ISSN No:-2456-2165

Technique for Fabrication of Customised Metal Mesh Reinforced Complete Dentures – Pressing Need to Avoid Complete Denture Fractures A Case Report

Dr. Aishwarya Roy [1]
Final year PG, Dept. of Prosthodontics
SRM Dental College, Ramapuram
Chennai, India

Dr. B. Muthukumar [2]
Professor & HOD, Dept. of Prosthodontics
SRM Dental College, Ramapuram
Chennai, India

Abstract:- The creation of complete dentures can present significant challenges for clinicians, with a higher likelihood of denture fractures in maxillary dentures compared to mandibular ones. The limitations of heat-cure acrylic resin to withstand heavy occlusal loads alone often result in denture fractures. This issue can be effectively addressed through the use of innovative materials and appropriate techniques. Introducing metal mesh reinforcement in dentures offers a satisfactory and cost-effective solution, simultaneously imparting a lightweight and stable quality to the prosthesis within the oral cavity. This case report details the fabrication process of a custom-made metal mesh-reinforced maxillary and mandibular complete dentures for a 54-year-old male patient seeking stronger and more durable dentures. The described procedure is both straightforward and effective in enhancing the resistance of the dentures to masticatory loads.

Keywords:- *Metal Mesh; Denture Fracture; Complete Denture; Reinforced Denture.*

I. INTRODUCTION

Complete dentures have been a pivotal solution for individuals with missing teeth, restoring not only their ability to chew and speak but also their self-esteem and overall quality of life [1]. However, the success of complete dentures is contingent on various factors, including the materials used and the design [2]. One crucial aspect that has significantly improved the efficacy and longevity of complete dentures is the incorporation of reinforcements. Reinforcements, often composed of metals like cobalt-chromium or titanium, play a pivotal role in stabilizing complete dentures [3]. Traditional acrylic dentures are prone to flexing, particularly when subjected to substantial biting forces. This flexibility can lead to discomfort and instability [4]. Metal reinforcements embedded in the denture base minimize this flexion, providing a more secure fit. Reinforcements help distribute the forces generated during oral functions more evenly across the underlying tissues. This prevents undue stress on specific areas of the mouth, reducing the risk of sore spots and ulcers [5,6]

Durability is another vital factor influencing the effectiveness of complete dentures. A denture that breaks or wears down quickly can lead to patient frustration and the need for frequent replacements. Reinforcements address this issue effectively. The metal framework in reinforced complete dentures significantly enhances their resistance to fracture and breakage. This is particularly crucial for patients with powerful bites or those who grind their teeth, as they subject the denture to greater mechanical stress. Reinforced complete dentures tend to have a longer lifespan compared to their acrylic counterparts. Patients can expect to use them for an extended period, reducing the need for frequent replacements. The need for reinforcements in complete dentures cannot be overstated. They serve as the backbone of stable, durable, and comfortable prostheses, addressing the challenges posed by the dynamic oral environment. By improving stability and reducing the risk of breakage, they significantly enhance patient satisfaction, ultimately contributing to better oral health and overall quality of life. Dentists and prosthodontists should continue to embrace the incorporation of reinforcements in complete dentures as a cornerstone of modern dental practice, ensuring that patients can smile, eat, and speak with confidence and ease [7,8].

II. CASE- REPORT

A 54-year-old male patient presented to the Department of Prosthodontics and Crown & Bridge with a primary concern of missing upper and lower teeth. The patient had a 10-year history of diabetes and was currently under medication. Intraoral examination revealed complete edentulism in both the maxillary and mandibular arches. The patient was provided with an overview of different treatment options, including: 1. Implant-supported overdentures in both the maxillary and mandibular arches, 2. Cast metal maxillary denture combined with a removable conventional mandibular denture, and 3. Metal mesh-reinforced maxillary denture paired with a conventional mandibular denture.

Due to financial constraints, the patient opted against the implant-supported overdentures. Instead, the patient chose the economical option of metal mesh-reinforced maxillary and mandibular dentures. This choice offered the

ISSN No:-2456-2165

advantages of enhanced strength, increased fracture resistance, and a lighter weight in comparison to cast metal dentures, aligning with the patient's preferences and budgetary considerations.

A. Clinical Procedure

The prosthetic procedure began with the creation of primary impressions for the maxillary and mandibular arches, utilizing alginate tray material (Zhermack, regular setting, chromatic). Subsequently, a maxillary special tray was crafted using auto-polymerizing acrylic resin (DPI-RR), followed by border molding with green stick compound (DPI Pinnacle) and the final impression using addition silicone (Aquasil Ultra Monophase, Dentsply) (*Fig.1*). A master cast was then produced using GoldStone Dental Stone (Class III Green) (*Fig.2*).

Fig 1: Secondary Impression of maxillary and mandibular arches

Fig 2: Master casts for both arches

Base plates and occlusal rims were fashioned on their respective master casts, and jaw relation procedures were undertaken to record a tentative centric relation. The maxillary and mandibular casts were mounted on a 3-point articulator, and teeth arrangement was accomplished in a Class I relation. A try-in was conducted in the patient's mouth to assess fit, function, and aesthetics, securing the patient's approval (*Fig.3*).

Fig 3: Try-in of the complete denture

Following this, the maxillary and mandibular master cast was duplicated with alginate, and the duplicated cast was employed for the adaptation of a brass metal mesh (*Fig.4*) that was customised using a Chain link wire mesh making machine. The metal mesh was accurately sized and contoured using a carborundum disk, and universal pliers were utilized for precise adaptation to the cast. Conventional laboratory steps for denture acrylization ensued, involving a unique sandwiched procedure. A portion of the heat-cure resin (DPI India) was adapted onto the maxillary cast, followed by the placement of the metal mesh, and conventional packing and curing were carried out. After deflasking, the denture underwent finishing and polishing (*Fig.5*).

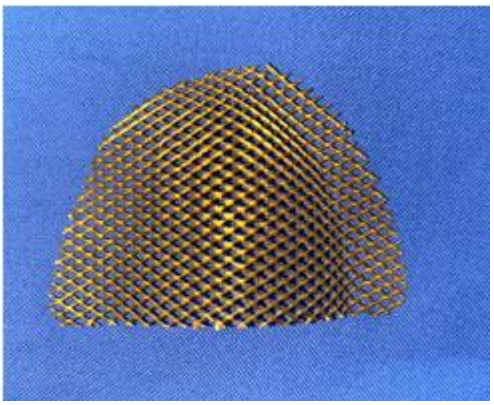

Fig 4: Customised brass metal mesh for maxillary denture base

Fig 5: Finished and polished dentures

ISSN No:-2456-2165

The metal mesh-reinforced maxillary and mandibular dentures were inserted, with occlusal adjustments made to the maxillary denture. Post-denture insertion instructions were provided, and the patient was recalled after two days for a follow-up checkup. The function and aesthetics of the denture were well-received by the patient (*Fig.6*).

Fig 6: Post insertion front profile

B. Procedure of Customizing the Brass metal mesh

This system is composed of a wire bobbin supplying raw wire, and a DC motor with a shaft linked to a distinctive mechanism for bending. When the DC geared motor operates, it rotates, in turn rotating a rectangular rod fixed inside a hollow round tube. A milling operation is executed on the tube to create a spiral-shaped cutout. As the rectangular rod spins within this hollow tube, the wire end from the bobbin is hooked onto the rod through the slot in the hollow tube. With the motor in motion, the rod's rotation causes the wire to spiral outward along the spiral-shaped cutout of the tube. This innovative mechanism efficiently achieves the desired bending requirements (*Fig. 7*)

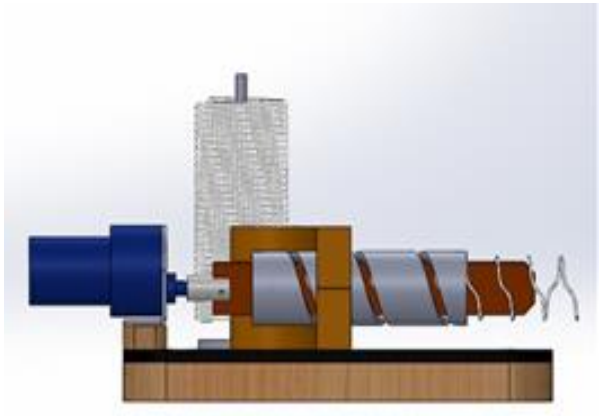

Fig 7: Block diagram of customised chain linking machine

III. DISCUSSION

According to a recent denture survey, midline fractures emerged as the most prevalent issue, with 71% observed in maxillary complete dentures and 29% in mandibular dentures [9].

A denture that undergoes repair with heat-cured resin typically retains around 85% of its original strength. In contrast, when repaired with auto-polymerizing resin, the denture exhibits only 55% to 65% of the original strength of a heat-cure denture [10].

The occurrence of denture fractures poses a significant challenge, impacting not only the well-being of patients but also presenting a noteworthy concern for dentists and dental laboratory technicians [11].

The risk of denture fracture is particularly pronounced when the denture base is thin, and masticatory forces are elevated. An ideal denture base material is characterized by biocompatibility with oral tissues, exceptional esthetics, superior mechanical properties—especially modulus of elasticity, impact strength, flexural strength, and hardness—sufficient bond strength with artificial teeth and lining materials, and the ability to undergo repairs or alterations in contours while maintaining dimensional accuracy. Prosthesis fractures typically arise from the initiation and propagation of cracks in areas of high stress concentration. Addressing this issue requires strategic measures [12].

Over the years, a variety of fibers, including carbon, aramid, polyethylene, jute, and glass fibers, have been incorporated into acrylic resin in an effort to enhance its mechanical properties. However, challenges such as inadequate wetting of fibers within the acrylic resin and the polymerization shrinkage of polymethyl methacrylate (PMMA) contribute to the deterioration of the resin layer on the surface of the fibers. This, in turn, diminishes the bond between the fibers and the polymer. The processing of fiber-reinforced denture bases appears to be technique-sensitive and challenging to fabricate in the dental laboratory [13].

Metallic inserts, whether in the form of mesh, wires, or plates, showcase superior strength, increased resistance to fatigue, and reduced susceptibility to breakage under typical conditions. This case report not only emphasizes the straightforward technique for creating a metal mesh-reinforced complete denture but also discusses the construction of the metal mesh without the need for a sophisticated manufacturing unit. Instead, a simple tabletop machine is employed, making the process less laborious and enabling the customization of brass metal mesh for individualized patient care [14,15].

IV. CONCLUSION

Prosthodontists face a significant challenge in delivering successful treatment for patients with completely edentulous arches. Metal mesh reinforced dentures emerge as a promising solution, providing enhanced strength and fracture resistance. This treatment option proves valuable for patients experiencing recurrent denture fractures, particularly those attributable to heavy occlusal loading.

ACKNOWLEDGMENT

I would like to express my deepest appreciation to Dr. M. Saravanan, my mentor and my junior Dr. Debapriya Biswas for their valuable contributions.

REFERENCES

[1]. Jar, Alabbas & Khormi, Abdullah & Al-khamiss, Norah & Alnaim, Atheer & Alharbi, Zainab & Holba, Hesham & Alshamrani, Abdullah & Khormi, Anwer & Alharbi, Amani & Almutairi, Arwa & Alhegbani, Faisal. (2023). The effect of dentures on oral health and the quality of life. International Journal Of Community Medicine And Public Health. 10.18203/2394-6040.ijcmph20233524.

[2]. Oweis Y, Ereifej N, Al-Asmar A, Nedal A. Factors Affecting Patient Satisfaction with Complete Dentures. Int J Dent. 2022 Apr 8;2022:9565320. doi: 10.1155/2022/9565320. PMID: 35432542; PMCID: PMC9012642.

[3]. Taylor M, Masood M, Mnatzaganian G. Longevity of complete dentures: A systematic review and meta-analysis. J Prosthet Dent. 2021 Apr;125(4):611-619. doi: 10.1016/j.prosdent.2020.02.019. Epub 2020 Apr 28. PMID: 32359852.

[4]. Takahashi T, Gonda T, Maeda Y. Influence of reinforcing materials on strain of maxillary complete denture. Acta Odontol Scand. 2013 Mar;71(2):307-11. doi: 10.3109/00016357.2012.680903. Epub 2012 May 1. PMID: 22545819.

[5]. Akinyamoju CA, Dosumu OO, Taiwo JO, Ogunrinde TJ, Akinyamoju AO. Oral health-related quality of life: acrylic versus flexible partial dentures. Ghana Med J. 2019 Jun;53(2):163-169. doi: 10.4314/gmj.v53i2.12. PMID: 31481813; PMCID: PMC6697771.

[6]. Balch JH, Smith PD, Marin MA, Cagna DR. Reinforcement of a mandibular complete denture with internal metal framework. J Prosthet Dent. 2013 Mar;109(3):202-5. doi: 10.1016/S0022-3913(13)60045-1. PMID: 23522371.

[7]. Narva, Katja & Lassila, Lippo & Vallittu, Pekka. (2005). The static strength and modulus of fiber reinforced denture base polymer. Dental materials : official publication of the Academy of Dental Materials. 21. 421-8. 10.1016/j.dental.2004.07.007.

[8]. Vijaysinh Mori H, Jadhav R, Sabane A, Patil A, Gachake A, Gurunath Kalsekar B. An In Vitro Study Comparing the Impact and Flexural Strength of Leucitone 199 Denture Base Resin and Conventional Denture Base Resin Enhanced With Glass Fibre Mesh and Polyethylene Fibre Mesh. Cureus. 2023 Sep 25;15(9):e45935. doi: 10.7759/cureus.45935. PMID: 37885506; PMCID: PMC10599458.

[9]. Rathee M, Singh S, Alam M, Jain P, Divakar S.Management of Repeated Denture Fracture Through Direct Metal Laser Sintering Metal Reinforced DentureJ Clin of Diagn Res.2023; 17(3):ZD04-ZD06. https://www.doi.org/10.7860/JCDR/2023/59227/17587

[10]. Heidari, Bijan & Firouz, Farnaz & Izadi, Alireza & Ahmadvand, Shahbaz & Radan, Pegah. (2016). Flexural Strength of Cold and Heat Cure Acrylic Resins Reinforced with Different Materials. Journal of dentistry (Tehran, Iran). 12. 316-23.

[11]. Choudhary S. Complete denture fracture - A proposed classification system and its incidence in National Capital Region population: A survey. J Indian Prosthodont Soc. 2019 Oct-Dec;19(4):307-312. doi: 10.4103/jips.jips_312_18. Epub 2019 Oct 10. PMID: 31649439; PMCID: PMC6803796.

[12]. Dhiman RK, Chowdhury SR. Midline Fractures in Single Maxillary Complete Acrylic vs Flexible Dentures. Med J Armed Forces India. 2009 Apr;65(2):141-5. doi: 10.1016/S0377-1237(09)80128-7. Epub 2011 Jul 21. PMID: 27408221; PMCID: PMC4921429.

[13]. Issam Elfaleh, Fethi Abbassi, Mohamed Habibi, Furqan Ahmad, Mohamed Guedri, Mondher Nasri, Christian Garnier, A comprehensive review of natural fibers and their composites: An eco-friendly alternative to conventional materials, Results in Engineering, Volume 19,2023, 101271, ISSN 2590-1230, https://doi.org/10.1016/j.rineng.2023.101271.

[14]. Alla, Rama Krishna & Sajjan, M C Suresh & Alluri, Venkata & Ginjupalli, Kishore & Upadhya, Nagaraj. (2013). Influence of Fiber Reinforcement on the Properties of Denture Base Resins. Journal of Biomaterials and Nanobiotechnology. 4. 91-97. 10.4236/jbnb.2013.41012.

[15]. Murthy, H & Shaik, Sharaz & Sachdeva, Harleen & Khare, Sumit & Haralur, Satheesh & Roopa, K. (2015). Effect of Reinforcement Using Stainless Steel Mesh, Glass Fibers, and Polyethylene on the Impact Strength of Heat Cure Denture Base Resin - An In Vitro Study. Journal of international oral health : JIOH. 7. 71-9.