

## Effect Of Two Different Finish Line Designs On The Internal Fit Of Newer Translucent Zirconia And CAD Metal Ceramic Crowns- A Systematic Review

Dr Zainab Inayatullah, Dr Punit RS Khurana, Dr Anju Aggarwal,  
Dr Aditya Chaudhary, Dr Kartika N. Kumar, Dr Naila Perween

*Final Year Resident, Department Of Prosthodontics, Crown And Bridge, Oral Implantology And Maxillofacial Prosthodontics1*

*Professor & HOD, Department Of Prosthodontics, Crown And Bridge, Oral Implantology And Maxillofacial Prosthodontics2*

*Professor, Department Of Prosthodontics, Crown And Bridge, Oral Implantology And Maxillofacial Prosthodontics3*

*Professor, Department Of Prosthodontics, Crown And Bridge, Oral Implantology And Maxillofacial Prosthodontics4*

*Professor, Department Of Prosthodontics, Crown And Bridge, Oral Implantology And Maxillofacial Prosthodontics5*

*Reader, Department Of Prosthodontics, Crown And Bridge, Oral Implantology And Maxillofacial Prosthodontics6*

---

### **Abstract:**

#### **Purpose:**

The internal fit of crowns plays a vital role in the clinical success and longevity of dental restorations. This systematic review aimed to evaluate and compare the effect of shoulder and chamfer finish line designs on the internal fit of newer translucent zirconia crowns and CAD metal-ceramic crowns.

#### **Materials and Methods:**

An electronic search was conducted in PubMed, EBSCO, Google Scholar, and ProQuest databases for English-language studies published between 2012 and 2024. The search strategy included terms such as "finish lines," "shoulder vs chamfer," "zirconia," "CAD metal-ceramic crowns," and "internal fit." Only clinical or in vitro studies assessing the effect of shoulder and chamfer finish lines on marginal or internal fit were included. A total of 20 studies met the inclusion criteria. Data extraction focused on study type, population, crown material, finish line design, outcome measures, and conclusions.

#### **Results:**

The included studies encompassed in vitro experiments, systematic reviews, and meta-analyses. Internal fit values varied across materials and techniques, with reported gaps ranging from 89.76  $\mu\text{m}$  for metal-ceramic crowns to 158.27  $\mu\text{m}$  for In-Ceram Alumina crowns (Martins et al., 2012). Several studies found chamfer finish lines to favor internal adaptation, whereas shoulder finish lines provided better marginal adaptation (Yu et al., 2018; Ahmad et al., 2019). Some evidence indicated deep chamfer designs demonstrated superior adaptation compared to conventional chamfer or shoulder (Shah et al., 2020; Al Maaz et al., 2019). Overall, both designs produced clinically acceptable marginal and internal gaps ( $<120 \mu\text{m}$ ), though no consensus exists on the superior finish line.

#### **Conclusion:**

Both chamfer and shoulder finish lines yield clinically acceptable internal fit in zirconia and CAD metal-ceramic crowns. Chamfer designs are more conservative and enhance internal adaptation, while shoulder margins improve marginal accuracy. The choice of finish line should therefore be guided by clinical requirements, tooth condition, and restorative material. Further well-designed clinical trials are warranted to validate these findings.

**Keywords:** Zirconia crowns, CAD metal-ceramic crowns, finish lines, shoulder, chamfer, internal fit, marginal adaptation

---

Date of Submission: 05-09-2025

Date of Acceptance: 15-09-2025

---

## **I. Introduction**

Restorative materials have become a cornerstone in dental prostheses, with all-ceramic and metal-ceramic systems at the forefront of modern restorative dentistry. Both offer esthetic, biocompatible, and durable solutions for creating natural-looking dental crowns. All-ceramic materials, particularly translucent zirconia, have revolutionized crown fabrication. Compared to other ceramic materials, the use of Zirconia often reduces complications such as over preparation of the tooth and therefore leads to a prosthesis that retains most of the tooth structure.<sup>1</sup>

In addition to the development of ceramic materials, new processing technologies have been introduced for the fabrication of all-ceramic crowns. All-ceramic crowns are made using a variety of ceramic-based materials, including heat-pressed, slip-cast, CAD/CAM (computer-assisted design/computer-assisted machining), technologies, as opposed to the traditional method used to create the metal-ceramic prosthesis.<sup>2</sup>

The performance of the all-ceramic crowns are complex and depends on factors like those controlled by the clinician and those that are patient-dependent.<sup>3</sup> The longevity of the prosthesis depends on a number of factors, including the framework design, laboratory processing techniques, the shape and thickness of the porcelain veneer and core, and the elastic modulus of the restorative components.<sup>4</sup> The role of finish lines is also an essential part of tooth preparation. Different finish lines have been advocated for different purposes. Different finish lines have been advocated for different purposes. However, the choice of finish line design, which dictates how the crown interfaces with the tooth, directly impacts the internal fit.

The influence of finish lines on the marginal and/or internal adaptations of ceramic crowns has been widely investigated in various studies.<sup>5,6</sup> However, which finish line offers better marginal and internal adaptations is not clear.

Hence, this systematic review aims to give an update on which finish line offers better internal fit in regard to Zirconia and CAD metal ceramic crowns.

## **II. Material And Methods**

The inclusion criteria for admittance in the systematic review was based on the type of study, namely, clinical studies on humans, assessing

The effect of two different finish lines (shoulder and chamfer) on the internal fit of newer translucent Zirconia crowns

The effect of two different finish lines on the internal fit of CAD metal-ceramic crowns Studies that evaluated the marginal and/or internal adaptations and measurements of crowns.

A Systematic search in the National Library of Medicine's PubMed Database, Google Scholar, EBSCO and ProQuest was performed to identify all peer-reviewed articles in the English literature dealing with the effect of two different finish lines according to the search strategy described in the following sections.

The systemic literature search and data extraction were performed by two independent researchers. The following databases were incorporated in the systematic review for relevant literature: PubMed, EBSCO, Google scholar, and ProQuest.

The following search terms were used "finish lines", "shoulder vs chamfer" "ceramics", "CAD metal-ceramic crowns", "internal fit". The search was limited to articles on adult populations (+19 years) in the English language published during the past 13 years.

The search string was

("finish line" OR margin OR shoulder OR chamfer)

AND

("internal"[Text Word] OR "fit"[Text Word]) OR "marginal fit" OR "marginal adaptation"

AND

"new"[Text Word] AND "zirconias"[Text Word] OR "zirconium oxide"[Text Word] OR "zirconia"[Text Word])

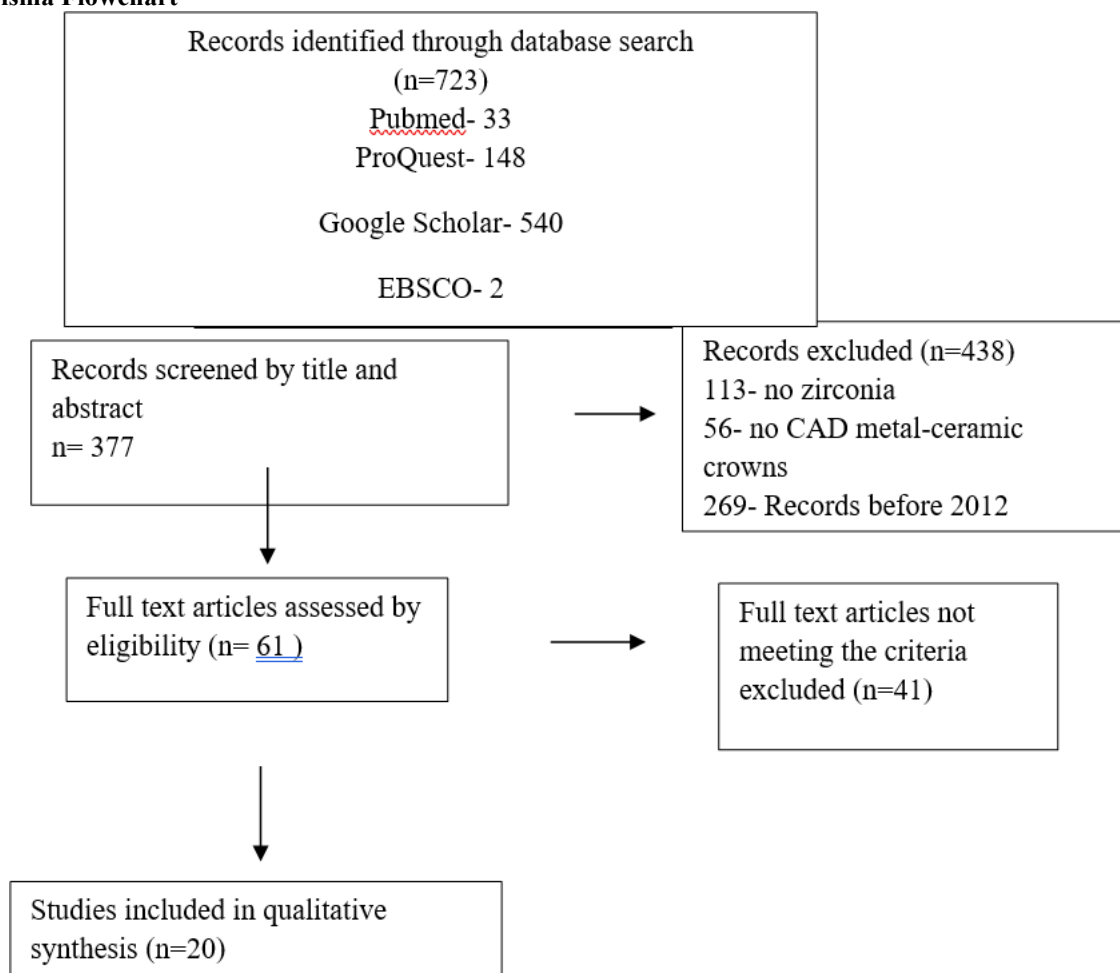
AND

"computer aided design"[MeSH Terms] OR ("computer aided"[Text Word] AND "design"[Text Word]) OR "computer aided design"[Text Word] OR ("cad"[Text Word] AND "cam"[Text Word]) OR "cad cam"[Text Word] OR ("printing, three dimensional"[MeSH Terms] OR ("printing"[Text Word] AND "three dimensional"[Text Word]) OR "three-dimensional printing"[Text Word] OR ("3d"[Text Word] AND "printing"[Text Word]) OR "3d printing"[Text Word])

For article selection or first approach, two researchers independently selected potentially eligible articles by title and abstract. Articles that met PICO and inclusion criteria are included in the review for the final analysis. Only articles from the electronic search were considered. All studies included were published from 2012 to 2024, and no exception was made for including studies before 2012.

Data were collected from studies that compared the effect of two different finish lines. The data included the finish line design/preparation design, type of crowns, and marginal and internal gap measurements.

#### Prisma Flowchart



### III. Result

A total of 20 articles were selected for this systematic review that included the effect of different finish lines on the internal fit of newer translucent zirconia and CAD metal-ceramic crowns.

All studies included were published from 2012 to 2024, and no exception was made for including studies before 2012. Only articles from the electronic search were considered. The literature that did not meet the inclusion criteria were fixed dental prosthesis of two or more units, implant-supported prostheses, testing other types of all-ceramic restorations that were not fabricated by zirconia, non-English studies, non-peer reviewed studies, and testing bond strength or studies involving accuracy of intraoral and extraoral scanners.

S. no.	Author & Year	Type of Study	Population	Intervention	Control Or Comparison	Outcome	Conclusion
1.	Martins LM, 20124	In-vitro study	Sixty standardized resin-tooth replicas of a maxillary first molar (n=20) each.	Glass-infiltrated alumina (ICA - In-Ceram Alumina), yttria-stabilized tetragonal zirconia polycrystals (Y-TZP IPS e.max, ZrCAD), and metal-ceramic (MC - Ni-Cr alloy) crowns	Circumferential Chamfer 1.2mm	Internal fit was measured on the occlusal space (OS), axial space (AS)	Smallest IF was observed in the MC group (89.76 $\mu$ m) and the largest in the ICA group (158.27 $\mu$ m). Y-TZP crowns displayed an IF average of 132.54 $\mu$ m.
2.	Chandrasekar S, 20122	In-vitro study	Thirty copings of Maxillary Central incisor; 15-Zirconia 15-Nickel-Chromium copings	Zirconia coping and Nickel-chromium copings	Shoulder finish line	Mean Marginal gap was recorded for both copings and was expected to be more in Ni-Cr copings.	Higher Mean marginal gap was recorded in Ni-Cr copings compared to zirconia copings.
3.	Subasi G, 20123	In-vitro study	Forty machined stainless steel molar die models	IPS e.max Press and partially yttrium-stabilized zirconium oxide ceramic.	Shoulder and Chamfer finish line	The marginal fit was evaluated by measuring the gap between the edge of the coping and the prepared steel die margin.	Both types of all-ceramic copings demonstrated that the mean marginal fit was considered acceptable for clinical application ( $\leq 120 \mu$ m).
4.	Kim KB, 20137	In-vitro study	The 20 specimens were produced using the casting and the SLS methods; 10 samples were made in each group.	Cobalt-Chromium Crowns made by conventional lost-wax technique and Selective laser technique	Chamfer Finish line	Marginal and internal gap of two different crowns was measured by two-dimensional and three-dimensional replica techniques.	The gap of the FDPs produced by the SLS was greater than that of the FDPs produced by the conventional casting in all measured areas.
5.	Re Dino, 20148	In-vitro	A total of 20 copings were divided into two groups based on the finish line.	Lava Zirconia crown-copings	Chamfer and Shoulder finish line	Marginal fit was measured between the zirconia coping and the preparation edge.	Chamfer and Shoulder preparation did not show any differences regarding gap dimension.
6.	Habib 9	In-vitro study	40 sound or minimally restored extracted molar teeth (mostly third molars)	Zirconia copings	Shoulder and Chamfer finish line	Marginal adaptation of single unit Zirconia copings was assessed on prepared extracted teeth with two different margin designs.	Marginal adaptation of zirconia copings with either Shoulder or Chamfer margin design was the same.
7.	Erise Y (2017)10	In-vitro Study	Thirty standardized stainless steel master dies were fabricated	CAD/CAM Monolithic Ceramic crowns and Metal-ceramic crowns.	Chamfer Finish line	marginal fit was evaluated among monolithic zirconia, monolithic lithium disilicate, and conventional metal-ceramic crowns	IPS e.max CAD showed the lowest discrepancies when compared to metal-ceramic crowns.
8.	Yu H (2018)11	Systematic review and meta-analysis	16 studies	Ceramic crowns	Rounded shoulder and chamfer finish line	Marginal and internal adaptation were evaluated on ceramic crowns using two different finish lines	Internal adaptation favoured chamfer finish line where as marginal adaptation favoured rounded shoulder.
9.	Jalalian	In-vitro	10 samples	Zirconia	Sloped	Evaluation of	Deep chamfer showed

	EA (2018)12			copings	shoulder and deep chamfer	marginal gap and internal gap on zirconia restorations.	better vertical adaptation than sloped shoulder while in terms of marginal and internal adaptation, sloped shoulder design was superior.
10.	Ahmad WM (2019)13	Invitro study	120 crowns	Monolithic zirconia	Different finish line widths (chamfer finish line)	Marginal fit of zirconia crowns were assessed using different finish line widths.	1.0 mm finish line preparations with either 0.8 mm or 1.5 mm occlusal reduction had better marginal fit in both sintering protocols compared to 0.5 mm or 1.2 mm finish lines.
11.	Al Maaz A, 201914	In-vitro study	90 specimens	Base (Co-Cr), high noble (Au-Pd-Ag), and noble alloy (Co-Pd) using SLM) technology	3 finish lines – Chamfer, Deep Chamfer and Shoulder Finish lines	Marginal and Internal gaps were <u>evaluated</u> <u>on</u> 3 different materials using SLM technology.	SLM-fabricated Co-Cr copings on teeth prepared with a deep chamfer finish line demonstrated the lowest marginal gap
12.	Ahmad WM (2019)13	Systemic Review	46 studies	Zirconia OR zirconium OR yttrium stabilized tetragonal zirconia YTZP	N/A	Marginal fit and other factors that influence the adaptation of zirconia crowns were evaluated.	Shoulder finish lines had a slightly better marginal adaptation compared with chamfer finish lines.
13.	Shah N (2020)15	Systematic Review	9 articles were selected for evaluation	Cobalt- chromium metal copings fabricated <u>using</u> (CAD- CAM) technology	Deep chamfer, chamfer, and Shoulder finish line	Marginal and internal adaptation of cobalt chromium copings were evaluated.	Better marginal adaptation was reported in deep chamfer finish line preparation followed by shoulder and chamfer finish line preparations.
14.	<del>Sadeqi</del> HA (2021)16	In- vitro study	32 samples	Milled monolithic zirconia (Zi) and zirconia- reinforced lithium silicate (ZLS) crowns	Rounded Shoulder	Evaluation of Marginal/Intern al Fit and Fracture Load of Monolithic Zirconia and Zirconia Lithium Silicate (ZLS) CAD/CAM Crown Systems.	No significant differences between the Zi and ZLS crowns in terms of marginal and internal gaps
15.	Akbar (2022)17	In vitro study	180 samples	Crowns fabricated by CEREC system	Chamfer and shoulder finish lines	Marginal integrity was evaluated on crowns fabricated by CEREC system.	Both chamfer and shoulder finish lines produce acceptable marginal integrity of CEREC 3D crowns
16.	Faruqi S, 202218	In vitro study		Layered zirconia, monolithic zirconia, and pressed lithium disilicate	Shoulder and chamfer finish line	Marginal adaptation was evaluated on ceramic crowns on four designated points on the mesial, distal, buccal, and palatal surface.	Chamfer finish lines produced better fitting restorations, and heat pressed lithium disilicate crowns showed better adaptation at the margins than both layered zirconia and monolithic zirconia
17.	Al-Saleh (2022)19	In vitro study	Ninety Samples	3D-Printed, Selective laser melting (SLM), milled (CAD- CAM) and Lost wax technique fabricated Cobalt	Shoulder, radial shoulder, chamfer finish line	The misfit of 3D-Printed, Selective laser melting (SLM), milled CAD- CAM) and Lost wax technique fabricated (CoCr) alloy	Vertical misfit was low with shoulder margins, and horizontal misfit was better with chamfer marginal configuration

				chromium (CoCr) alloy copings		copings was evaluated using 2 finish lines.	
18.	Baig M, (2022)20	In vitro study	40 samples	Zirconia CAD CAM and Lithium Disilicate crowns	Shoulder and chamfer finish lines	Marginal gap and overhang were evaluated at 6 different points on ceramic crowns.	Shoulder margins produced smaller gaps compared to chamfer finish lines
19.	Moslemi oon M, (2023)21	In vitro study	9 samples	Zirconia CAD CAM copings	Radial shoulder and Deep Chamfer finish lines	Marginal adaptation of zirconia copings was evaluated.	There was no significant difference between the two preparation designs in terms of the mean vertical gap
20.	AbdElaziz M (2024)22	In-vitro study	60 crowns	Yttria multi-layered(YML) zirconia	Knife edge, chamfer and rounded shoulder	Effects of cement gap thickness and fracture resistance of crowns was evaluated.	Rounded shoulder pattern exhibited higher failure load values.

#### IV. Discussion

Achieving an accurate fit between the crown and the prepared tooth is essential for ensuring long-term success and patient satisfaction. One critical aspect that influences the internal fit of crowns is the choice of finish line design. Various styles of finish lines have been recommended for ceramic crown tooth preparation. Furthermore, the findings of the studies assessing the impact of finish-line design on the internal and marginal adaptations of ceramic crowns have shown contradicting results.

This review assessed the effect of shoulder and chamfer finish lines on the internal fit of newer zirconia crowns and CAD metal-ceramic crowns. The review is based on a structural review of articles which helped in gathering relevant data from each article by answering clinical questions put into a PICO format. The PICO format has assisted as a valuable tool for evidence-based medicine for both practicing clinicians and researchers.

In 2012, Martins LM et al<sup>4</sup> assessed the effect of chamfer finish line on In-Ceram Alumina, YTZ-P IPS e-max and metal ceramic crowns and found that metal-ceramic group showed poorer internal fit compared to the all-ceramic groups. The internal fit was measured on the occlusal and the axial surface. No difference was seen on the axial surface among the three groups. Friere Y in 2017 et al also found similar results where IPS e.max CAD showed the lowest discrepancies in marginal fit when compared to metal-ceramic crowns. This could be due to the precision of the digitization system and the mechanized technique used. <sup>23</sup>Most previous studies have analyzed IPS e.max Press, and all results were within ranges considered clinically acceptable.

However, in 2018, Yu H found contradicting results in which the studies showed that internal adaptation favoured chamfer finish line where as marginal adaptation favoured rounded shoulder. A significant difference in internal adaptation was found between the crowns with rounded shoulder and those with chamfer finish lines. The reason for the better seating of restorations with chamfer preparation was assumed to correlate with their poor marginal sealing (greater marginal gap). A smaller internal space was discovered to have the potential to cause early contact between the restoration's internal surface and the preparation, obstruct cement evacuation, and increase the marginal gap. It is possible that the design of chamfer allows the cement to escape marginally more readily without filtration, whereas with the rounded shoulder, the margins seal earlier and the filtration of the cement begins sooner.

Ahmad WM et al in 2019 derived similar results from their systematic review which showed that shoulder finish lines had a slightly better marginal adaptation compared to chamfer finish lines. The results for this study was inconclusive as other factors that influence the fit of zirconia crowns were also included.

In 2020, Shah N compared marginal adaptation on cobalt-chromium copings using three different finish lines i.e. Deep chamfer, Chamfer, and Shoulder finish lines. Marginal adaptation was reported to be better in deep chamfer finish line preparation followed by shoulder and chamfer finish line preparations.

The choice between chamfer and shoulder finish lines often depends on factors such as the dentist's preference, the specific case requirements, the type of restoration, and the condition of the patient's tooth. While chamfer finish lines are more conservative and offer better resistance to fracture, shoulder finish lines provide better marginal adaptation. This could be because shoulder preparations have poor seating prior to complete cementation.

#### V. Conclusion

The choice between chamfer and shoulder finish lines often depends on factors such as the dentist's preference, the specific case requirements, the type of restoration, and the condition of the patient's tooth. While chamfer finish lines are more conservative and offer better resistance to fracture, shoulder finish lines provide

better marginal adaptation. This could be because shoulder preparations have poor seating prior to complete cementation.

### References

- [1]. Sadid-Zadeh R, Sahraoui H, Lawson B, Cox R. Assessment Of Tooth Preparations Submitted To Dental Laboratories For Fabrication Of Monolithic Zirconia Crowns. Dent J (Basel). 2021 Oct 1;9(10).
- [2]. Chandrashekar S, Savadi RC, Dayalan M, Reddy GTP. A Comparative Evaluation Of The Marginal Adaptation Of Zirconium Coping And Nickel-Chromium Coping Using Shoulder Finish Line Design: An Invitro Study. Journal Of Indian Prosthodontist Society. 2012 Dec;12(4):248–51.
- [3]. Subasi G, Ozturk N, Inan O, Bozogullari N, Subasi Selcuk Universitesi G, Fakultesi D, Et Al. European Journal Of Dentistry Evaluation Of Marginal Fit Of Two All-Ceramic Copings With Two Finish Lines. Vol. 6. 2012.
- [4]. Martins LM, Lorenzoni FC, Oliveira De Melo A, Mendonça Da Silva L, Luiz J, Oliveira G De, Et Al., QWHUQDOO ; WWRIIWZRRDOOFHUDPLFFV\VWHPVVDQGGPHWDO Ceramic Crowns [Internet]. Available From: Wwww.Scielo.Br/Jaos
- [5]. Ferreira Quintas A, Oliveira F, Bottino MA. Vertical Marginal Discrepancy Of Ceramic Copings With Different Ceramic Materials, Finish Lines, And Luting Agents: An In Vitro Evaluation.
- [6]. Yu H, Chen Y Hui, Cheng H, Sawase T. Finish-Line Designs For Ceramic Crowns: A Systematic Review And Meta-Analysis. Vol. 122, Journal Of Prosthetic Dentistry. Mosby Inc.; 2019. P. 22-30.E5.
- [7]. Kim KB, Kim JH, Kim WC, Kim HY, Kim JH. Evaluation Of The Marginal And Internal Gap Of Metal-Ceramic Crown Fabricated With A Selective Laser Sintering Technology: Two- And Threedimensional Replica Techniques. Journal Of Advanced Prosthodontics. 2013;5(2):179–86.
- [8]. Augusti G, Re D, Cerutti F, Student P, Cerutti A. THE INTERNATIONAL JOURNAL OF ESTHETIC DENTISTRY Comparison Of Marginal Fit Of Lava CAD/CAM Crown-Copings With Two Finish Lines. THE INTERNATIONAL JOURNAL OF ESTHETIC DENTISTRY.