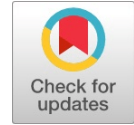


# Aesthetics of Claps in Removable Partial Denture - A Literature Review

Satyajit Muluk, Ishita Grover



**Abstract:** Since 1930, partial denture frameworks have been made from metallic alloys like cobalt-chromium [Co-Cr] and resin polymers such as Polymethylmethacrylate [PMMA]. However, the main limitation of these materials over the last 15 years has been related to aesthetics. The show of a metallic clasp has not been widely accepted. The objectives of this study are:- 1) To find a material for removable partial dentures that has aesthetic clasps and 2) To compare the strength and functionality of the aesthetic clasps with Cobalt - chromium or other metallic clasps. Being a review paper, the methodology involved referring to related articles. Removable dentures made with PEEK, Valplast, Zirconia framework and transparent dentures were compared. The aim of this study was to find an aesthetic solution to the metallic show of the removable partial dentures. PEEK and Zirconia framework dentures give aesthetics along with a sound framework whereas Valplast and transparent flexible dentures are high on the aesthetic quotient but are functionally less stable. Cast partial dentures are stronger but aesthetically compromised. With newer technologies like PEEK, Zirconia in distal extension and Valplast and transparent dentures in tooth-bound cases, an amalgamation of aesthetics, stability and functionality was found.

**Keywords:** Clasps, Valplast, PEEK, Zirconia, Transparent dentures.

## I. INTRODUCTION

Removable partial dentures have been an effective and affordable aid to treat partially edentulous patients. The purpose of the use of removable partial dentures is for functions like mastication, speech and aesthetics. Along with functionality, aesthetics influences the appearance, dignity and self-esteem of a person, which are equally important.[1] Over the past century, partial denture frameworks have generally been made from metallic alloys [Co-Cr] and resin polymers [PMMA]. However, one of the specific limitations of [Co-Cr] material over the last 15-20 years has been related to aesthetics.[2] In recent years many advances have been made to overcome these challenges through the introduction of Zirconia, PEEK, Valplast and transparent dentures.[3] All these materials were put through the test for precision, biocompatibility, sustainability, stain resistance, comfort and fit.

The purpose of this article is to study the literature on the aesthetics and functionality of RPD. The objectives of this study are -

- 1) To find a material for removable partial dentures that has aesthetic clasps.
- 2) To compare the strength and functionality of the aesthetic clasps with [Co-Cr] or other metallic clasps.

## II. MATERIALS AND METHODS

Being a review paper, the methodology involved referring to 29 related published articles out of which 15 were from PubMed-indexed journals, and websites based on aesthetics, functionality, etc. of PEEK, Valplast, Zirconia framework and transparent dentures. Initially, the abstract of the articles searched was reviewed and then the full text was obtained for assessment and further references. The articles were gathered from The Journal of Prosthodontics, The Journal of Prosthetic Dentistry, PubMed, European Journal of Oral Sciences, International Journal of Recent Advances in Multidisciplinary Research, The Journal of Advanced Prosthodontic, Journal of International Dental and Medical Research, Journal of Dental Sciences and Research, ResearchGate, Indian Journal of Dental Research, Journal of Oral Rehabilitation.

A search was conducted by using keywords like Clasps, Valplast, PEEK, Zirconia, and Transparent dentures in the removable partial denture. Each RPD material utilized has a couple of advantages and disadvantages. The main advantages are aesthetic satisfaction and leniency to insert and remove it.[4]

### A. Valplast

Since its inception, in the 1950s, Valplast has been fulfilling both patients' and dentists' demand of being more aesthetic and yet functional, as a substitute to traditional cast metal-based removable partial dentures.[5] Valplast is a polyamide resin made of biocompatible nylon.[6] Valplast used as a partial denture is virtually invisible as there are no metal clasps and the material itself blends with the mucosa of the mouth.[7] Valplast is a flexible-based resin, ideal for partial dentures and/or unilateral restorations; it is restricted to Kennedy's Class III situation. The biocompatible nylon and thermoplastic resin of Valplast offer an ideal degree of flexibility and stability when processed and finished to the recommended thickness.[5] Its properties like flexibility and light weight allow the restoration to adapt to the constant movement generated by masticatory muscles in the mouth.[8] It can also be recommended to patients who have acrylic allergies as Valplast does not contain acrylic monomer. Valplast also has the added advantage of its clasps being processed in the same material hence there is no metallic show even in the clasp area.[9]

Manuscript received on 27 April 2023 | Revised Manuscript received on 10 May 2023 | Manuscript Accepted on 15 May 2023 | Manuscript published on 30 May 2023.

\* Correspondence Author (s)

**Dr. Satyajit Muluk\***, M.A. Rangoonwala College of Dental Sciences & Research Centre, Pune (Maharashtra), India. E-mail: [dr.mulukss@gmail.com](mailto:dr.mulukss@gmail.com), ORCID: <https://orcid.org/0000-0003-2455-5994>

**Dr. Ishita Grover**, Associate Professor, M.A. Rangoonwala College of Dental Sciences & Research Centre, Pune (Maharashtra), India.

© The Authors. Published by Lattice Science Publication (LSP). This is an open access article under the CC-BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>)

Valplast may also be used as an alternate treatment plan in rehabilitating anomalies such as ectodermal dysplasia.[9] Along with its many advantages, there are disadvantages as well, being a polyamide material it is subjected to faster degradation and has lower wear resistance as compared to [Co-Cr] clasps dentures.[4] It has been found that patients using Valplast reported increased difficulty in cleaning the prosthesis, roughness perceived by the tongue, and increased retention loss.[4] But for daily cleaning of the partial denture and removing the loose particles the sonic denture cleaner or placing it in running water can be useful.[7] Valplast loosens its polish and the surface roughens in due course of time by brushing it, which in case results in high plaque and/or calculus accumulation.[7] The Valplast dentures are usually more expensive than the partial dentures whose metal clasps are visible.[7] Valplast is used for provisional or temporary applications and not as a long-term restoration.[9] For clinicians also, it possess a threat while grinding the prosthesis and avoiding skin contact with the heated sleeve, to overcome proper ventilation masks and a vacuum should be used and the procedure is technique sensitive.[9] Other reasons to recommend Valplast are for patients having a history of partial frame breakage, an alternative to implants or fixed products, in single denture cases, in challenging cases including paediatric patients, cancerous mouths or cleft palates and the presence of tori.

### B. PEEK

Polyetheretherketone (PEEK) is a semi-crystalline thermoplastic biomaterial with a chemical formula of  $(-C_6H_4-O-C_6H_4-O-C_6H_4-CO-)_n$ . It is one of the Polyaryletherketones (PAEKs) polymer group family, which is characterized by ultra-high molecular weight polyethylene (UHMWPE).[10] Polyetheretherketone (PEEK) is a synthetic, tooth-coloured polymeric material which is white in colour with excellent mechanical properties and has been proposed to use in prosthodontic appliances such as fixed prosthesis and removable partial denture prosthesis.[11] PEEK displays high biocompatibility, high-temperature resistance and outstanding chemical stability.[12] PEEK demonstrates superior tensile strength and lower plastic deformation in elastic regions.[13] PEEK has a higher Young's modulus.[13] It is highly precise and does not change its shape with respect to time. The flexibility and high elastic feature of PEEK could potentially decrease the stress on abutment teeth, which in turn could be very beneficial in designing clasps using deep undercuts on the remaining teeth hence eradicating denture pain due to the reason of excessive local pressure.[13] The white colour and high strength of PEEK permit RPD fabrication with non-metal aesthetic clasps and occlusal rests in addition to better occlusal stability.[12] To achieve the gingival colour of the PEEK framework of the partial denture, Visio-like can be used and other materials such as acid etching composite material can be applied.[14] The denture framework of PEEK having notches on the labial and buccal frenum are less susceptible to fracture.[13] In addition to this, the low specific weight of PEEK material permits the fabrication of lighter prosthesis with good functionality.[12] PEEK, which is known to have very good mechanical properties, is also bio-inert, tissue-compatible, non-cytotoxic, electrically non-conductive and thermally insulating, has zero corrosion rate, high strength-to-weight ratio, extremely low water absorption and is radiolucent. These properties of PEEK prevent any intra-oral reaction to

saliva making it an ideal material for use within the oral cavity. Other benefits of PEEK are no residual solvents, no irritation or redness or burning sensation, tough and durable with its melting temperature of 340° Celsius, neutral taste, lightweight and easy to clean as it is resistant to deposits and staining enabling wearing of the removable dentures for a longer time without any problem. PEEK framework is non-allergic, x-ray and scanner friendly, shock absorbent during chewing and has a high resistance to abrasion and decay. PEEK dentures are sustainable and have a long life than conventional dentures. Computer-aided design and Computer-aided manufacture (CAD-CAM) systems have increased their use in dentistry by successfully constructing dentures by using PEEK as per patients' anatomy.[11] Tannous et al. has suggested that denture clasps made of PEEK have lower retentive forces compared to [Co-Cr] clasps.[15] The adaption process appears easy, which results in a good marginal fit while in contrast, polishing appears difficult but is necessary for an optimal running surface and subsequent measurements.[16] It has also been used as a biomaterial in orthopaedics for many years.[11]

### C. Zirconia

At the 1996 international symposium in Munich, zirconium dioxide was considered to fulfil all the criteria for an ideal restorative material in dentistry.[17] It is a white powdered ceramic material. It has been medically utilized since the 1960s as a prosthesis in the surgery of hips, fingers and ears. Zirconia's metal properties and natural white colour with its level of translucency make it easy to match with the colour of the teeth and hence it is used for making dental crowns, removable partial dentures and implants. Computer-aided design- Computer-aided manufacture (CAD-CAM) can be used to process all-ceramic prosthesis, especially zirconia-based dental prosthesis.[18] It can be milled from a single block making it a strong dental prosthetic. Nevertheless, Computer-aided design - Computer-aided manufacture (CAD-CAM) technology decreases the chair side adjustment time. The advantage of Computer-aided design - Computer-aided manufacture (CAD-CAM) technology includes the simplicity and precision of replicating details such as rest seats, guiding planes and retentive undercuts.[19] Zirconia removable partial denture has a good cosmetic appearance with no metal. The desirable optical property of Zirconia, such as shading adaptation to the basic shades and a reduction in the layer thickness helps to achieve the desired colour.[17] Zirconia has high flexural strength ranging from 900-1200MPa.[20] Zirconia and [Co-Cr] have an almost equal degree of deformation even after the stimulated life span of removable partial dentures.[21] It is the strongest metal possible and almost impossible to break as it can withstand heavy clenching and grinding forces. Fracture toughness values for zirconia range from 5.5 to 7.4 MPa which is much higher than all other metal core materials which is why the fracture of zirconia is sporadic.[18] Not only thickness but a high rate of chipping was observed, in the application of zirconia as framework material.[22]

Even if the fracture occurs in zirconia removable partial dentures, it is not because of material but due to parafunctional habits and trauma which can be overcome to a limit by making the size of the connector at least 9 mm to withstand clinical loading in the posterior teeth.[18]

**D. Visiclear (Transparent dentures)**

VisiClear Partial Dentures are an ideal substitute for the traditional metal-based structure. Visiclear partial dentures are made of a biocompatible and nylon-free framework which is a thermoplastic material.[23] VisiClear is a new partial denture framework material that offers dentists and their patients higher performance advantages over traditional flexible and metal framework options.[24] Aesthetically, it allows it to blend with the surrounding oral tissues due to its thin and translucent framework as well as allows anatomical carving and a range of denture teeth.[25] Even though it is thin and translucent, it is less prone to staining and odour.[26] It is more water resistant than other alternatives.[27] It has superior flexibility and provides proper fit and comfort which makes them virtually unbreakable. It not only satisfies remarkable fit but also features smooth anatomy. As it is a 100% metal-free framework it is very easy for any chair side adjustments.[28] It is elastic, repairable or relinable, easy to polish, and lightweight. VisiClear is a great intermediary option.[23] It works best for people who do not want to go any length of time with gaps in their smiles. It not only satisfies aesthetic demand but also helps as a temporary solution for patients who are healthy enough to receive dental implants and need a recovery period of three to four months from implant placement surgery before an implant-supported prosthetic can be added. During the recovery period, VisiClear offers a great way for maintaining normal oral function before permanent restorations are completed. VisiClear is also indicated for making occlusal splints and night guards.[29] As it is a sturdy alternative to conventional removable partial dentures it can withstand typical bite force.[23] Along with the above virtues, it is easy to clean and maintain VisiClear which allows for improved patient satisfaction.

**III. RESULT**

PEEK and Zirconia framework dentures give aesthetics along with a sound framework whereas Valplast and transparent flexible dentures are high on the aesthetic quotient but are functionally less stable.

**IV. DISCUSSION**

Cast partial dentures are stronger but aesthetically can be compromised. Patients also complain of a metallic taste sensation, increased prosthesis weight, allergic reactions to metal and the need for better mastication with stable prosthesis have led to the introduction of several thermoplastic materials in clinical practice.[12] With newer technologies like Valplast and transparent flexible dentures in tooth-bound cases and PEEK, Zirconia in distal extension brings an amalgamation of aesthetics, stability and functionality. As in Valplast, the biocompatible nylon is a virtual individual with no metal clasps, flexibility and stability which are recommended for patients who are prone to acrylic allergies. Valplast may be used as an alternate treatment plan in rehabilitating the anomalies such as ectodermal dysplasia (Jain, 2015). Similarly, transparent flexible dentures, are

made of a biocompatible and nylon-free framework, which is a thin, translucent and thermoplastic material with superior flexibility. Both are lightweight. The vices of these flexible dentures are Valplast loosens its polish and surface roughens and do not have a threshold for strong chewing force. Visiclear is used as a temporary denture and not a permanent denture. PEEK and Zirconia, both are white in colour. PEEK has superior tensile strength and lower plastic deformation in elastic regions also it is highly precise and does not change shape. To fabricate these two dentures, CAD-CAM technology is used. CAD-CAM decreases chair-side adjustment time as it can replicate the details with precision. The shortcoming of CAD-CAM is that it cannot bring out the uniform thickness of the virtually designed framework. Zirconia and [Co-Cr] have an almost equal degree of deformation even after the stimulated life span of removable partial dentures (Jeng.et.al. 2019). Zirconia is a strong metal and it can bear heavy clenches while chewing. PEEK is bio-inert, non-cytotoxic, with zero corrosion rate. PEEK has long life span than conventional dentures. On the contrary, PEEK has a low retentive force and polishing is difficult. Zirconia has a high rate of chipping. If any of the four RPDs have not been polished or cleaned properly the dentures are prone to staining and difficult to repair. The patients should be informed to soak the denture in water for 10 – 15 minutes a day while brushing the natural teeth to avoid the abrasion of the prosthesis. Also, the patients should be told to maintain good oral hygiene and to clean the prosthesis after every meal.

**V. CONCLUSION**

Partial edentulism can be treated through different removable partial dentures. There are several options through which RPD’s framework can be made. Valplast and transparent flexible dentures are the first choices of patients who are highly concerned about aesthetics. Nowadays, these dentures have become an elective treatment option for most patients. But there are still a group of patients who prefers sturdiness over aesthetics, to them PEEK and Zirconia framework partial dentures are advised. These two frameworks can be made by using CAD-CAM technology. These dentures are strong and can tolerate heavy clenching forces. Further research and clinical trials are required to explore these materials and other modifications with them for further dental applications.

**DECLARATION**

Funding/ Grants/ Financial Support	No. I didn't receive any funding.
Conflicts of Interest/ Competing Interests	No conflicts of interest to the best of our knowledge.
Ethical Approval and Consent to Participate	No, the article does not require ethical approval and consent to participate with evidence.
Availability of Data and Material/ Data Access Statement	Not relevant.
Authors Contributions	All authors have equal participation in this article.





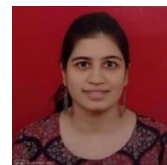
## REFERENCES

1. Khan SB, Geerts GA. Aesthetic clasp design for removable partial dentures: a literature review. *SADJ*. 2005 Jun;60(5):190-4. PMID: 16052751.
2. Muhsin SA. Evaluation of Poly (etheretherketone) for Use as Innovative Material in the Fabrication of a Removable Partial Denture Framework (Doctoral dissertation, University of Sheffield).
3. Gargari M, Gloria F, Cappello A, Ottria L. Strength of zirconia fixed partial dentures: review of the literature. *ORAL & implantology*. 2010 Oct;3(4):15.
4. Manzon L, Fratto G, Poli O, Infusino E. Patient and clinical evaluation of traditional metal and polyamide removable partial dentures in an elderly cohort. *Journal of Prosthodontics*. 2019 Oct;28(8):868-75. [[CrossRef](#)]
5. DiTolla M. Flexible, esthetic partial dentures. *Chairside Perspective*. 2004;5.
6. Silvia S, Djais AA, Soekanto SA. The amount of Streptococcus mutans biofilm on metal, acrylic resin, and valplast denture bases. *Journal of International Dental and Medical Research*. 2018 Sep 1;11(3):899-905.
7. Shammur SN, Jagadeesh KN, Kalavathi SD, Kashinath KR. Flexible Dentures—An alternate for rigid dentures. *J Dent Sciences and Research*. 2010 Feb;1:74-9.
8. Kaira LS, Dayakara HR, Singh R. Flexible denture for partially edentulous arches. *Journal of dentofacial sciences*. 2012;1:39-42.
9. Jain AR. Flexible denture for partially edentulous arches—Case reports. *Int J Recent Adv Multidisciplinary Res*. 2015;2:182-6.
10. Reinhart TJ, Clements LL. Introduction to composites. *Engineered materials handbook*.. 1993;1:27-34.
11. Najeeb S, Zafar MS, Khurshid Z, Siddiqui F. Applications of polyetheretherketone (PEEK) in oral implantology and prosthodontics. *Journal of prosthodontic research*. 2016 Jan 1;60(1):12-9. [[CrossRef](#)]
12. Harb IE, Abdel-Khalek EA, Hegazy SA. CAD/CAM constructed poly (etheretherketone)(PEEK) framework of Kennedy class I removable partial denture: a clinical report. *Journal of Prosthodontics*. 2019 Feb;28(2):e595-8. [[CrossRef](#)]
13. Muhsin SA, Hatton PV, Johnson A, Sereno N, Wood DJ. Determination of Polyetheretherketone (PEEK) mechanical properties as a denture material. *The Saudi dental journal*. 2019 Jul 1;31(3):382-91. [[CrossRef](#)]
14. Sadek SA. Comparative Study Clarifying the Usage of PEEK as Suitable Material to Be Used as Partial Denture Attachment and Framework. *Open Access Maced J Med Sci*. 2019 Apr 13;7(7):1193-1197. doi: 10.3889/oamjms.2019.287. PMID: 31049106; PMCID: PMC6490496. [[CrossRef](#)]
15. Tannous F, Steiner M, Shahin R, Kern M. Retentive forces and fatigue resistance of thermoplastic resin clasps. *Dental Mater* 2012;28:273-8. [[CrossRef](#)]
16. Stock V, Schmidlin PR, Merk S, Wagner C, Roos M, Eichberger M, Stawarczyk B. PEEK primary crowns with cobalt-chromium, zirconia and galvanic secondary crowns with different tapers—A comparison of retention forces. *Materials*. 2016 Mar;9(3):187. [[CrossRef](#)]
17. Raut A, Rao P L, Ravindranath T. Zirconium for esthetic rehabilitation: An overview. *Indian J Dent Res* 2011;22:140-3 [[CrossRef](#)]
18. Triwatana P, Nagaviroj N, Tulapornchai C. Clinical performance and failures of zirconia-based fixed partial dentures: a review literature. *The journal of advanced prosthodontics*. 2012 May 1;4(2):76-83. [[CrossRef](#)]
19. Paek J, Noh K, Pae A, Lee H, Kim HS. Fabrication of a CAD/CAM monolithic zirconia crown to fit an existing partial removable dental prosthesis. *The Journal of Advanced Prosthodontics*. 2016 Aug 1;8(4):329-32. [[CrossRef](#)]
20. Baldassarri M, Stappert CF, Wolff MS, Thompson VP, Zhang Y. Residual stresses in porcelain-veneered zirconia prosthesis. *Dental materials*. 2012 Aug 1;28(8):873-9. [[CrossRef](#)]
21. Peng TY, Shimoe S, Tanoue N, Akebono H, Murayama T, Satoda T. Fatigue resistance of yttria-stabilized tetragonal zirconia polycrystal clasps for removable partial dentures. *European Journal of Oral Sciences*. 2019 Jun;127(3):269-75. [[CrossRef](#)]
22. Sailer I, Fehér A, Filser F, Gauckler LJ, Lütthy H, Hämmerle CH. Five-year clinical results of zirconia frameworks for posterior fixed partial dentures. *International Journal of Prosthodontics*. 2007 Jul 1;20(4).
23. Martina M. Reynolds. General and Cosmetic Dentistry. VisiClear™ Partial Dentures. February 5, 2018. Available at: <https://www.centralparkdentistmartinareynolds.net/> [Last accessed on 14-05-2022].
24. DentistryIQ. MicroDental Labs introduces VisiClear Partial Dentures. July 15, 2013. Available at: <https://www.dentistryiq.com/> [Last accessed on 14-05-2022].
25. DIMARTINO VISICLEAR™. PARTIAL DENTURES WITH FULL PERFORMANCE. DiMartinoVisiClear Partial Dentures are a flexible alternative for doctors seeking a higher performance partial denture. Available at: [https://www.google.co.in/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKewi7nuL5uNz3AhUeTWwGHQFoAysQFnoECAMQAQ&url=https%3A%2F%2Fwww.dimartinodentallab.com%2Fs%2F130570\\_DMT\\_VisiClear\\_Flyer\\_w\\_Prices.pdf&usq=AOvVawleKUNWFBsiPyoUIWHzd11o](https://www.google.co.in/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKewi7nuL5uNz3AhUeTWwGHQFoAysQFnoECAMQAQ&url=https%3A%2F%2Fwww.dimartinodentallab.com%2Fs%2F130570_DMT_VisiClear_Flyer_w_Prices.pdf&usq=AOvVawleKUNWFBsiPyoUIWHzd11o) [Last accessed on 14-05-2022].
26. AEGIS Dental Network. Inside dentistry. VisiClear™ Partial Dentures. Available at: <https://www.aegisdentalnetwork.com/id> [Last accessed on 14-05-2022].
27. Zahn Dental Labs. MillableVisiClear Has Arrived: Everything You Need to Know. September 13, 2018. Available at: <https://www.henryschein.com/us-en/zahn/digitaldentistry/keyprint.aspx> [Last accessed on 14-05-2022].
28. Dental Product Report. Tetra Dynamics introduces VisiClear partial dentures. [dentalproductsreport.com-2015-02-01](https://www.dentalproductsreport.com-2015-02-01), Issue 2 February 26, 2015. Available at: <https://www.dentalproductsreport.com/> [Last accessed on 14-05-2022].
29. Myerson. VisiClear. Available at: <https://www.myersonstooth.com/> [Last accessed on 14-05-2022].

## AUTHORS PROFILE



**Dr. Satyajit Muluk.** I am a dental graduate from M.A.Rangoonwala Dental College and Research Centre affiliated with MUHS, Nashik. I have published three papers:- 1) Nano Anesthesia and Nano Drug Delivery- A review article, 2) Food Fortification with anti-cariogenic agents: A comprehensive review and 3) Effects of Remineralising Agents on Attrited Teeth – An in vitro study.



**Dr. Ishita Grover.** I am an associate professor at M.A.Rangoonwala College of Dental Sciences and Research Center. I did my master's in Prosthodontics and Implantology. Along with that did Fellowship in Facial Aesthetics and Cosmetology (FFAC) and PG Diploma in Hospital and Health Care Management (PGDHHM). My publications:- 1) Single Nucleotide Polymorphisms of BMP2 Gene Association with Skeletal Class I Crowding: A PCR Study. 2) Evaluation of Serum Antioxidant Enzymes in Oral Submucous Fibrosis and Oral Squamous Cell Carcinoma- A Clinical and Biochemical Study. 3) Study of the Role of Salivary Lactate Dehydrogenase in Habitual Tobacco Chewers, Oral Submucous Fibrosis and Oral Cancer as a Biomarker.

**Disclaimer/Publisher's Note:** The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of the Lattice Science Publication (LSP)/ journal and/ or the editor(s). The Lattice Science Publication (LSP)/ journal and/ or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.

