

INTRODUCTION

Computer-aided design and computer-aided manufacturing (CAD/CAM) has significantly evolved over the last few years, and it has become a very popular in daily clinical practice.¹⁻³ Manufacturers recently have developed different types of lithium disilicate, but there is very limited independent data available comparing them.

This study aimed to evaluate the fracture resistance of chairside CAD/CAM veneers for maxillary central incisor fabricated with the traditional two novel pre-crystallized and two novel fully-crystallized lithium disilicate ceramic materials.

- The first null hypothesis was that there is no difference in fracture resistance among the traditional lithium disilicate IPS e.max CAD and the four-novel lithium disilicate Amber Mill, Cerec Tessera, n!ce Straumann and GC Initial LiSi Block.
- The second null hypothesis was that there is no difference among the pre-crystallized (IPS e.max CAD, Amber Mill and Cerec Tessera) lithium disilicate and the fully crystallized (n!ce Straumann and GC Initial LiSi Block) ceramics.

METHODS

Seventy-five chairside CAD/CAM veneers (15 specimens/group) for maxillary right central incisors were fabricated with different lithium disilicate brands:

(1) IPS e.max CAD; (2) Amber Mill; (3) Cerec Tessera; (4) n!ce Straumann and (5) GC Initial LiSi Block.

The description of the ceramics used in this study can be found in Table 1.

Tooth preparations were scanned with a laboratory scanner (D1000, 3Shape) and a total of 60 tooth dies were 3D printed out of resin.

The pre-crystallized veneers were fired in a furnace in order to fully crystallize them, following their manufacturer's recommendations for firing schedules.

Restorations were cemented with resin luting cement (Variolink Esthetic, Ivoclar Vivadent) to 3D-printed resin dies. Bonded restorations received 10,000 thermal cycles between 5° and 55°C with a dwell time of 20 seconds. (Figure 1)

Then, the restorations were loaded until fracture. (Figure 2)

The fracture resistance force in Newtons was recorded and values from all specimens in each group were averaged.

The fractured specimens were analyzed with field emission scanning electron microscopy (SEM) images. Statistical analysis conducted in this study, included both ANOVA and independent samples t-tests.

RESULTS

The fracture resistance of chairside CAD/CAM veneer restorations for maxillary central incisor fabricated with different lithium disilicate is shown in Table 2. The type of lithium disilicate influenced the fracture strength for the veneer restoration. The fracture resistance values of the veneer restorations were significantly different ($p < 0.001$) based on the type of ceramic used.

Traditional pre-crystallized IPS e.max CAD displayed the highest fracture resistance value (640N), followed by fully-crystallized n!ce Straumann (547 N), pre-crystallized Cerec Tessera (503 N), pre-crystallized Amber Mill (476 N) and the lowest values by fully-crystallized GC Initial LiSi Block (431 N).

Group	State	Number of Specimens	Fracture Force in N
1	Pre-crystallized	15	640 ± (109.8) ^a
2	Pre-crystallized	15	476 ± (123.8) ^b
3	Pre-crystallized	15	503 ± (80.0) ^b
4	Fully-crystallized	15	547 ± (131.1) ^{a,b}
5	Fully-crystallized	15	431 ± (130.4) ^b

Values in parenthesis are standard deviations. Similar letters mean no significant differences.

Table 2. Fracture resistance results.

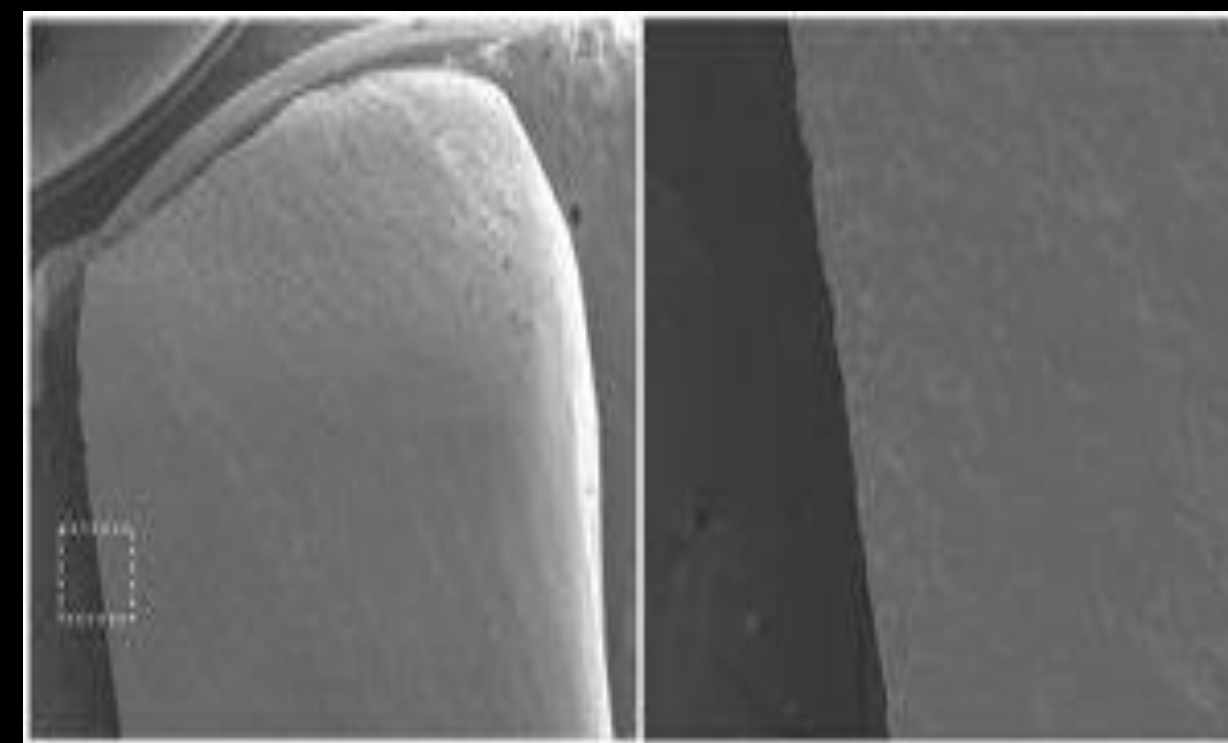


Figure 4. Group 2

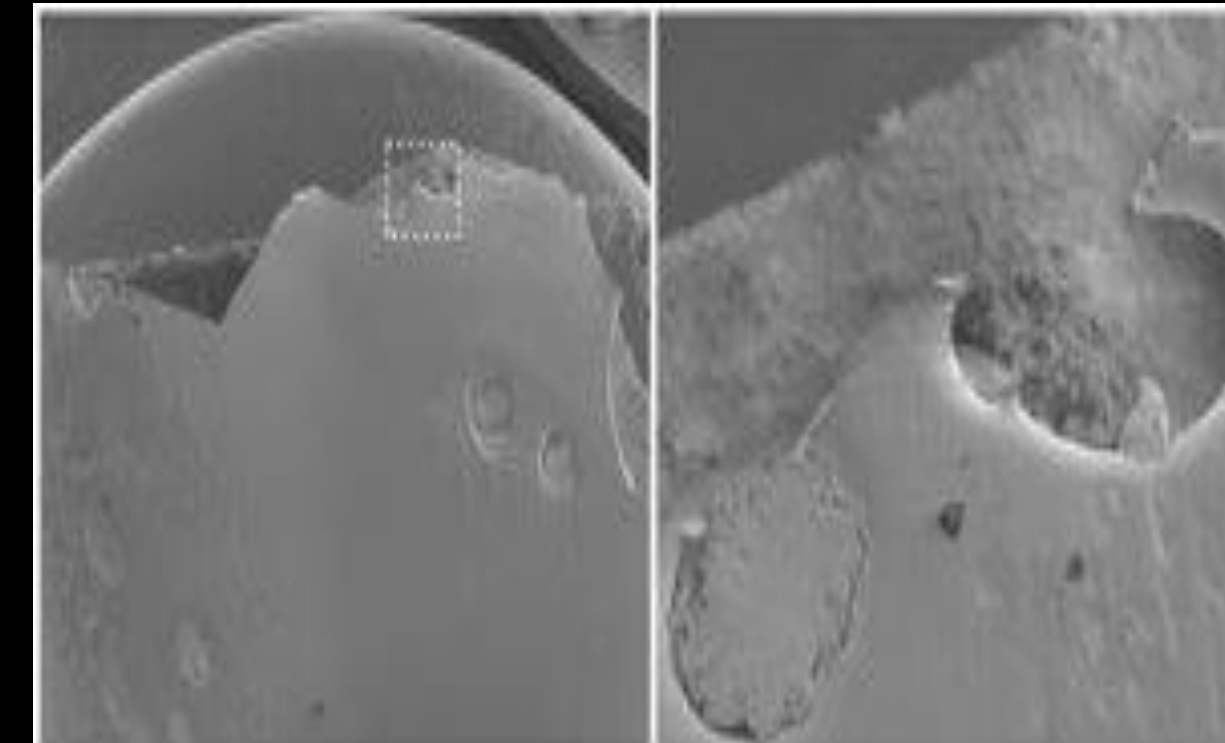


Figure 5. Group 3

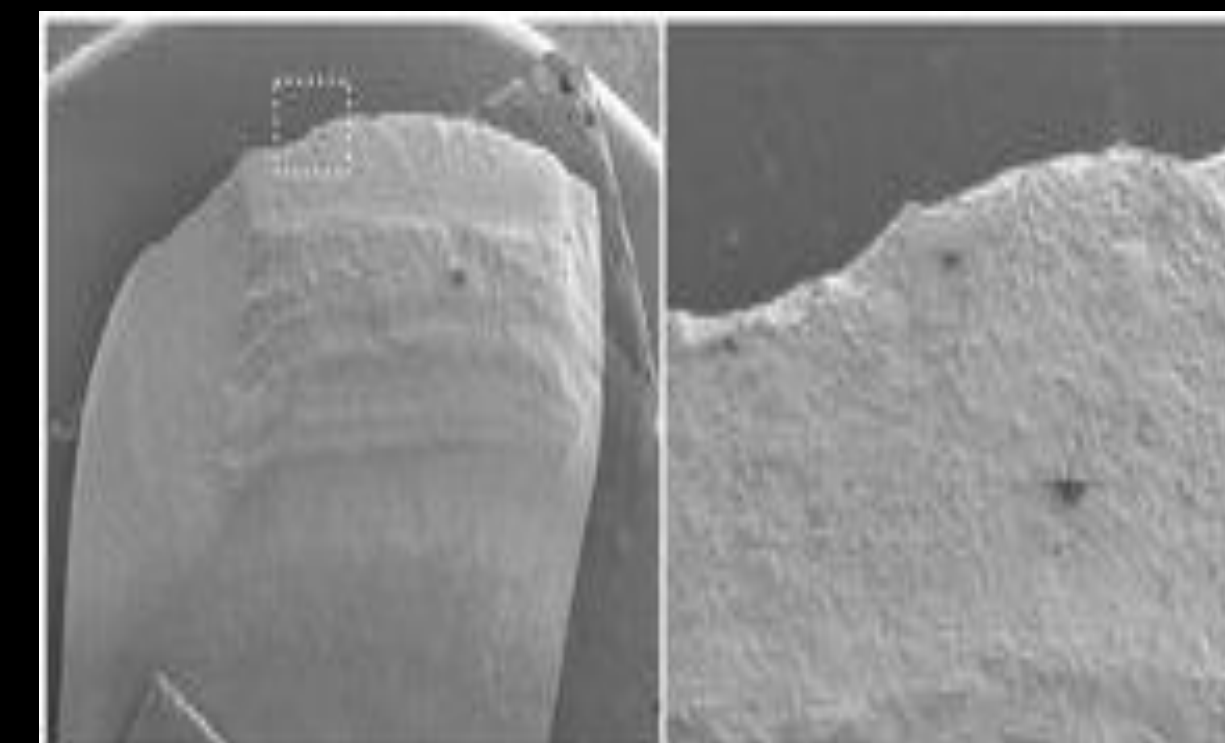


Figure 6. Group 4

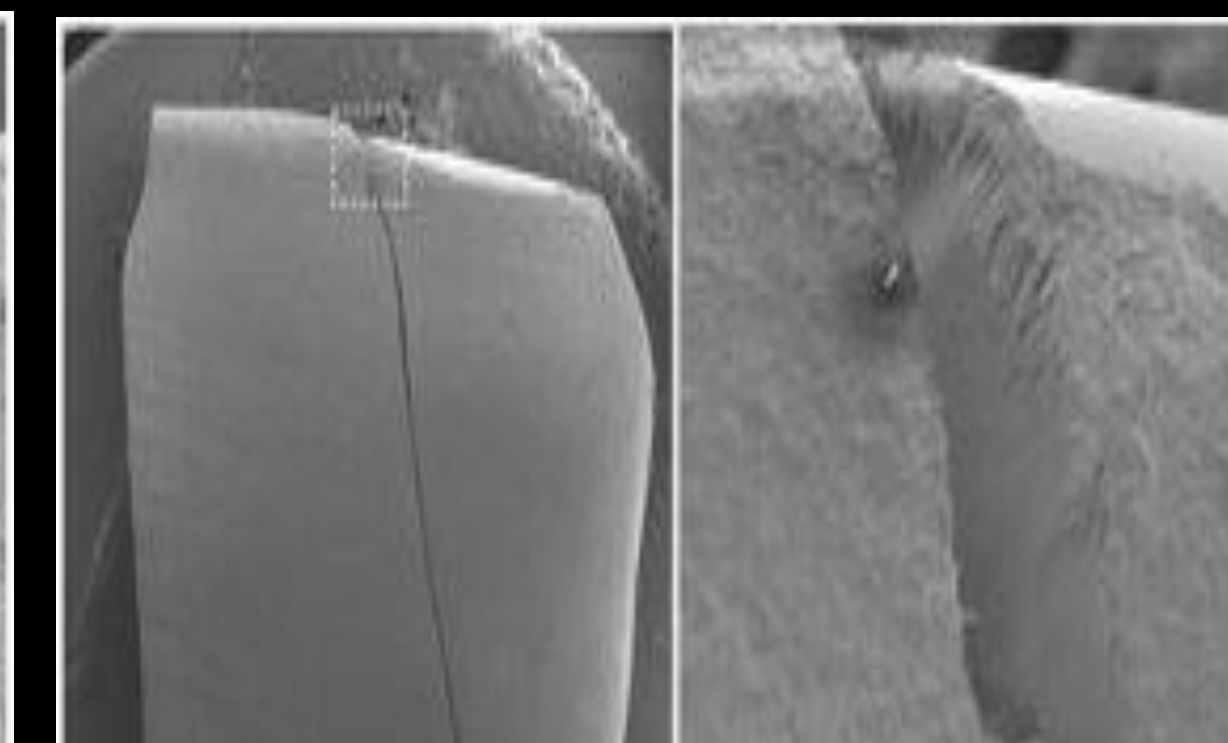


Figure 7. Group 5

Figures 3-7: Representative SEM images of fractured chairside CAD/CAM veneers fabricated with 20x and 100x magnification.

When comparing the fracture resistance of novel Lithium Disilicate ceramic material to the IPS e.max CAD group, which acted as the control, significant differences were noted.

These findings imply that the clinical performance of novel lithium disilicate veneers varied when compared to the e.max CAD group.

Representative SEM images of the fractured samples are shown in Figures 3-7. The fractured surfaces were evaluated from a fractographic point of view. It should be noted that the different locations of the cracks in the restoration can differentiate between specimens. (IPS e.max CAD) displayed defined and irregular crack lines; (Amber Mill) showed clear, clean and smooth crack lines, (Cerec Tessera) exhibited very irregular crack and sharp lines and caused some porosities; (n!ce Straumann) also demonstrated clear and clean cracks, except for the start of the crack, which presented some irregularities; (GC Initial LiSi Bloc) demonstrated irregular and rough crack lines.

CONCLUSIONS

The fracture resistance of chairside CAD/CAM lithium disilicate veneers fabricated with traditional and novel ceramics varied according to the brand selected.

Newly developed materials do not necessarily have higher fracture resistance that traditionally developed materials. Ultimately, traditional chairside CAD/CAM lithium disilicate material for veneer restorations displayed higher fractured resistance than novel pre-crystallized and fully-crystallized ceramics.

REFERENCES

- Suganna M, Kausher H, Tarek Ahmed S, Sultan Alharbi H, Faraj Alsubaie B, Ds A, Haleem S, Meer Rownaq Ali AB. Contemporary Evidence of CAD-CAM in Dentistry: A Systematic Review. Cureus. 2022 Nov 20;14(11):e31687. doi: 10.7759/cureus.31687. PMID: 36561580; PMCID: PMC9767654
- Marchesi G, Camurri Piloni A, Nicolin V, Turco G, Di Lenarda R. Chairside CAD/CAM Materials: Current Trends of Clinical Uses. Biology (Basel). 2021 Nov 12;10(11):1170. doi: 10.3390/biology10111170.

Group	State	Components
1	Pre-crystallized	57–80% SiO ₂ ; 11–19% Li ₂ O; 0–13% K ₂ O; 0–11% P ₂ O ₅ ; 0–8% ZrO ₂ , 0–8% ZnO; 0–12% others oxides
2	Pre-crystallized	<78% SiO ₂ , <12% Li ₂ O, <12% coloring oxides:
3	Pre-crystallized	90% Li ₂ Si ₂ O ₅ , 5% Li ₃ PO ₄ , 5% Li _{0.5} Al _{0.5} Si _{2.5} O ₆ (virgilite)
4	Fully-crystallized	64–70% SiO ₂ ; 10.5–12.5% Li ₂ O; 0–3% K ₂ O; 3–8% P ₂ O ₅ ; 0–0.5% ZrO ₂ ; 10.5–11.5% Al ₂ O ₃ ; 1–2% CaO; 0–9% pigments; 1–3% Na ₂ O.
5	Fully-crystallized	55–80% SiO ₂ , 10–30% Li ₂ O; 5–20% other oxides.

Table 1. Description of ceramics used in this study.

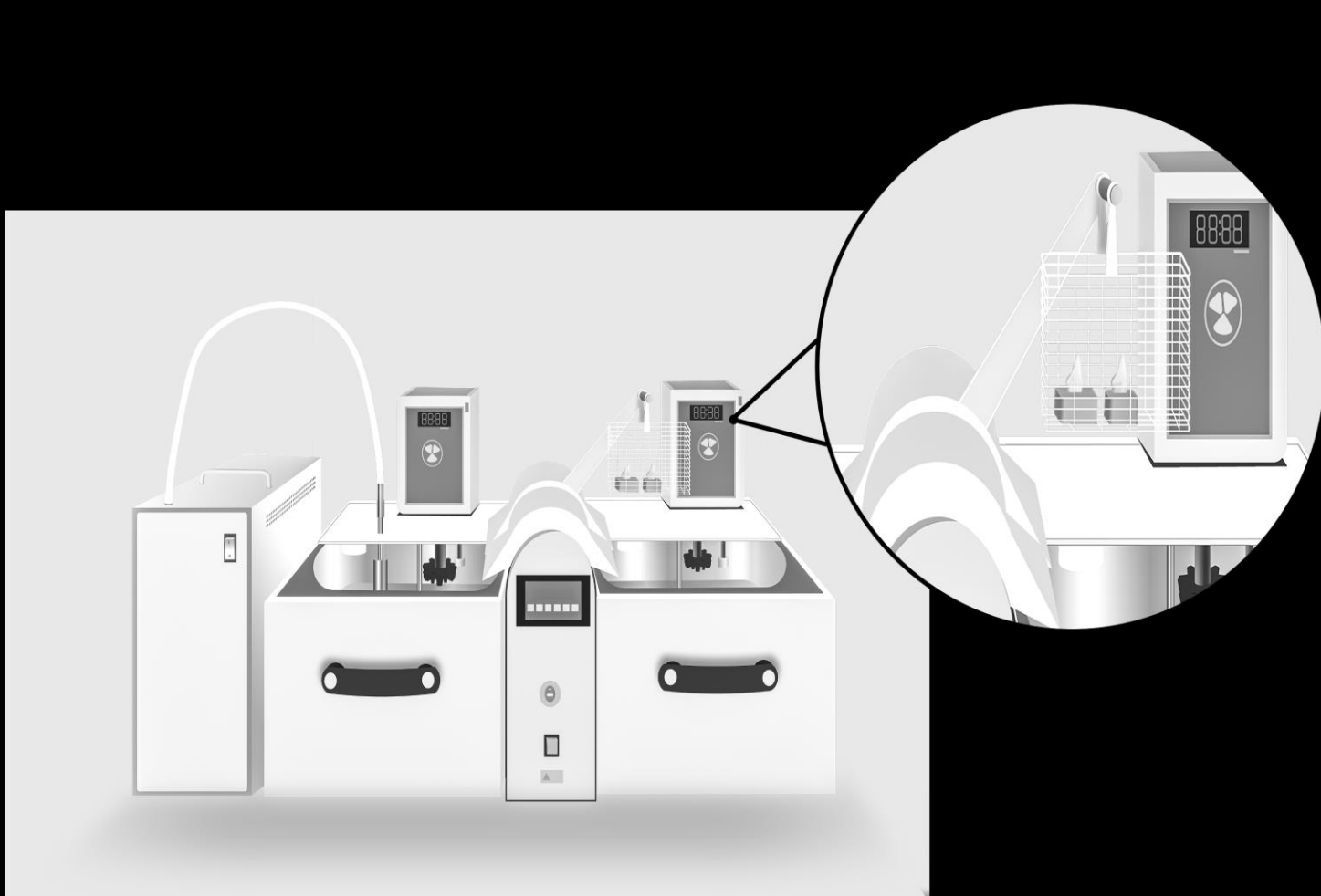


Figure 1. Thermocycling.

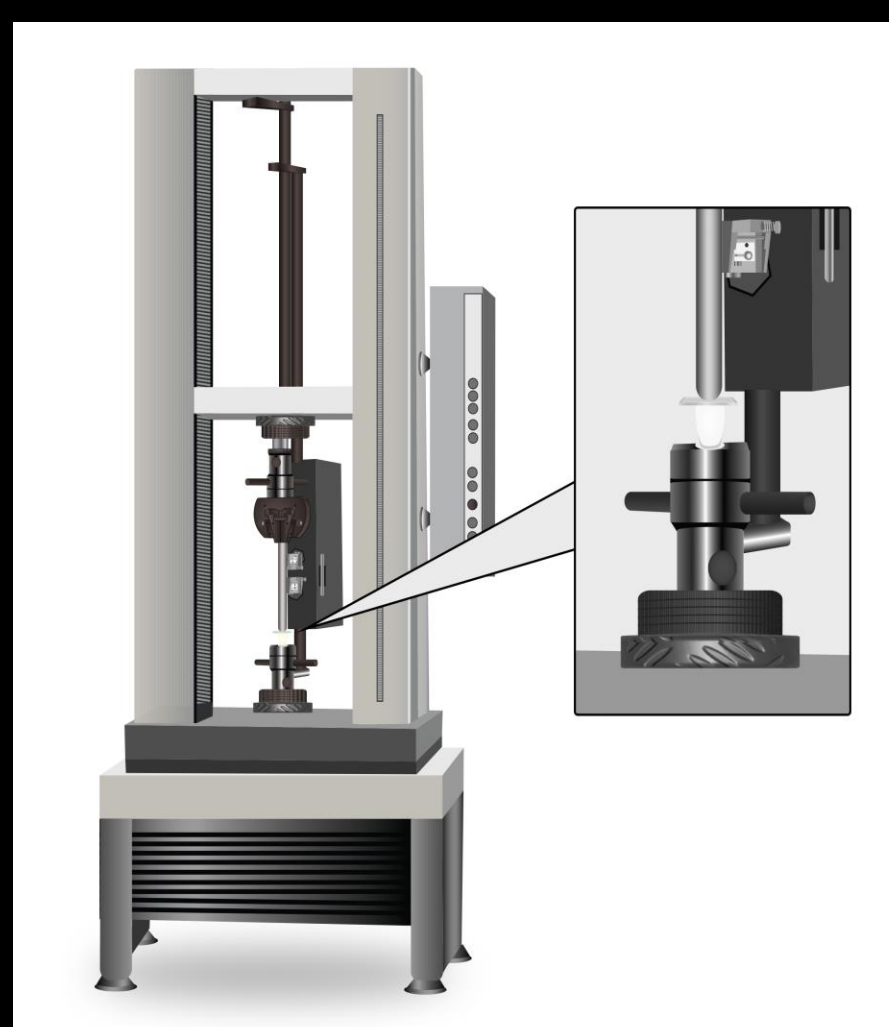


Figure 2. Fracture Testing.