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The Suction Cup Denture: A Century-Old Technology Reborn

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Complete denture wearers may be one of the largest underserved dental patient populations, with numbers estimated at more than 40 million in the United States alone. A significant number of these patients have dentures with diminished or poor function for a variety of reasons. Contributing structural factors include changes in the denture base, such as warping or breakage, and wear, fracture, and loss of the denture teeth. Contributing physiologic factors include atrophy through bony resorption, thinning of the overlying gingiva and mucosa, decreased or altered salivary flow and quality, soft- and hard-tissue lesions, neuromuscular challenges, temporomandibular dysfunction, resective surgery, and trauma, among others.

Of these, the most common detrimental oral change is atrophy of the alveolar ridge, causing altered bony and soft-tissue architecture. The end result is a significant decrease in denture base support and retention of the prosthesis. While it is possible to enhance the resorbed ridge and/or place implants, not all patients are surgical candidates, especially the elderly and the medically compromised. This large group of patients must resort to improving denture retention with a variety of nonsurgical alternatives, the most common of which includes the use of denture adhesive pastes, powders, and pads.

Denture adhesives merely reduce the amount of lateral movements that occur while dentures are in contact with basal tissues. This benefit can mislead a patient into ignoring his or her need for professional help when dentures actually become ill-fitting. Adhesives, however, are possibly the most commonly used over-the-counter remedy for loose dentures, with annual sales in the United States exceeding $200 million1 (12% more than for denture cleaners and nearly twice the spending on dental floss). Consumer surveys reveal that approximately 33% of denture patients purchase one or more denture adhesive products in a given year. This has led to the growth of a very large denture adhesive industry.2

Patient response to the use of these materials is not universally positive. Some patients object to the â€œgrainyâ€ or â€œgrittyâ€ texture of powder or to the taste or sensation of semidissolved adhesive materials that escape from under the denture.3 Others object to the difficulties encountered in removing adhesive from the denture and the oral tissues and the cost of the material. Denture adhesive products are frequently regarded as an impediment to a dentistâ€™s ability to evaluate accurately the health of a patientâ€™s oral tissues4,5 and the true character of denture adaptation.6-9 Scientific evidence favoring the support of routine and safe use of adhesives is lacking and is often an option of last resort for patients who have given up in search of a better alternative or are not educated to other possibilities.

A Brief History of Denture Retention

The retention of dentures to the edentulous arch is a story with a colorful past. In the 1700s, steel springs were used to hold the upper and lower dentures together while applying pressure to the lower denture.10 It was reported that the set of teeth could suddenly spring out of the wearer's mouth. George Washington was known to have worn spring-retained dentures. More recent innovations have made use of existing anatomy to aid in retention. These have included lingual muscular pressure against lingually positioned, denture-retained stainless steel clips; bendable flanges engaging the undercuts of the mylohyoid ridge; silicone-lined dentures;11 small projections that engage the soft tissue;12,13 the prong denture;14,15 and transitional mini-implants with ball attachments, among others.16

All of these techniques have both positive and negative attributes and cannot be used with complete success in all patients. There is one technique, the EZ-Suctioncup Denture (Aesthetic Porcelain Studios), that offers a unique and creative option in removable prosthetic retention, providing an alternative to ill-fitting, poorly retentive dentures.

The Suction Cup Denture

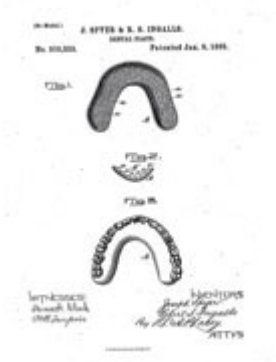

Figure 1. *The first US patent describing the use of multiple suction cups to enhance denture retention.*

This unique concept in denture retention was conceived and patented by Dr. J. Spyer and R.S. Ingalls17 in 1885 (Figure 1). The design consisted of a denture base fabricated from â€œrubber or any of the known materialsâ€"gold, platinum, or other metal.â€ During the fabrication process, final flasking was accomplished by creating an inner tissue-bearing lining of rubber with multiple tiny suction cup projections enhancing suctionand therefore the retention of the denture unit. After falling into disuse for several decades, this technique was reintroduced to dentistry in 1967 by Dr. A. C. Jermyn. In his research and clinical studies, Dr. Jermyn noted that this unique alteration in the denture intaglio

increased the surface area covered by the suction cups, distributing even pressure and greatly enhancing denture retention.18 The best results were obtained with a cup shaped with straight sides and a tapered interior angle of 12.5Â°.19 Since the soft tissue tended to conform to the shape of the cups, histologic studies were conducted that verified the long-term safety of this device.20 Over 2 decades later, the EZ-Suctioncup Denture was developed through the pioneering ingenuity of Mr. David Block, CDT21 (Aesthetic Porcelain Studios). This concept redesigned the entire suction cup denture fabrication process by focusing on materials science, adhesion dynamics, and highly accurate processing methods.

Materials and Technique

Table. Clinical Indications For Suction Cup Dentures

- Resorbed alveolar ridges
- Undercuts
- Rotational paths of insertion
- Salivary dysfunction
- Neurological disorders
- Resective surgery
- Traumatic changes of the oral cavity
- Medication induced xerostomia
- A history of head and neck irradiation
- Systemic disease
- Disease of the salivary glands
- Neurological diseases
- Cerebrovascular accident (stroke)
- Diminished tactile sensation
- Partially or wholly paralyzed oral musculature
- Orofacial dyskinesia (a prominent side effect of phenothiazine-class tranquilizers)

The EZ-Suctioncup Denture is a soft silicone liner applied to the tissue-bearing surface of a traditionally fabricated acrylic denture. The suction cups can be processed during the fabrication of new dentures or in the relining of existing dentures. The suction cup liner can be applied to both upper and lower dentures, with a maxillary denture having up to 200 suction cups and a mandibular denture more than 150. This prosthetic system is highly beneficial for edentulous patients with uneven ridge morphology,22 flat ridges, poor healing,23 post-infection tissue healing,24 long-term denture wear,25-29 and age,30 among others (see Table).31

Flat, denture-bearing surfaces offer greater suction cup retention compared to ridges. This interesting phenomenon occurs in the same way that suction cups pressed against a flat pane of glass stay in place. The squeezed elastic cups seek to return to their larger shape, thereby causing air pressure within the cups to be less than the pressure outside the cups. This in turn prevents the introduction of suction-breaking air common to the adhesive properties of nonflat surfaces. In addition, because the suction cup surface contains a minimum of 150 suction cups, there is an overwhelming increase in the denture-bearing surface area. Because the amount of retention provided by suction cup adhesion is proportionate to the area covered by the denture, there is a definitive advantage in maximizing the surface area covered by the denture.

Because mandibular dentures cover less surface area than maxillary prostheses, they are subject to a lower magnitude of adhesive retentive forces. Thus, the dentures should be extended to the limits of the health and function of the oral tissues, and efforts should at all times be made to preserve the alveolar height to maximize retention.

Case Report

Figure 2. *The patient presented with a mandibular deviation due to past trauma sustained while boxing.*

Figure 3. *The patient was a professional body builder and boxer (picture circa 1959).*

Figure 4. *The mandibular edentulous arch with*

Figure 5. *The maxillary edentulous arch presented*

uneven ridge morphology and edematous tissue.

with a midline growth on the hard palate and a shallow vault.

The patient (Figure 2), a 70-year-old male in excellent health, presented with an interesting history. In his youth, he had been a body builder and a boxer (Figure 3). He reported having had his jaw broken several times over the course of his boxing career. Due to repeated trauma and periodontal disease, he had become completely edentulous (Figures 4 and 5). Because of chronic dysfunction of the left temporomandibular complex, the chief complaint was focused on bilateral clicking and popping on opening, with chronic headaches and an inability to chew food properly. The patient could only retain the lower denture using an over-the-counter adhesive pad. The patient's complaints were verified and confirmed.

Figure 6. *The patient's existing dentures revealed uneven occlusal wear in a classic â€œroller coasterâ€ pattern.*

Figure 7. *A model of the lower arch prepared with suction cup preparations. Note the uneven ridge morphology.*

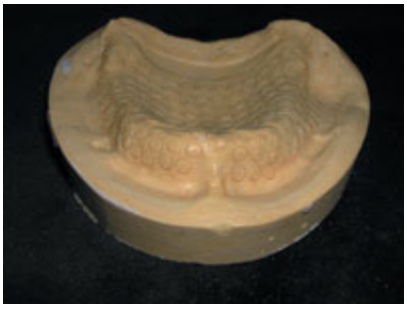

Figure 8. *A model of the upper arch with suction cup preparations. Note the narrowing and shallow nature of the arch form.*

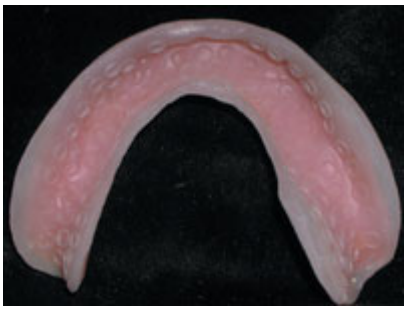

Figure 9. *The definitive laboratory fabricated EZ-Suction Cup Lower Denture.*

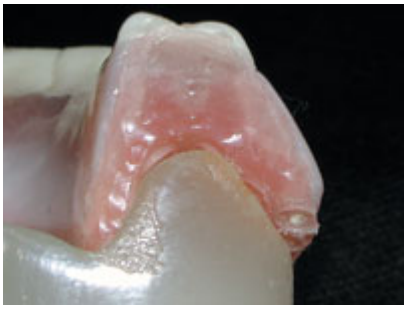

Figure 10. *A cutaway view of an EZ-Suction Cup Lower Denture demonstration model displays the intimate contact between the suction cup liner and the acrylic denture base.*

There was heavy and uneven wear of the denture teeth on the upper and lower right side. The denture teeth on the upper and lower left side originally set in crossbite were not in function (Figures 6 through 10). A significant loss of vertical

dimension of occlusion was a major contributing factor in the dysfunction of the TM complex. In order to create a comprehensive treatment plan, the patient was given a complete exam that included radiographs, study models of the edentulous arches and the existing dentures, and digital photographs.

The plan included fabricating a transitional upper/lower denture that would offer improved retention and a corrected vertical dimension of occlusion. This increase to the patient's corrected physiologic vertical dimension of occlusion would not only help to improve appearance but also decompress the TM capsule and joint assembly and reduce forces and pressure on the retrodiscal tissue. This in turn would allow surrounding tissues the ability to remodel and regain improved function. Because of the severity of the patient's problems, these transitional dentures would be worn for approximately 6 months. This would allow healing of traumatized tissues and an opportunity to make any necessary corrections in preparation for the definitive denture units.

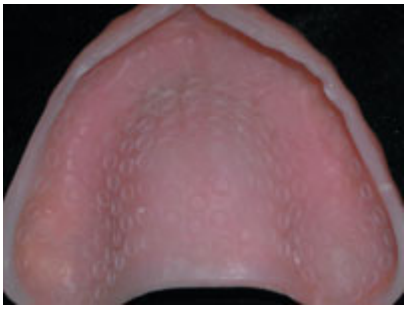

Figure 11. *The definitive laboratory fabricated EZ-Suction Cup Upper Denture.*

Figure 12. *The EZ-Suction Cup liner is easily adjusted by initially removing any gross material with scissors designed specifically for this purpose.*

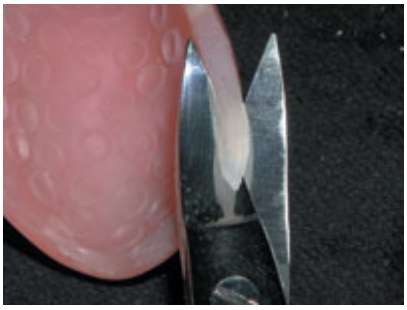

Figure 13. *The junction between the silicone and acrylic is refined with a bur designed for soft liner adjustment.*

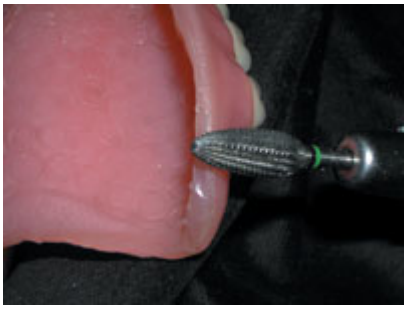

Figure 14. *This area is then polished using a soft liner polishing wheel.*

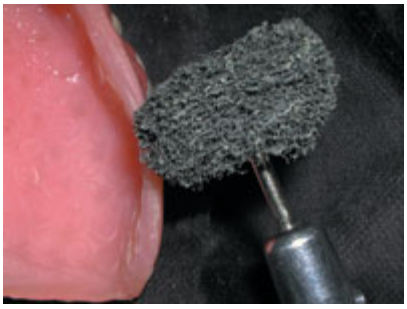

Figure 15. *A lateral view of the patient's previous denture. Note the severe occlusal wear contributing to the patient's initial complaint of TMJ dysfunction.*

Figure 16. *The completed EZ-Suction Cup denture demonstrates a harmonious occlusion that promoted repair and healing of the TMJ Complex.*

Figure 17. *The patient wearing the definitive prostheses. The mandible no longer deviates and the patient has a normal profile and facial form.*

Upon completion of this interim phase, final impressions were made using the transitional units as modified custom trays, followed by traditional occlusal rim records and wax up try-in. EZ-Suctioncup soft liners were processed in the tissue-bearing surfaces of the upper and lower dentures (Figures 9 through 11). After a follow-up appointment to balance the occlusion and adjust a minor denture sore in the upper buccal vestibule (Figures 12 through 14), the patient reported that the suction cup dentures remained secure during function (Figures 15 through 17). He commented, â€œIt doesnâ€™t feel like Iâ€™m wearing dentures. Iâ€™m not aware of them.â€

This is the ultimate goal: to create a prosthesis so comfortable and stable that the patient is not consciously aware of its presence.

Conclusion

A simple technique for enhancing the retention and stability of dentures has been described. A large number of small suction cups formed from soft, resilient silicone are processed in an otherwise conventional denture. These suction cups grip the oral tissue, providing an increased surface area for enhanced retention and a suction force for increased resistance. The procedure requires working

with a laboratory that is technologically advanced in the construction of this technique-sensitive procedure. When properly done, the EZ-Suctioncup Denture can offer an alternative to patients who seek a successful prosthetic result.

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Dr. Shuman maintains a full-time private practice outside Baltimore, Md, emphasizing reconstructive and aesthetic dentistry. He is a fellow of the Academy of General Dentistry, a fellow of the Pierre Fauchard Academy, and a member of the American Dental Association. Since 1989, Dr. Shuman has published more than 50 dental research and clinical articles that have appeared in numerous dental journals. The cutting edge techniques and entertaining style

of his seminars and hands-on courses have made him a hit in the dental world. Dr. Shuman has recently produced a complete Denture Educational System entitled â€œCreating the Denture Practice of Your Dreams,â€ which includes an instructional DVD, workbook, and CD-Rom. This educational system is an enjoyable, provocative, invaluable resource to your patients and practice. It may be ordered by calling (410) 766-5104, or by e-mail at ishumandds@erols.com, or visit ianshuman.com.

Disclosure: Together with Aesthetic Porcelain Studios, Dr. Shuman has produced a continuing education video on the suction cup denture and an accompanying book and CD entitled â€œCreating the Denture Practice of Your Dreams: A Powerful Step-By-Step Guide to Making Dentures Outrageously Simple.â€