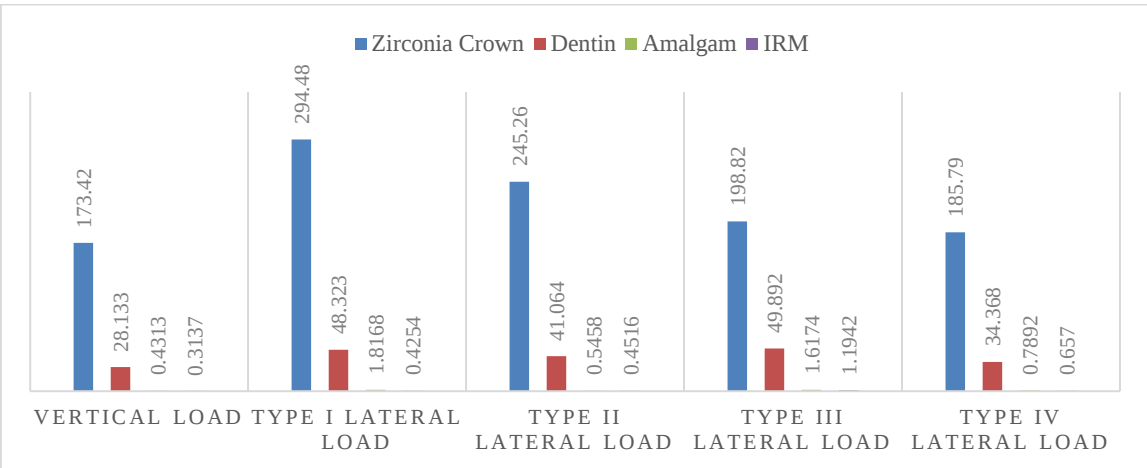


Chart 6: The maximum von-Mises stress values of model III-B

Table 9: the maximum von-Mises stress in Class II cavity with MOD Models

	Model I-A		Model II-A		Model III-A	
	Amalgam	Dentin	SSC	Dentin	Zirconia Crown	Dentin
Vertical load	64.842	31.231	86.284	23.93	81.189	21.67
Type I lateral load	34.081	56.264	274.61	46.061	272.09	46.584
Type II lateral load	20.422	52.556	273.99	39.613	271.58	38.526
Type III lateral load	97.184	54.938	245.58	42.028	224.59	41.776
Type IV lateral load	84.055	32.726	196.96	31.206	174.51	31.274

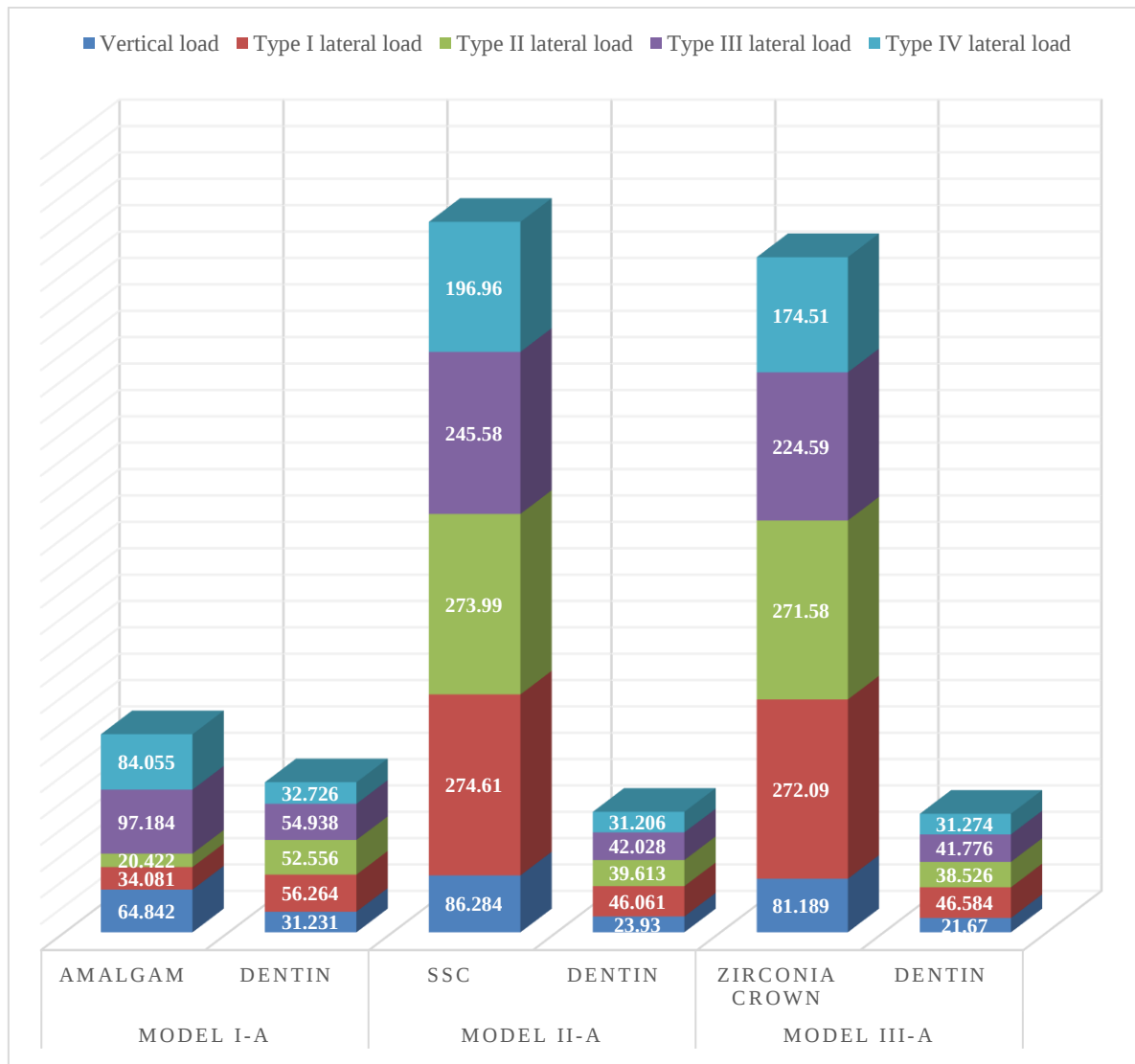


Chart 7: The maximum von-Mises stress values in Class II cavity with MOD models

Table 10: The maximum von-Mises stress in pulpotomy with MO cavity Models

	Model I-B		Model II-B		Model III-B	
	Amalgam	Dentin	SSC	Dentin	Zirconia Crown	Dentin
Vertical load	77.117	44.656	183.95	31.13	173.42	28.133
Type I lateral load	40.281	51.342	327	49.787	294.48	48.323
Type II lateral load	27.093	50.55	281.82	44.394	245.26	41.064
Type III lateral load	141.6	59.493	203.37	52.716	198.82	49.892
Type IV lateral load	54.526	46.625	191.84	37.664	185.79	34.368

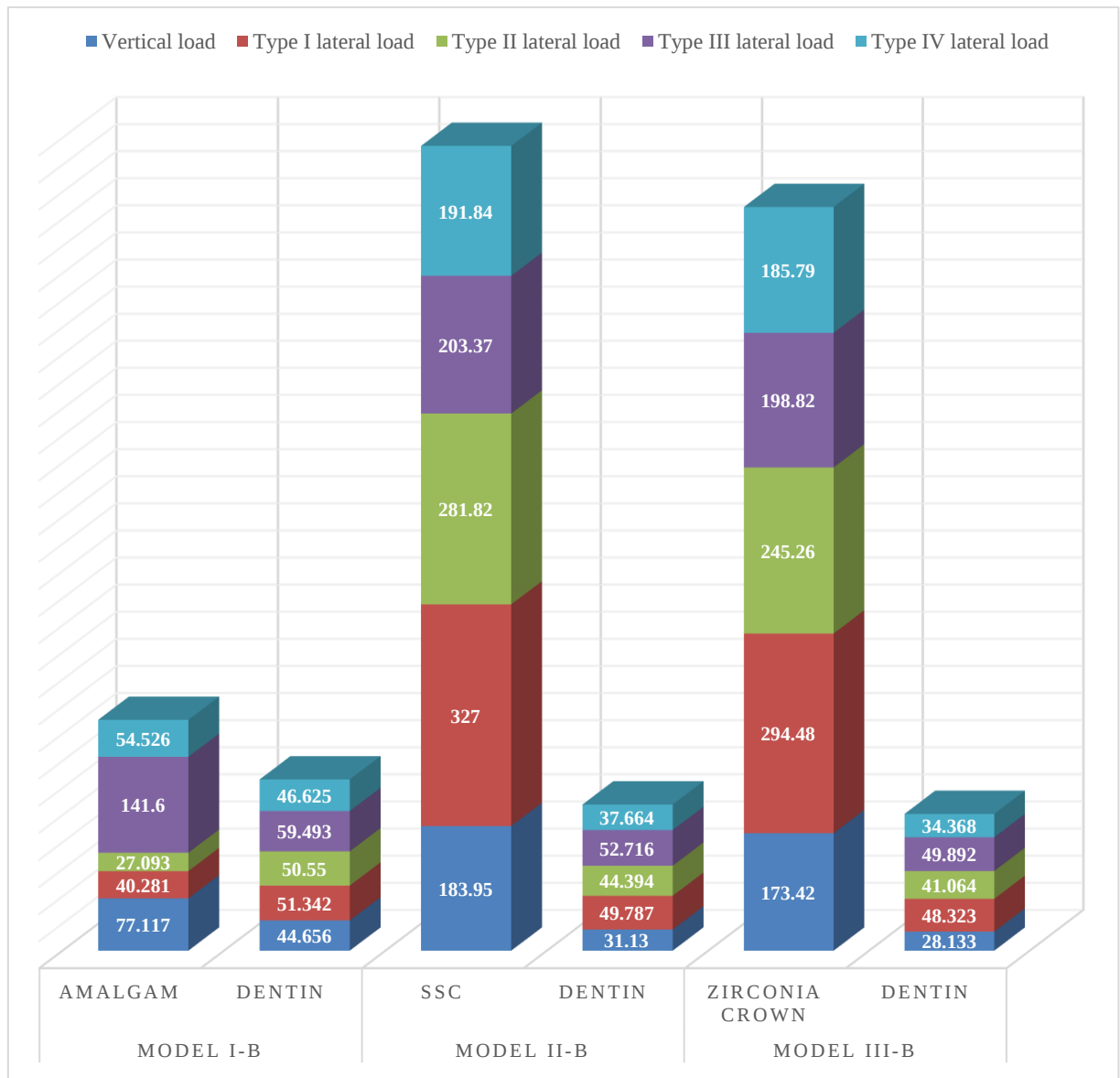


Chart 8: The maximum von-Mises stress values in pulpotomy with MO cavity models

Table 11: The maximum von-Mises stress in IRM.

	Model I-B	Model II-B	Model III-B
Vertical load	24.465	0.3437	0.3137
Type I lateral load	13.068	1.3895	0.4254
Type II lateral load	11.606	0.4882	0.4516
Type III lateral load	38.621	1.4712	1.1942
Type IV lateral load	17.632	1.1968	0.657

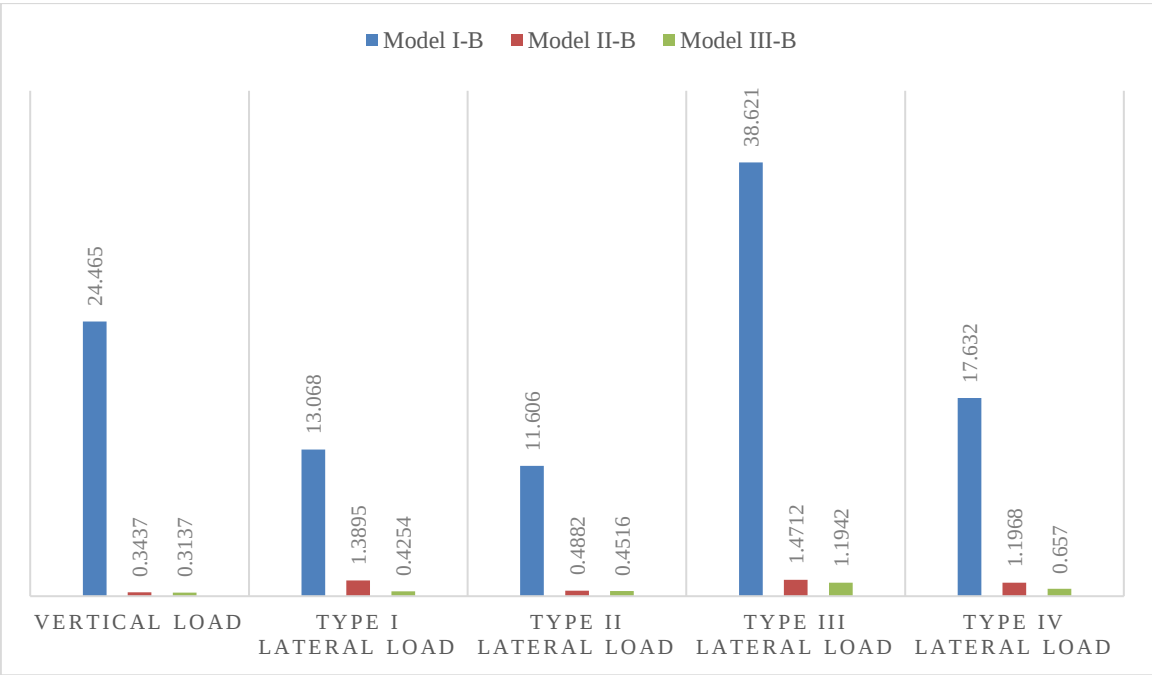


Chart 9:The maximum von-Mises stress in IRM

3. Database of results

All pictures in this file show pattern of stress distribution based on colors. At the upper left side of pictures there are some informations such as static structure, equivalent stress, type unit,time and date-time which indicate to fixed structure, the part of model in the picture, type of stress that was calculated (von Mises stress), unit of stress (megapascal), time which the model exposed to force (second), time-date of export picture from the program, respectively. In addition there is a color scale that shows different colors which represent range of stresses. Also, it shows the maximum and minimum stress level.

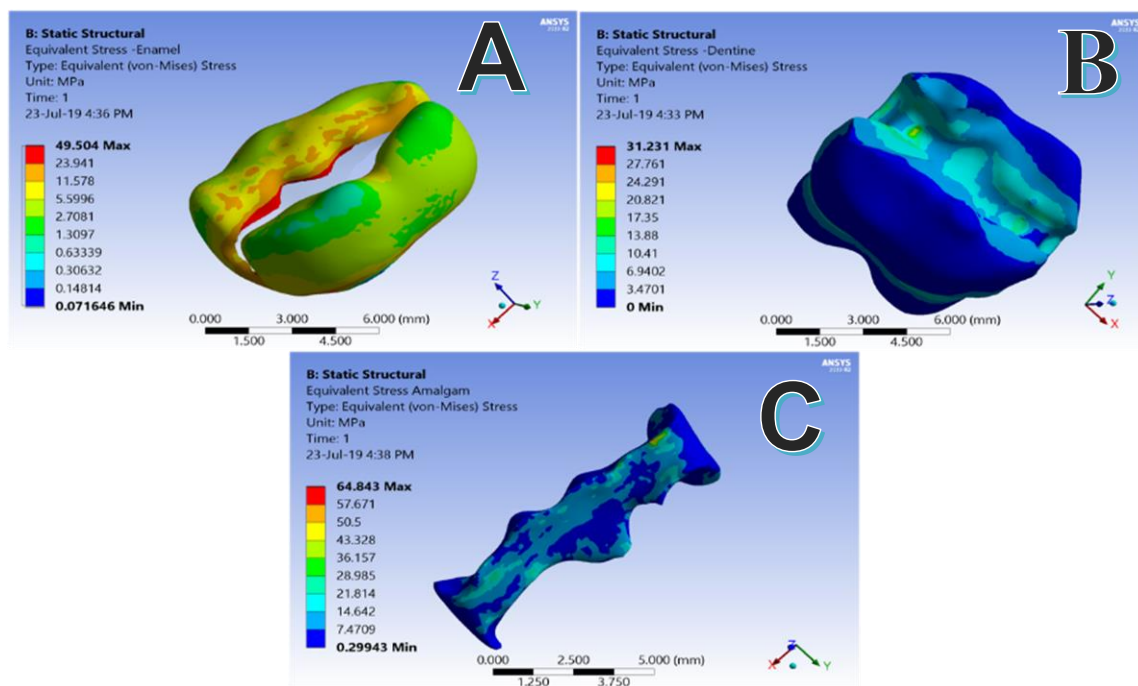


Figure 1:The von Mises Stress Pattern on Model I-A under Vertical Force (A) Enamel (B) Dentin (C) Amalgam

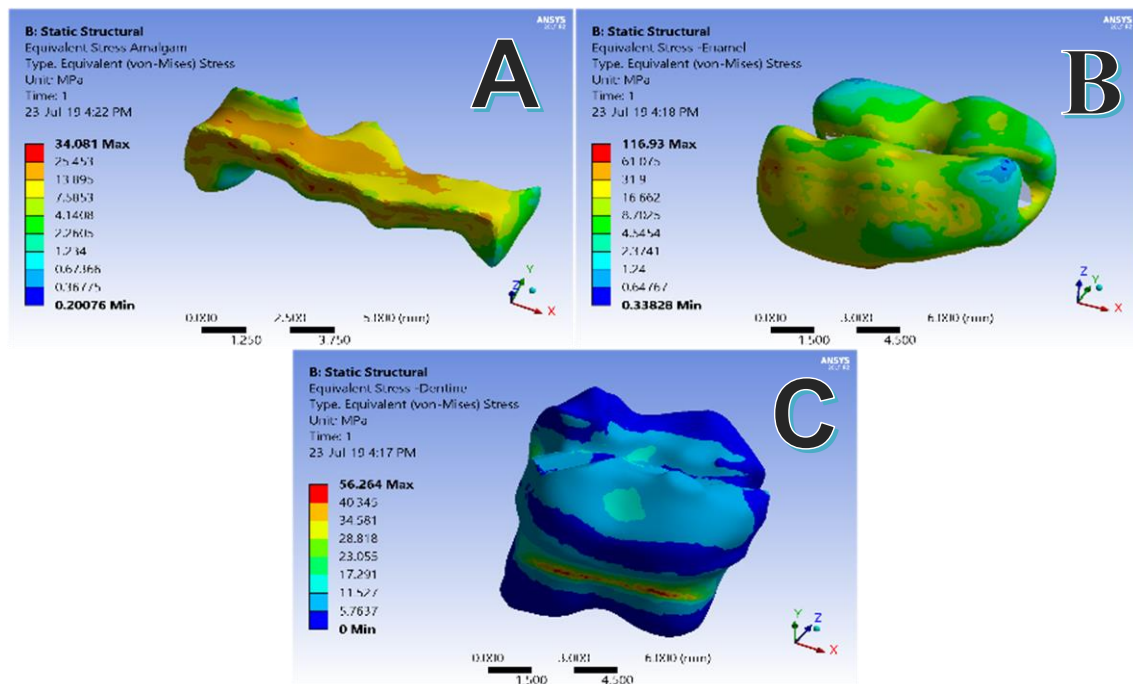


Figure 2: The von Mises Stress Pattern on Model I-A under Type I Lateral Force (A) Enamel (B) Dentin (C) Amalgam

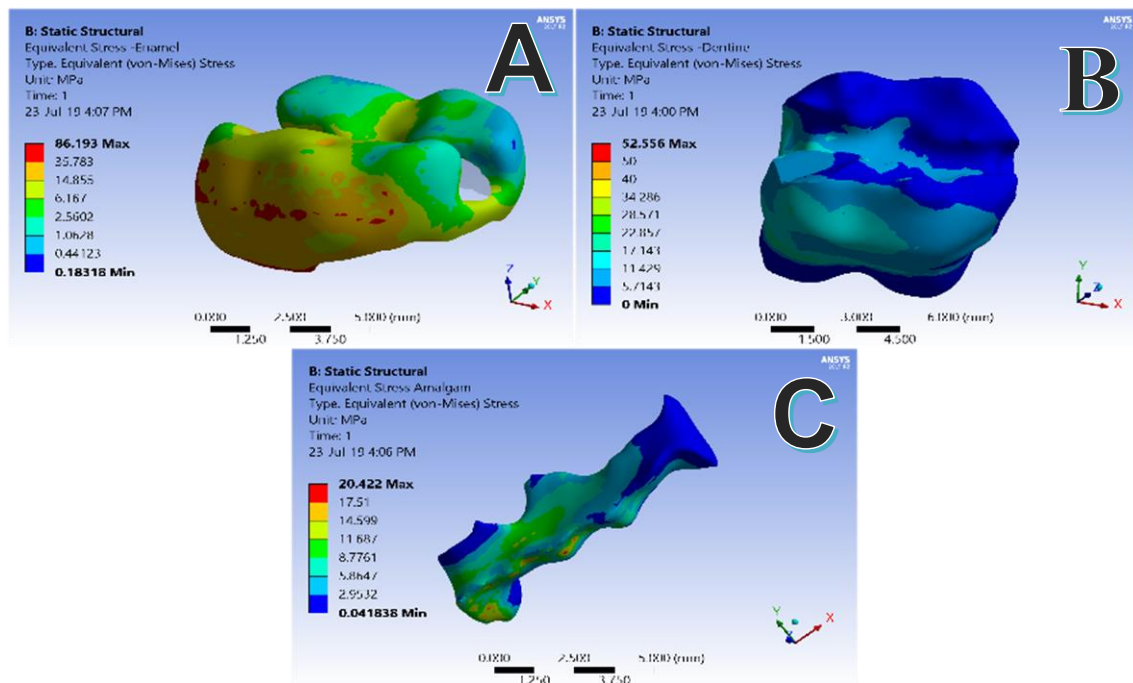


Figure 3: The von Mises Stress Pattern on Model I-A under Type II Lateral Force (A) Enamel (B) Dentin (C) Amalgam

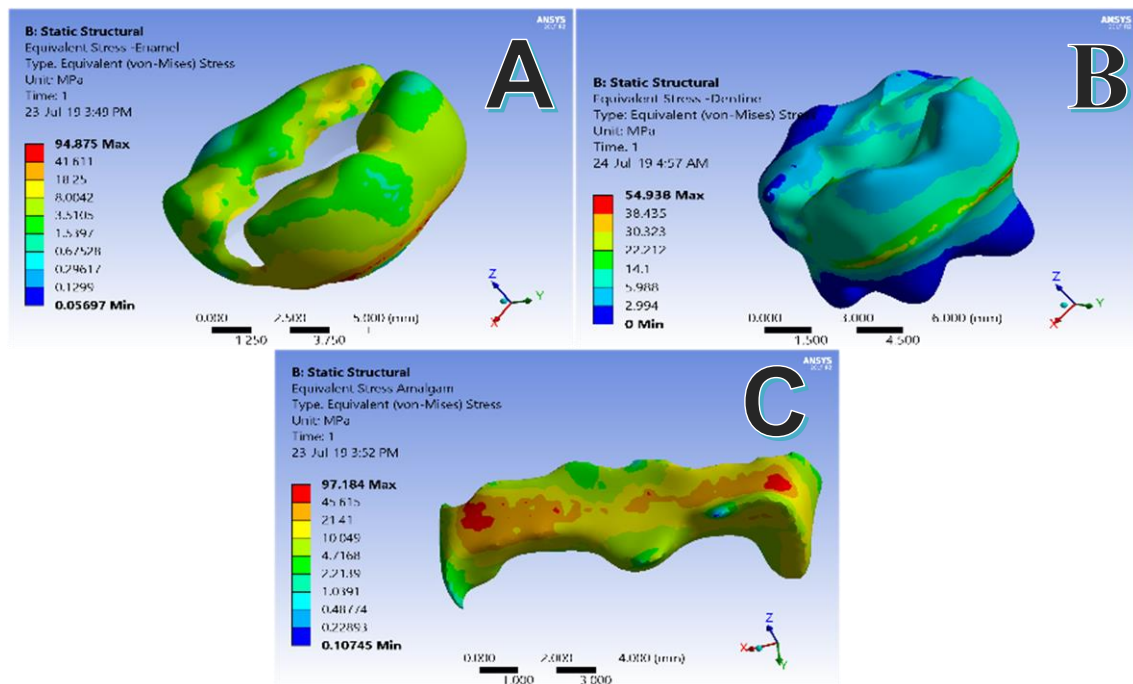


Figure 4: The von Mises Stress Pattern on Model I-A under Type III Lateral Force (A) Enamel (B) Dentin (C) Amalgam

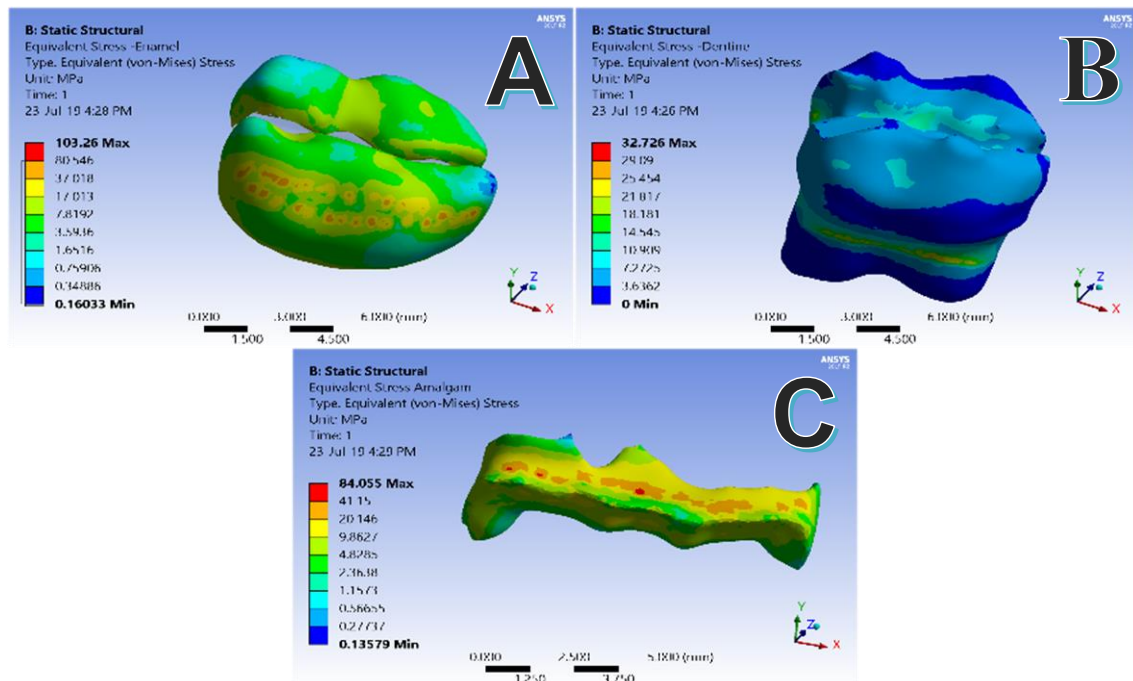


Figure 5: The von Mises Stress Pattern on Model I-A under Type IV Lateral Force (A) Enamel (B) Dentin (C) Amalgam

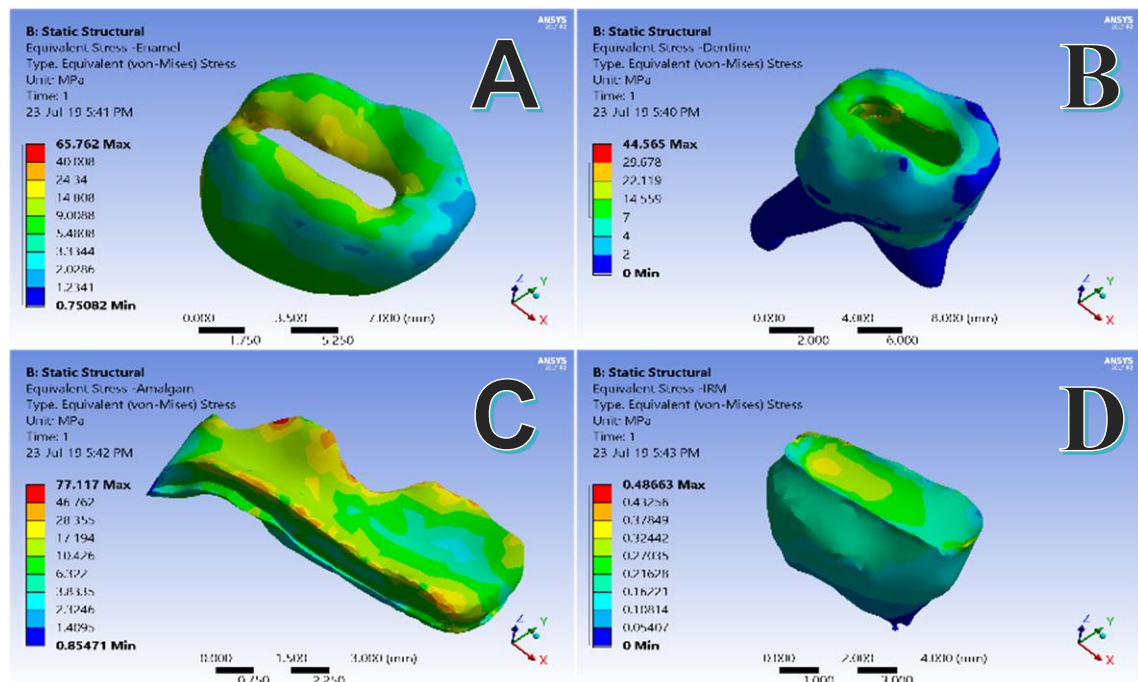


Figure 6: The von Mises Stress Pattern on Model I-B under Vertical Force (A) Enamel (B) Dentin (C) Amalgam (D) IRM

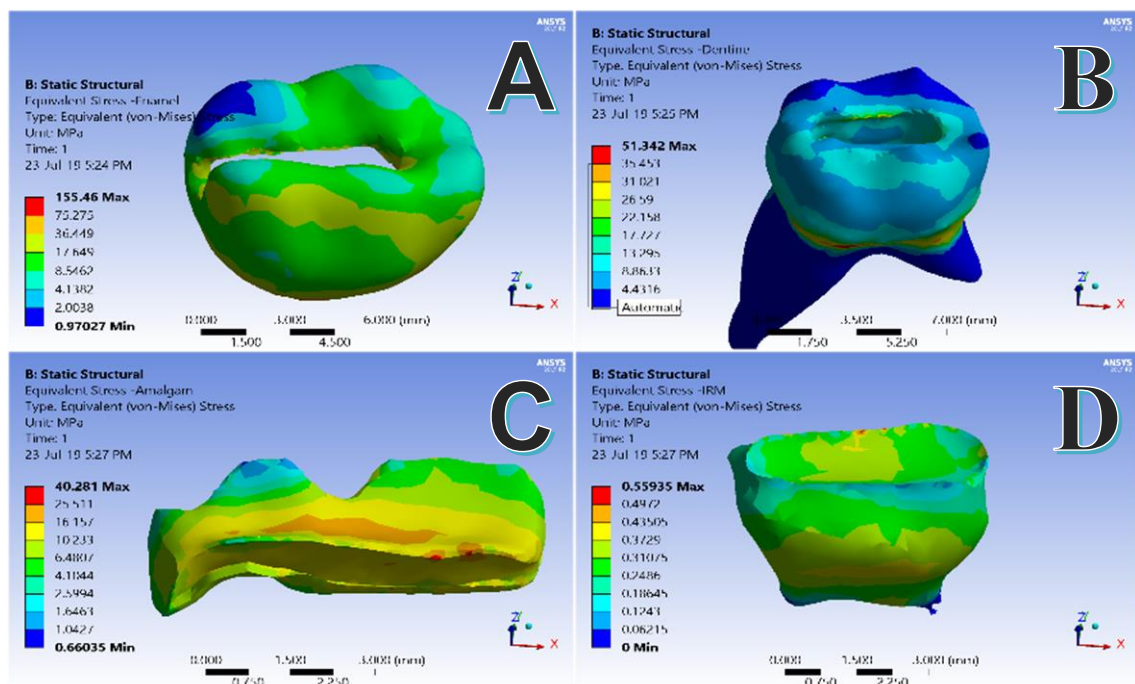


Figure 7: The von Mises Stress Pattern on Model I-B under Type I Lateral Force (A) Enamel (B) Dentin (C) Amalgam (D) IRM

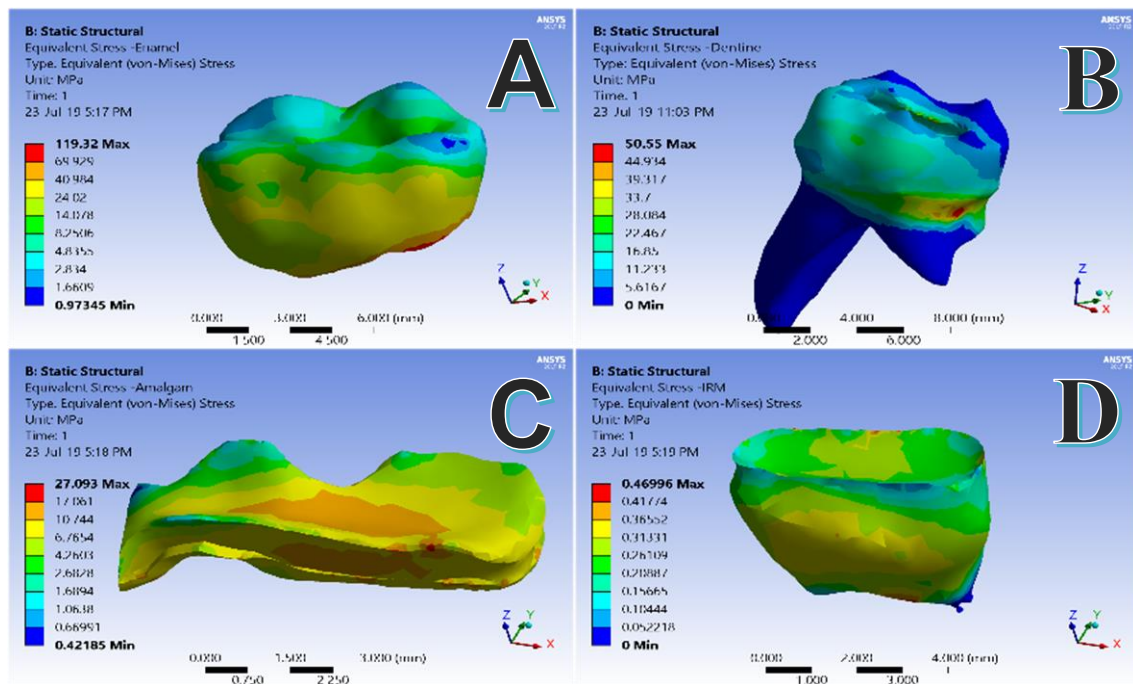


Figure 8: The von Mises Stress Pattern on Model I-B under Type II Lateral Force (A) Enamel (B) Dentin (C) Amalgam (D) IRM

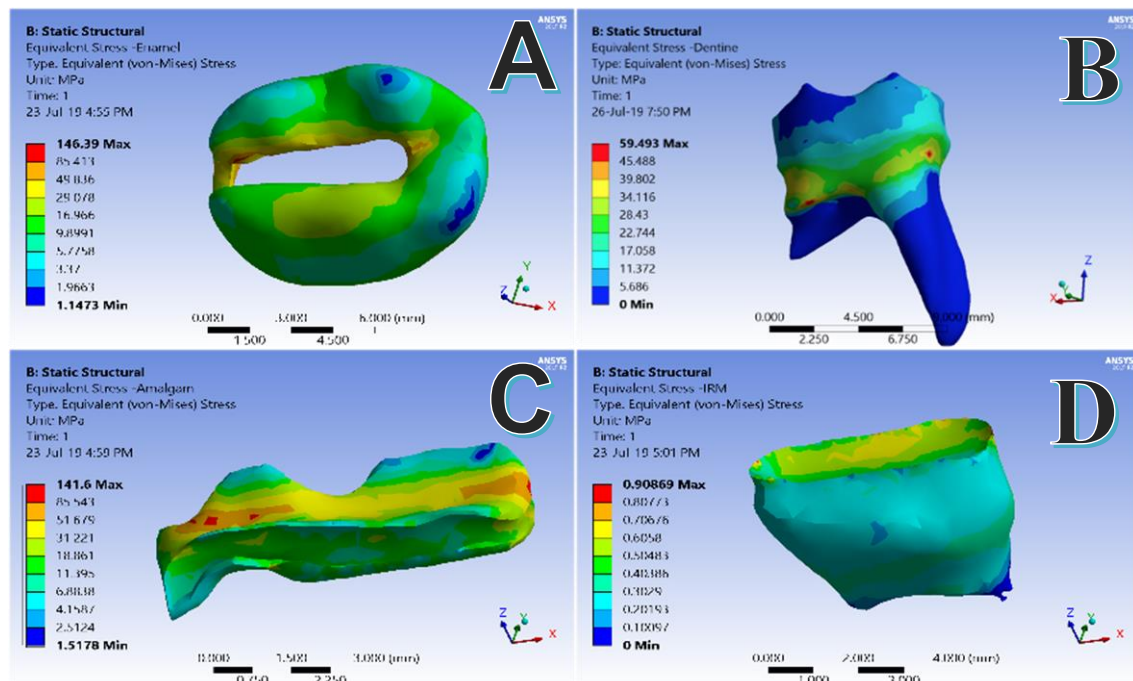


Figure 9: The von Mises Stress Pattern on Model I-B under Type III Lateral Force (A) Enamel (B) Dentin (C) Amalgam (D) IRM

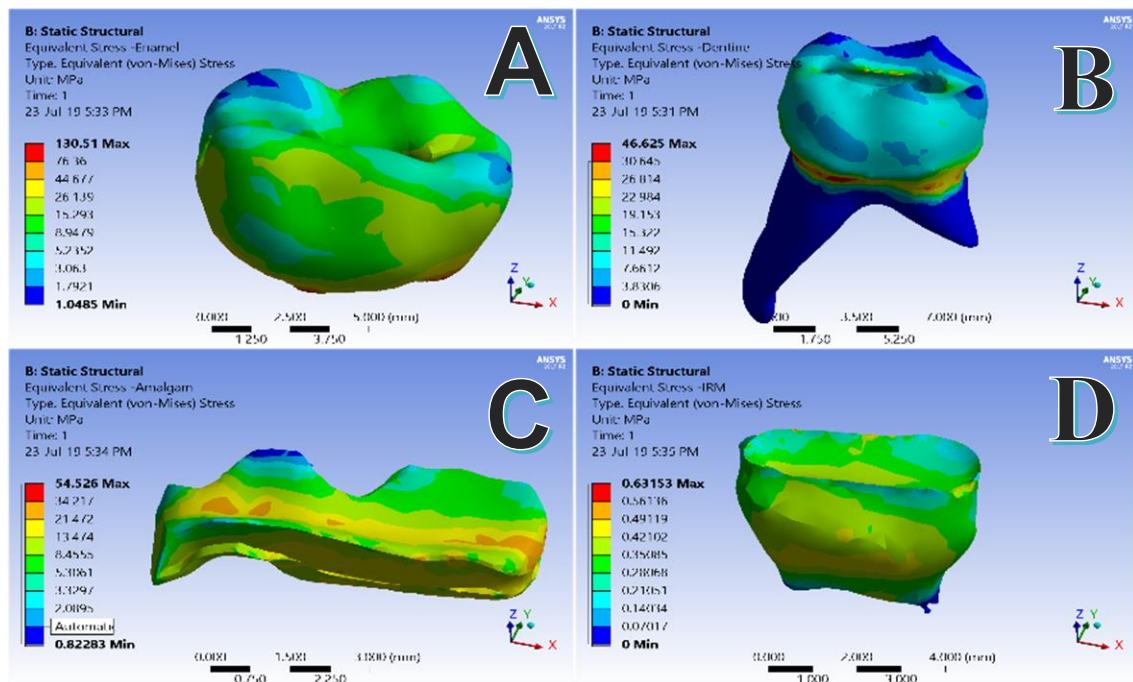


Figure 10: The von Mises Stress Pattern on Model I-B under Type IV Lateral Force (A) Enamel (B) Dentin (C) Amalgam (D) IRM

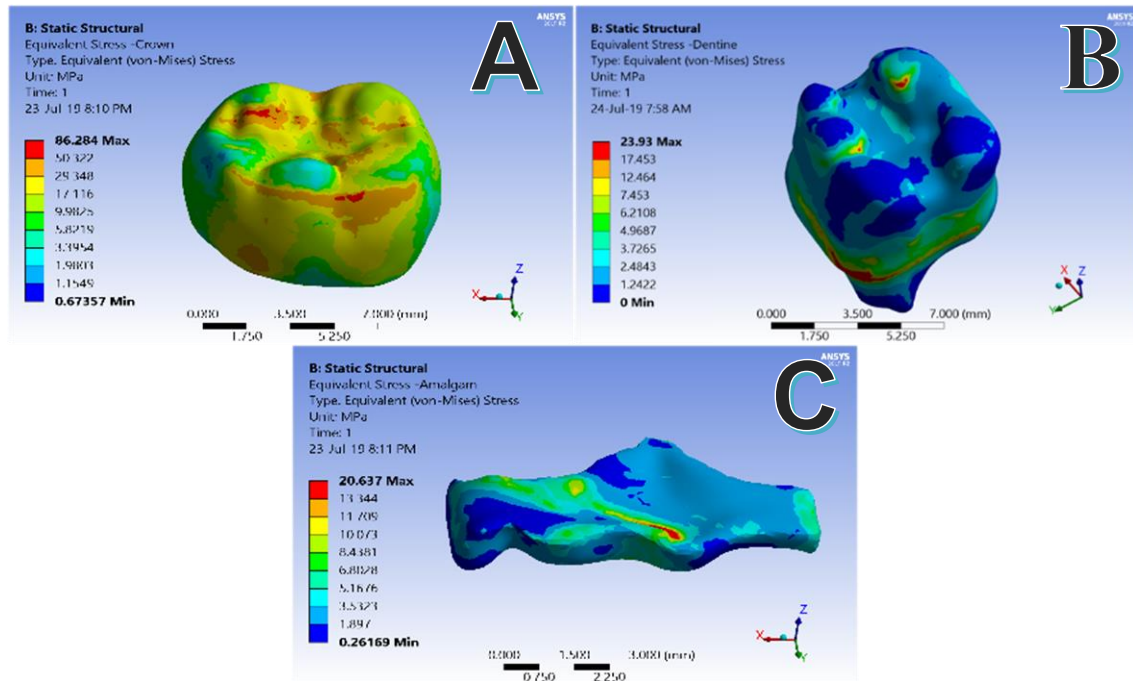


Figure 11: The von Mises Stress Pattern on Model II-A under Vertical Force (A) SSC (B) Dentin (C) Amalgam

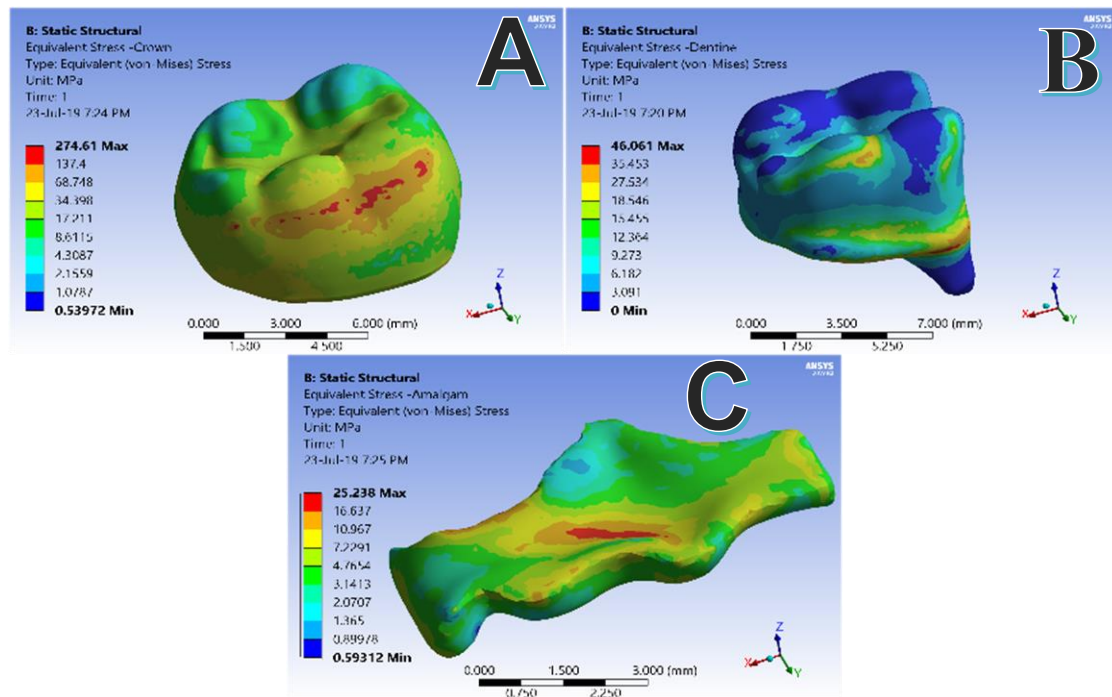


Figure 12: The von Mises Stress Pattern on Model II-A under Type I Lateral Force (A) SSC (B) Dentin (C) Amalgam

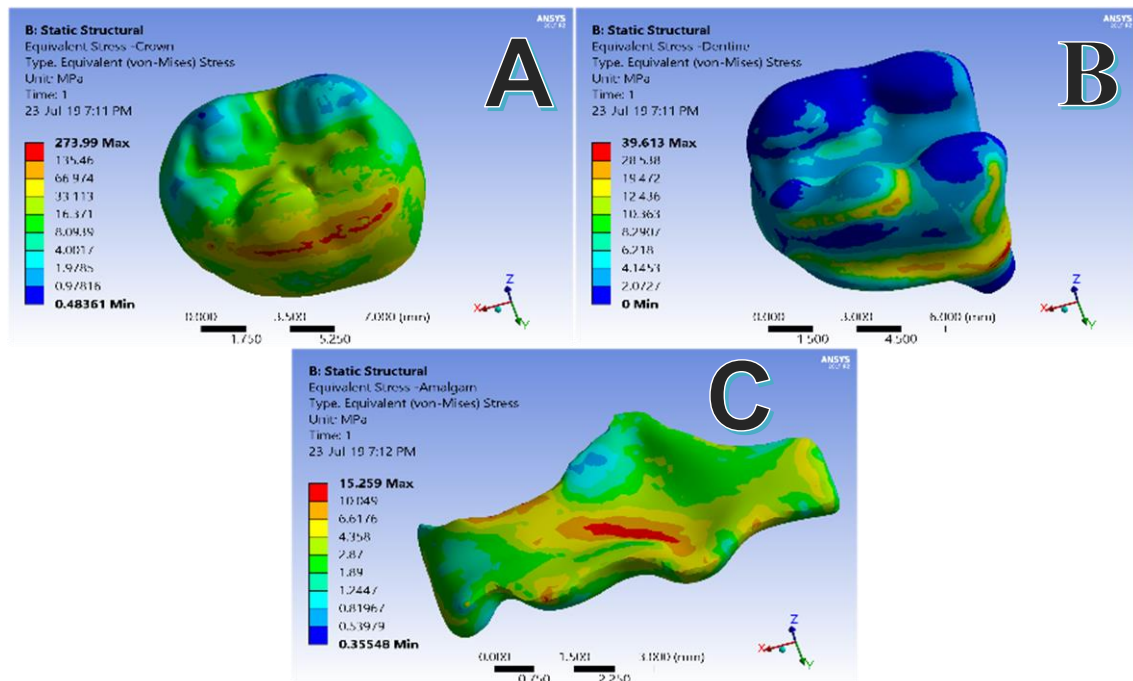


Figure 13: The von Mises Stress Pattern on Model II-A under Type II Lateral Force (A) SSC (B) Dentin (C) Amalgam

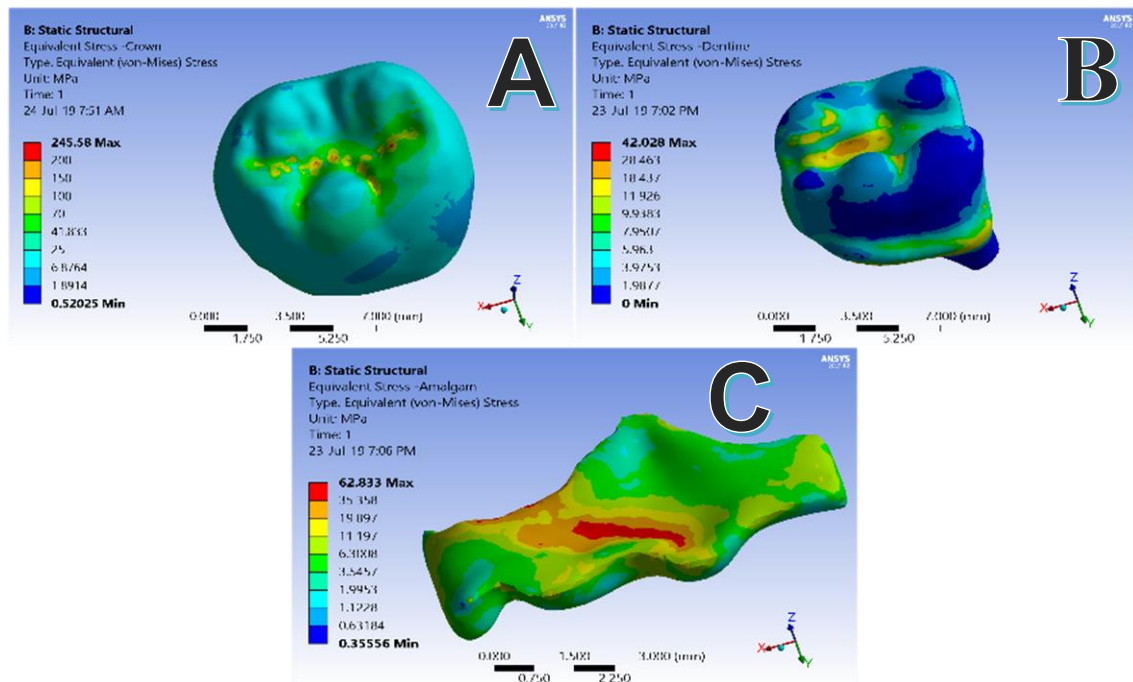


Figure 14: The von Mises Stress Pattern on Model II-A under Type III Lateral Force (A) SSC (B) Dentin (C) Amalgam

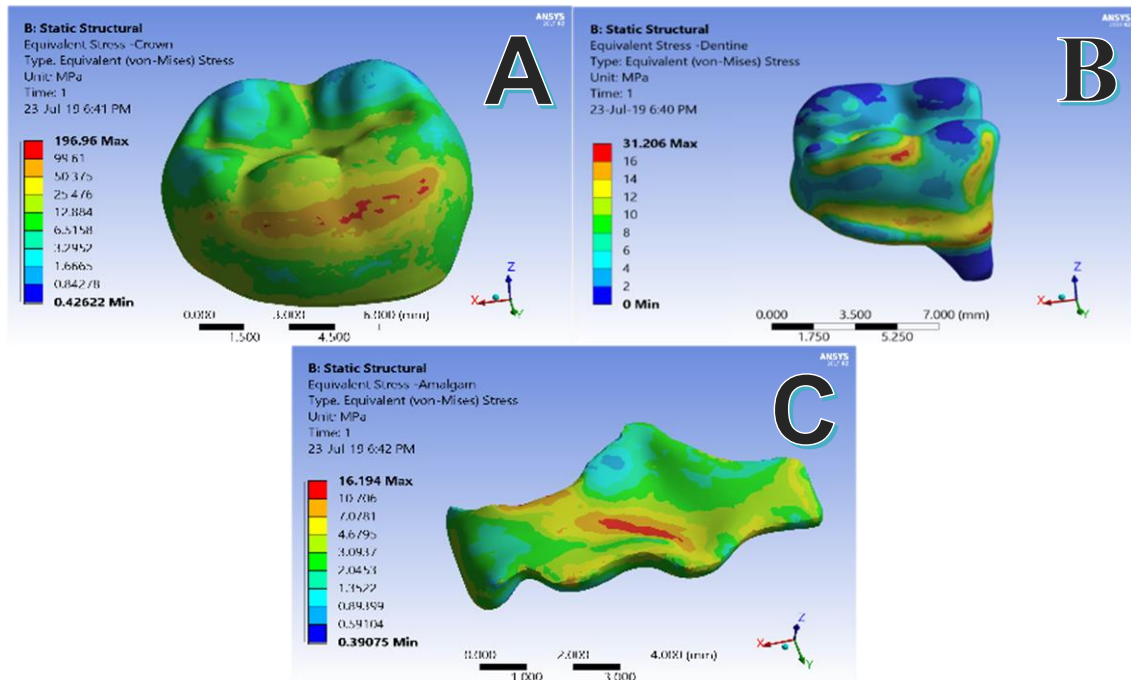


Figure 15: The von Mises Stress Pattern on Model II-A under Type IV Lateral Force (A) SSC (B) Dentin (C) Amalgam

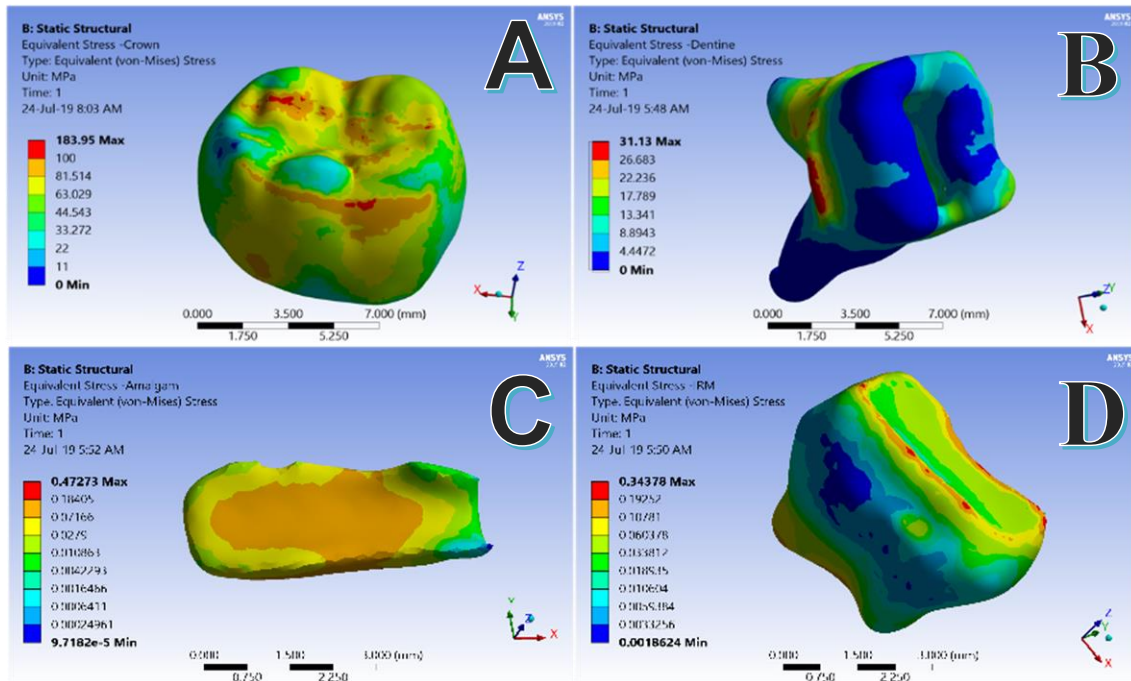


Figure 16: The von Mises Stress Pattern on Model II-B under Vertical Force (A) SSC (B) Dentin (C) Amalgam (D) IRM

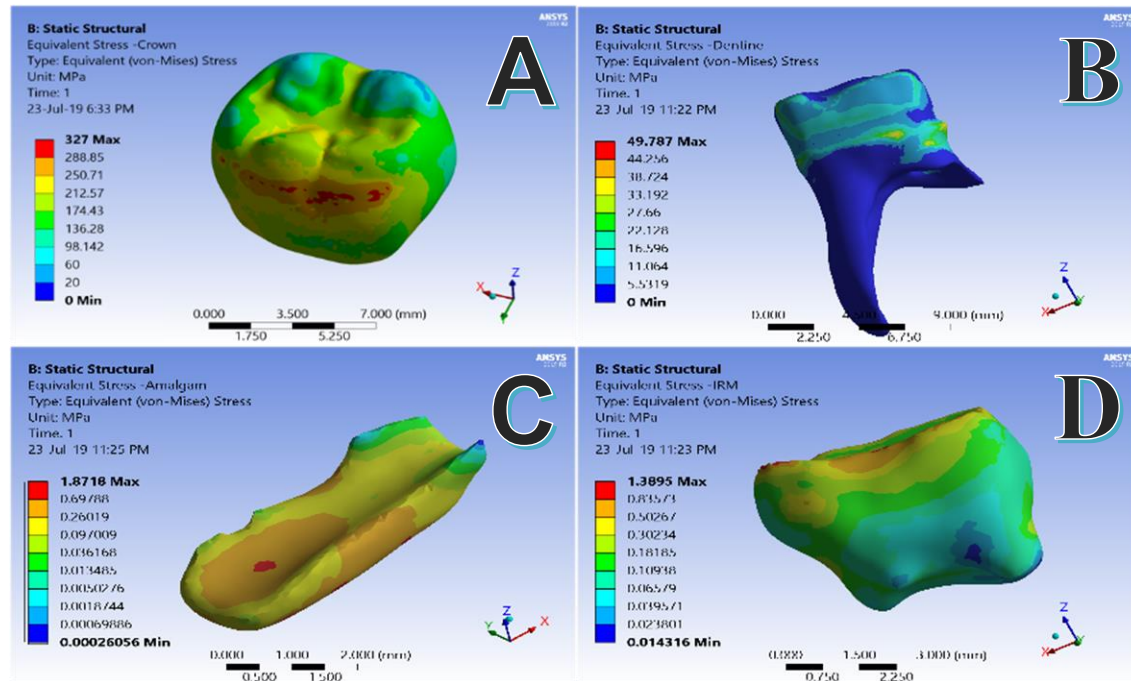


Figure 17: The von Mises Stress Pattern on Model II-B under Type I lateral Force (A) SSC (B) Dentin (C) Amalgam (D) IRM

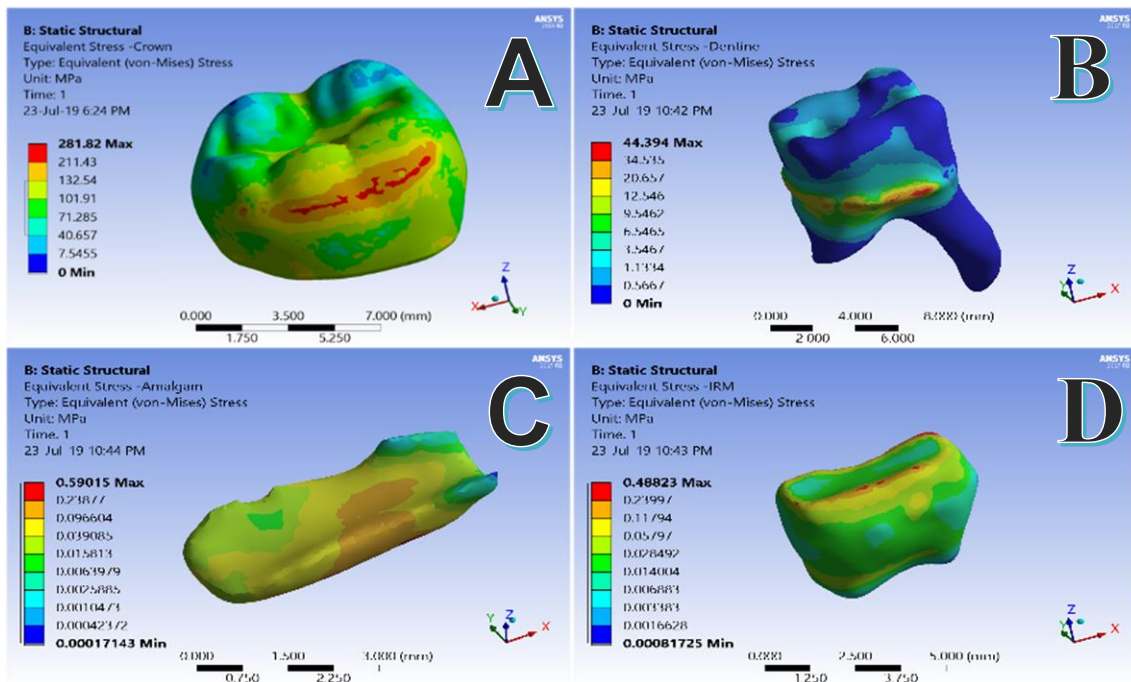


Figure 18: The von Mises Stress Pattern on Model II-B under Type II lateral Force (A) SSC (B) Dentin (C) Amalgam (D) IRM

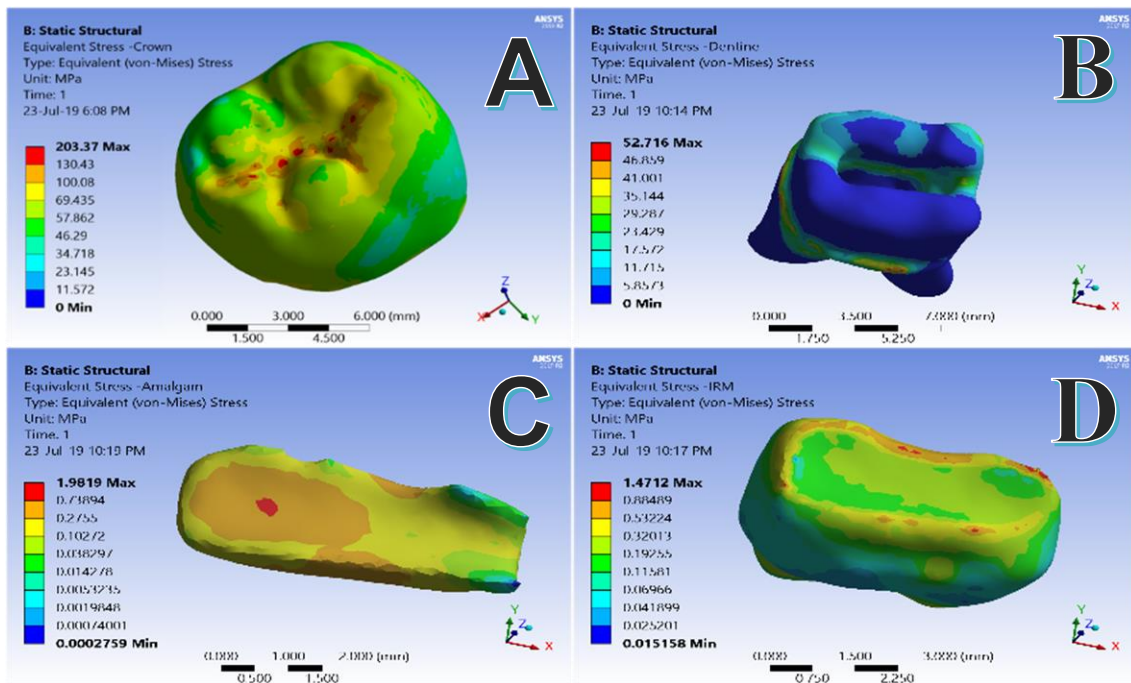


Figure 19: The von Mises Stress Pattern on Model II-B under Type III lateral Force (A) SSC (B) Dentin (C) Amalgam (D) IRM

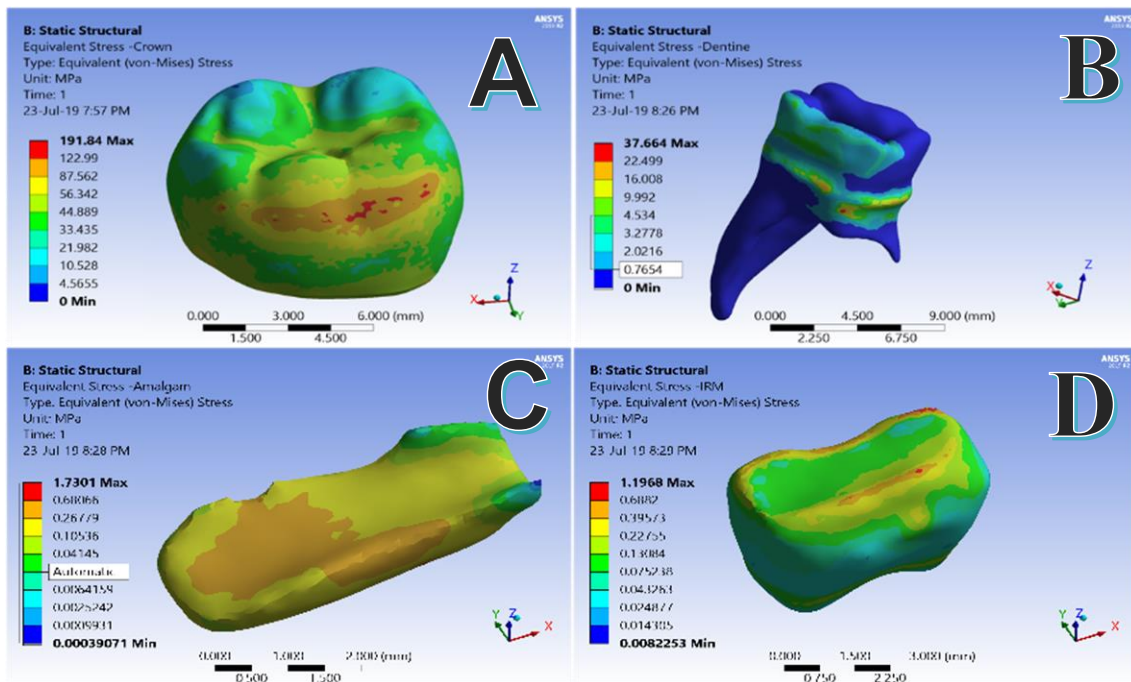


Figure 20: The von Mises Stress Pattern on Model II-B under Type IV lateral Force (A) SSC (B) Dentin (C) Amalgam (D) IRM

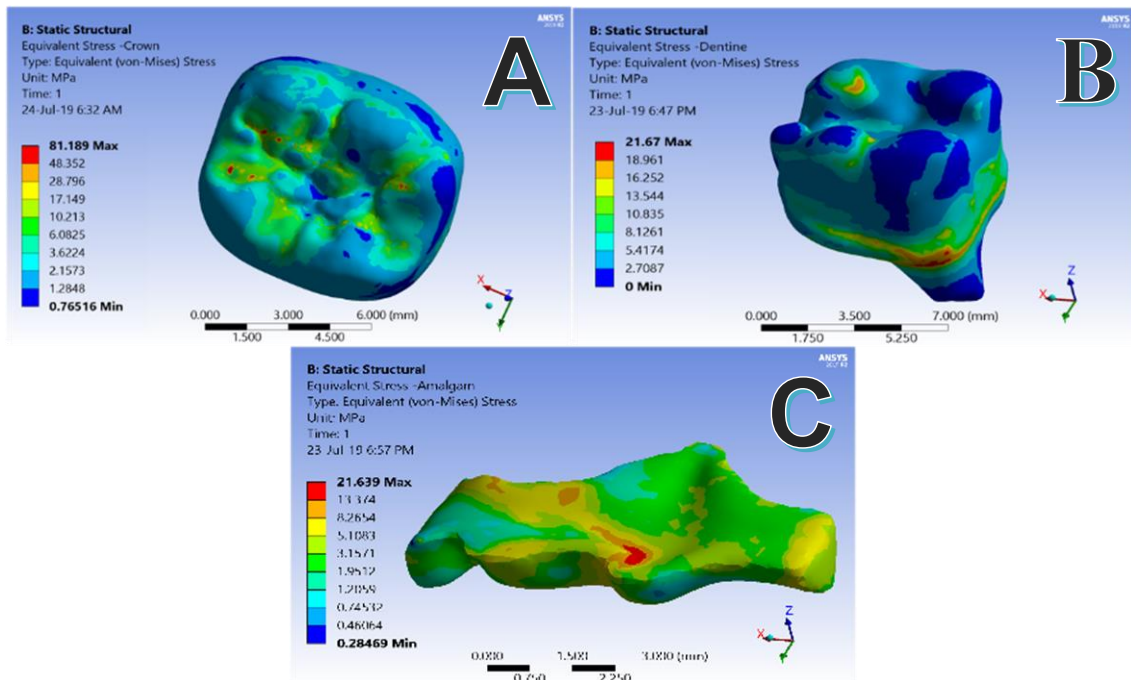


Figure 21: The von Mises Stress Pattern on Model III-A under Vertical Force (A) Zirconia crown (B) Dentin (C) Amalgam

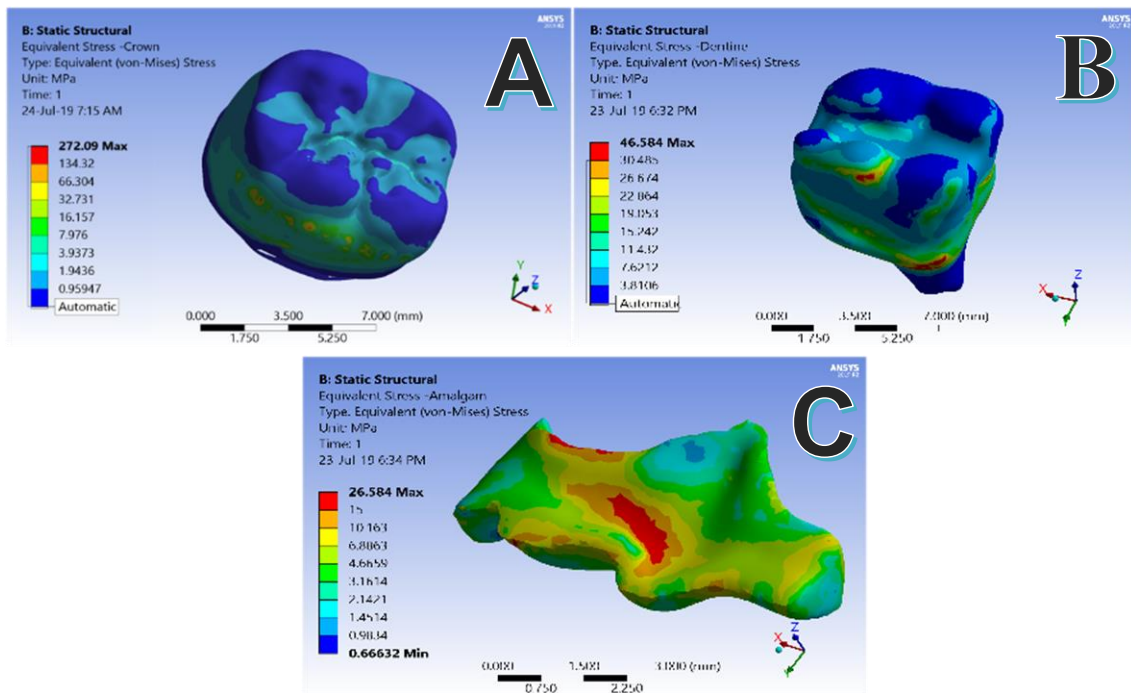


Figure 22: The von Mises Stress Pattern on Model III-A under Type I Lateral Force (A) Zirconia crown (B) Dentin (C) Amalgam

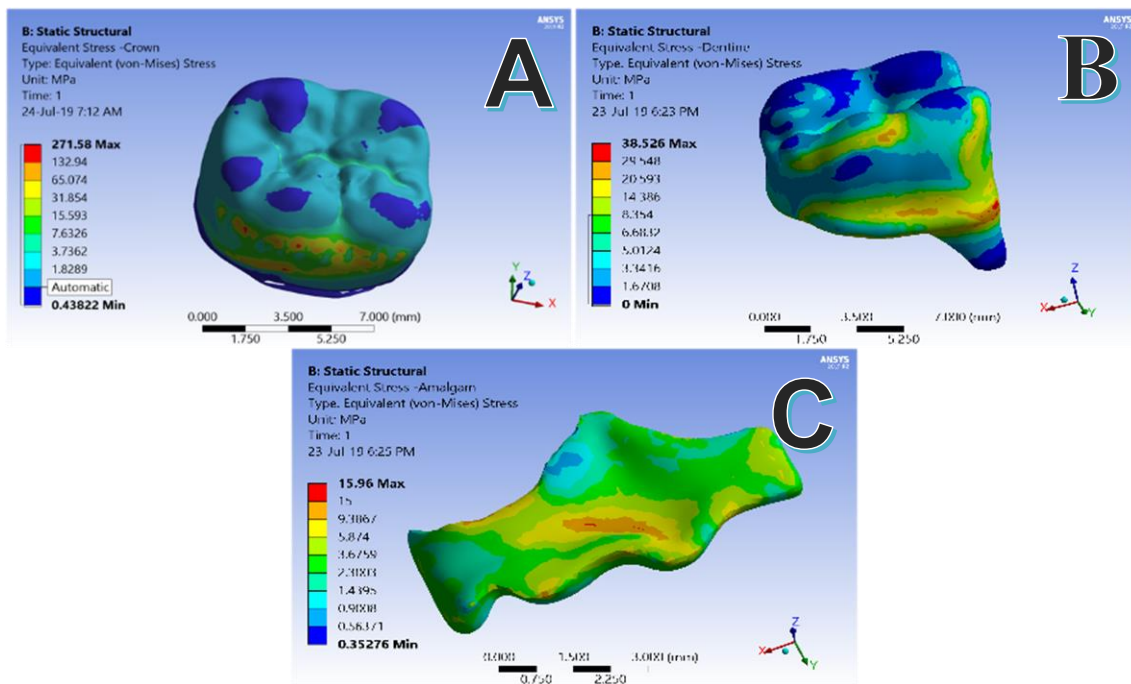


Figure 23: The von Mises Stress Pattern on Model III-A under Type II Lateral Force (A) Zirconia crown (B) Dentin (C) Amalgam

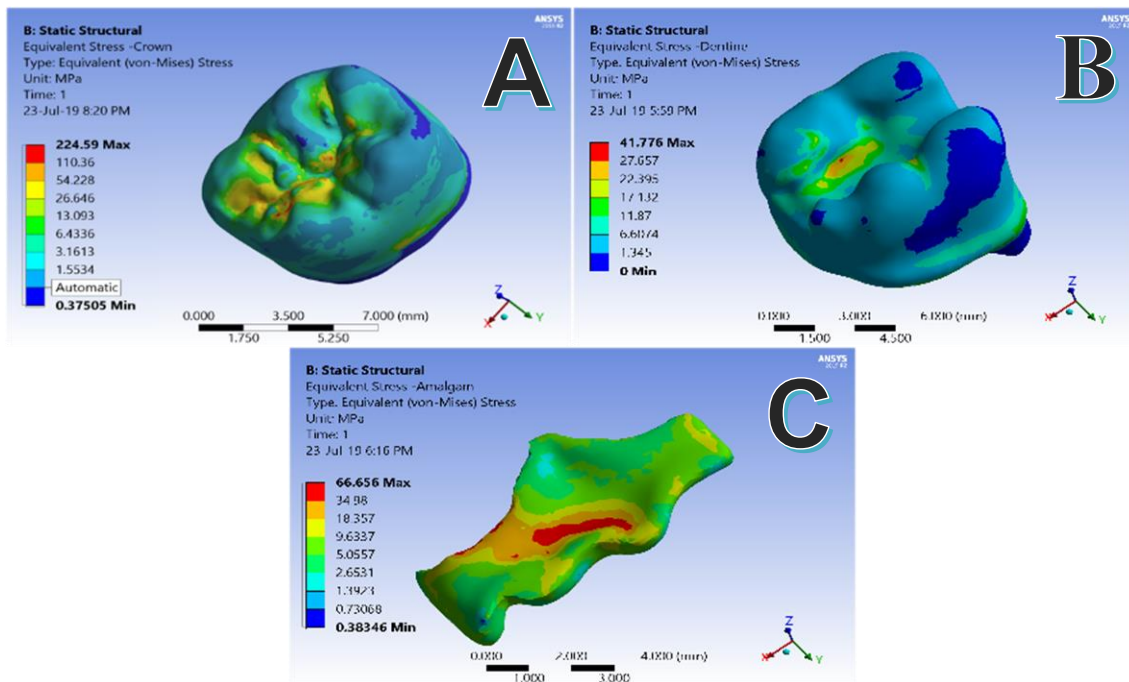


Figure 24: The von Mises Stress Pattern on Model III-A under Type III Lateral Force (A) Zirconia crown (B) Dentin (C) Amalgam

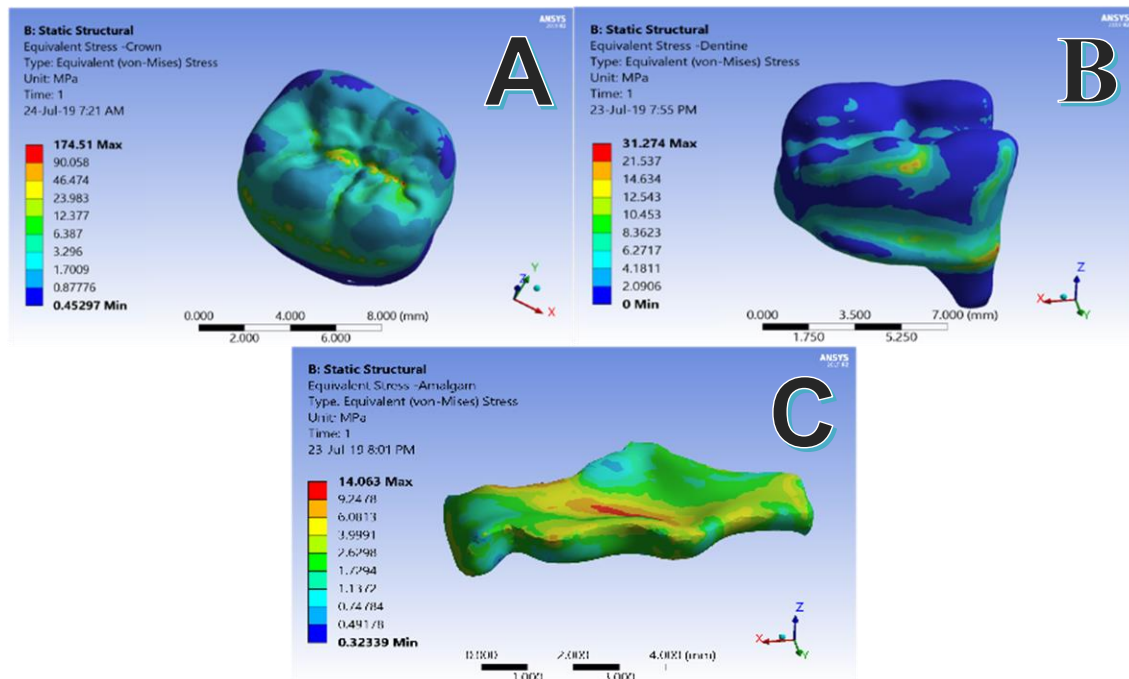


Figure 25: The von Mises Stress Pattern on Model III-A under Type IV Lateral Force (A) Zirconia crown (B) Dentin (C) Amalgam

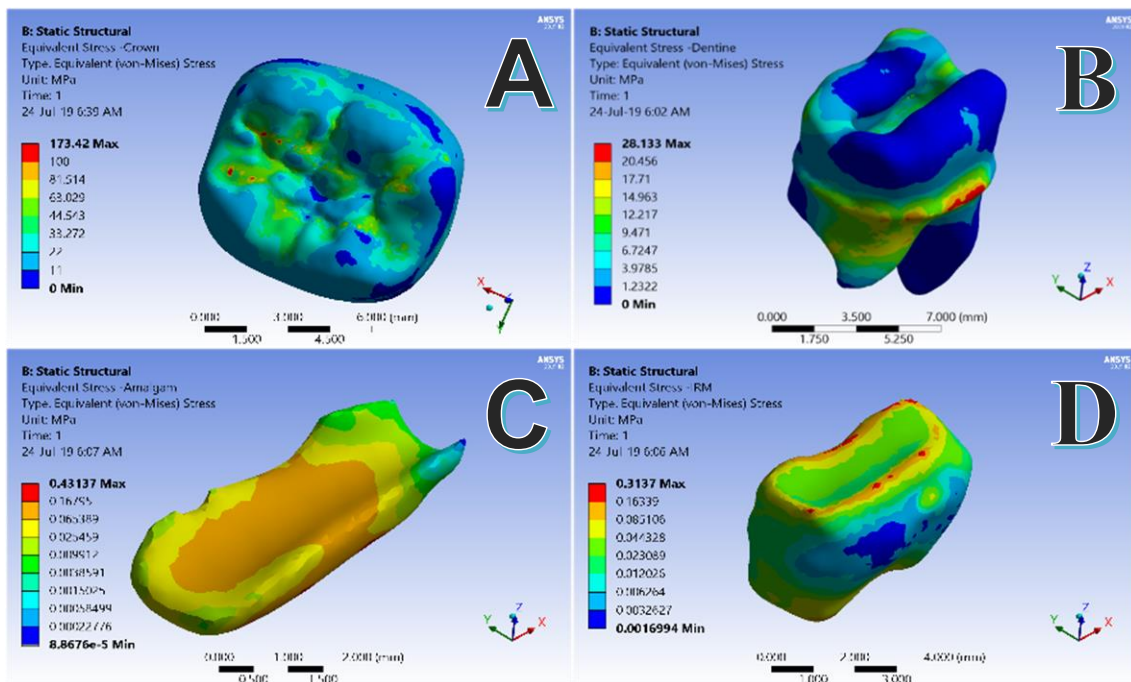


Figure 26: The von Mises Stress Pattern on Model III-B under Vertical Force (A) Zirconia crown (B) Dentin (C) Amalgam (D) IRM

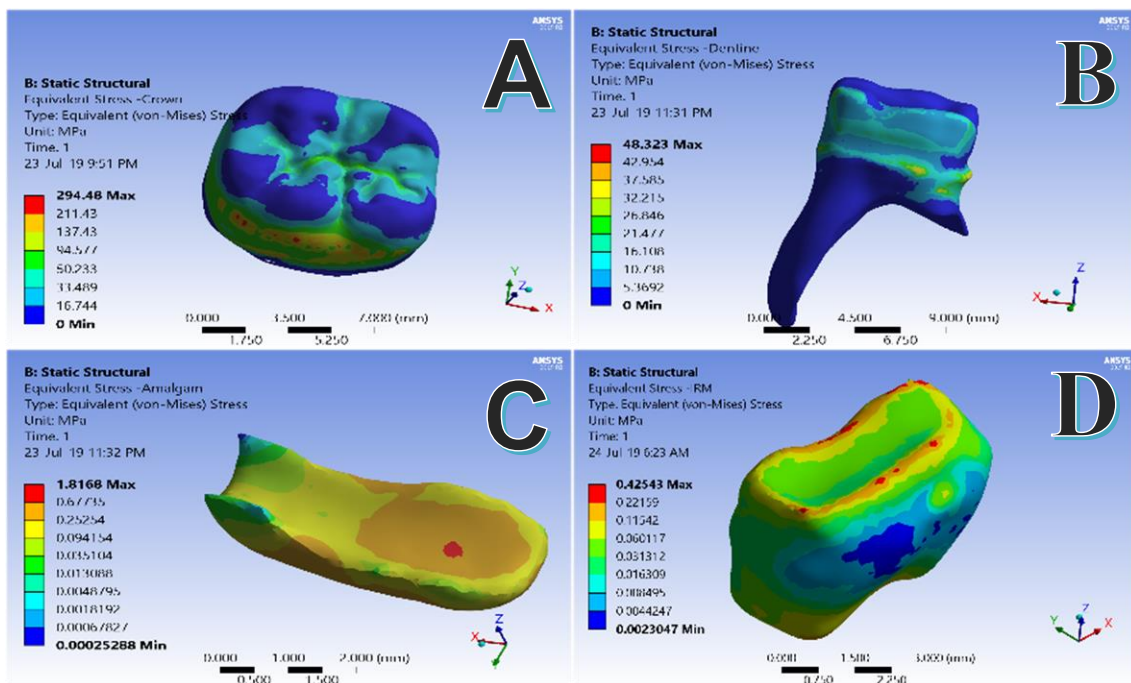


Figure 27: The von Mises Stress Pattern on Model III-B under Type I lateral Force (A) Zirconia crown (B) Dentin (C) Amalgam (D) IRM

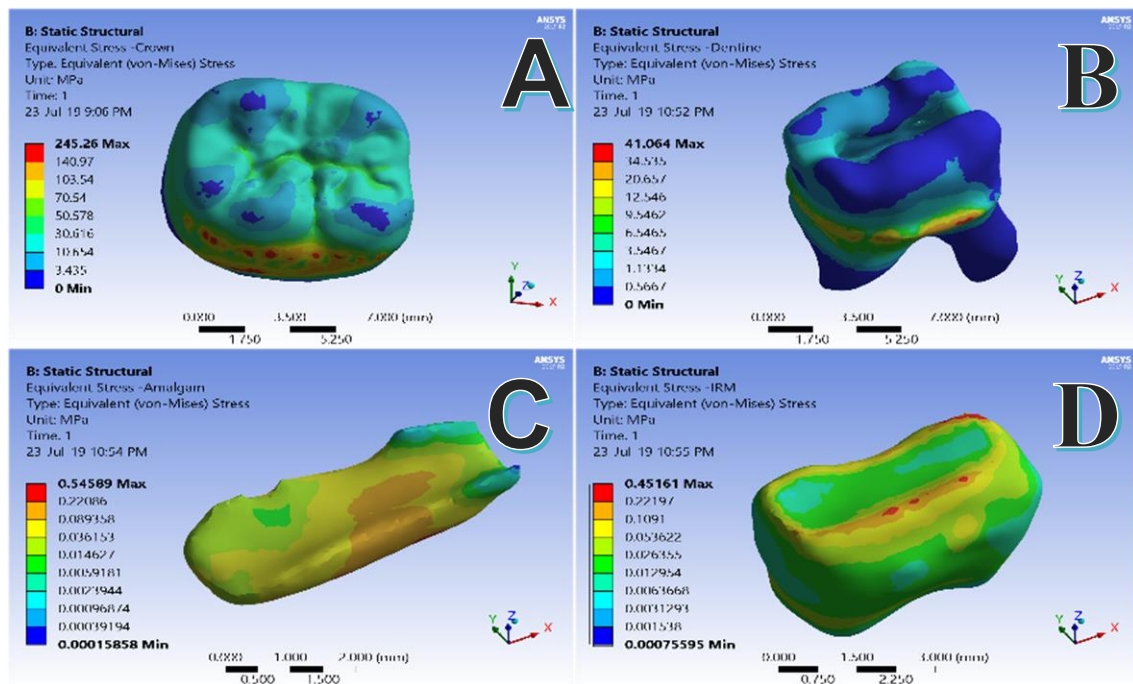


Figure 28: The von Mises Stress Pattern on Model III-B under Type II lateral Force (A) Zirconia crown (B) Dentin (C) Amalgam (D) IRM

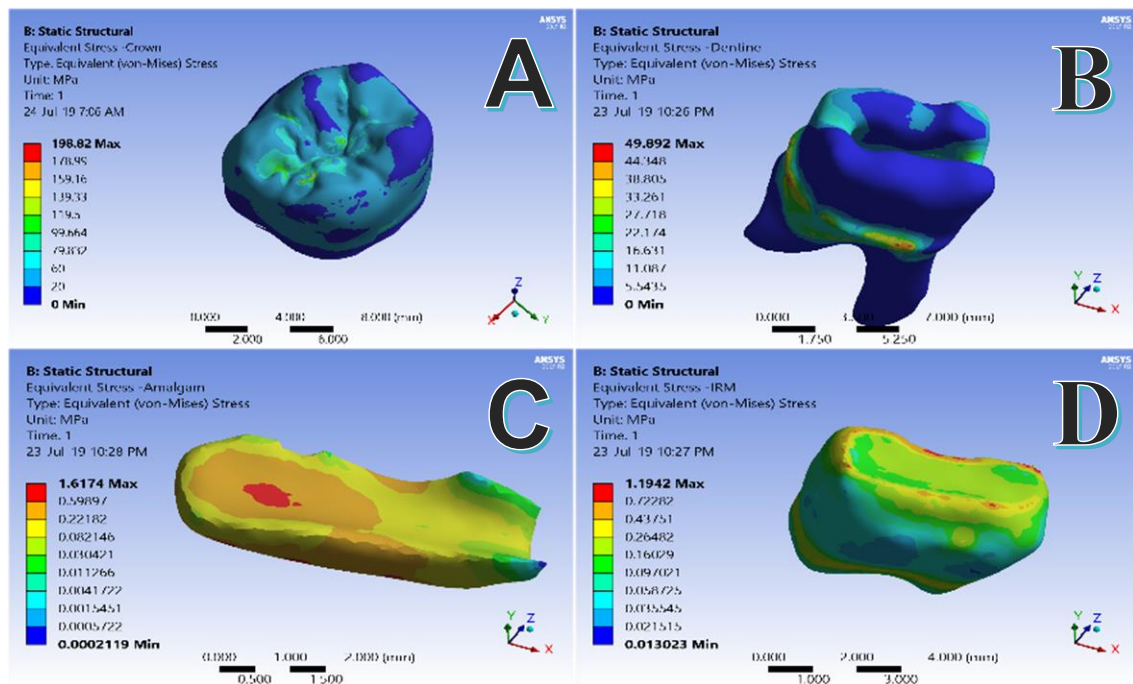


Figure 29: The von Mises Stress Pattern on Model III-B under Type III lateral Force (A) Zirconia crown (B) Dentin (C) Amalgam (D) IRM

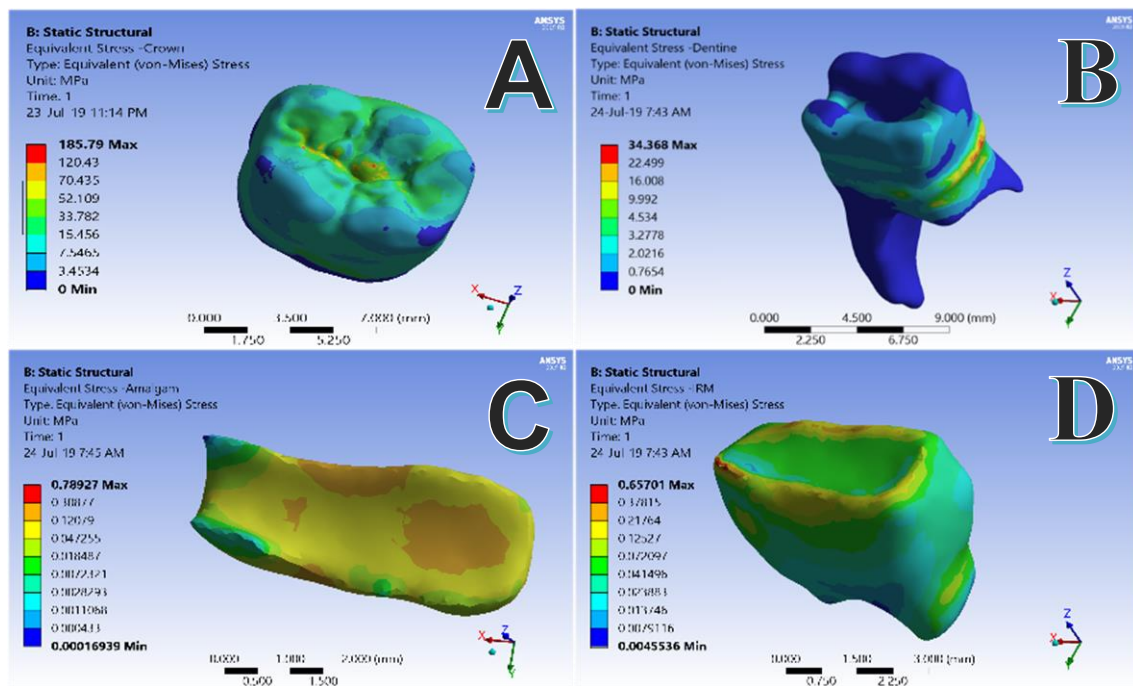


Figure 30: The von Mises Stress Pattern on Model III-B under Type IV lateral Force (A) Zirconia crown (B) Dentin (C) Amalgam (D) IRM