

Evaluation of Two Different Obturator's Linings on Retention in Maxillectomy Patients

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Abstract: The aim of the present work was to carry out an evaluation of two different obturator's linings on retention in maxillectomy cases. Ten patients participated in the study and the obturators were formed in 2 sections, with 2 paths of insertion, a soft liner section in the defect side and the other section formed from flexible acrylic resin. A flexible acrylic obturator frame was designed and remained unchanged to be used for all obturators done for each patient, while 54 different soft liner bulbs were constructed. Measurement of retention was done monthly in 4 phases, 6 months each, over 2 years. In the first year, this was done on the Mollosil obturators without application of silver nano particles, while in the second 6 months with silver nano particles. The same regimen was repeated in the second year on Multisil obturators. It was concluded that, the preferable protocol for construction of definitive obturators for maxillectomy patients is to use flexible acrylic frames lined with soft liners, starting with a moderate soft liner as (Mollosil), followed by a firmer soft liner as (Multisil), combined with decontamination of the lining by an antimicrobial agent.

Keywords: maxillectomy, obturators, retention, silver nanoparticles, soft liners.

1. Introduction

Maxillectomy is a treatment option for maxillary cancer that leaves the patient with a palatal defect, which may cause problems with swallowing, mastication and speech. These functional problems and changes in appearances may result in psychological disorders. The defect frequently is complex and therefore, reconstruction of such defect is often challenging. The primary objectives of maxillofacial prosthetic rehabilitation includes obturating the defect, restoring aesthetics, speech, mastication, and deglutition [1]. The use of short or long term soft lining material to engage the soft tissue undercuts is well tolerated by the patient and also adds to retention. However, the temporary and permanent soft lining materials are not resistant to adhesion and possible surface damage caused by oral microbes, and therefore their use should be either combined with antimicrobial agents or limited to short-term periods [2]. Flexible acrylic material was chosen to make a prosthesis more patient friendly [3].

Prosthetic rehabilitation of large maxillary defects with two-piece obturators offered the possibility of adequate oral rehabilitation by fabricating light weight prosthesis, which was easy to use. The bulb covered the undercut areas of the defect enhancing the facial contour and retention. It facilitated easy examination of underlying tissues, recreation

of the anatomic barrier between the oral and nasal cavities and restoration of the function and esthetics [4]. Optimum retention and stability are highly required for the construction of a maxillectomy obturator.

2. Materials and Methods

In this study, 10 flexible acrylic obturator frames and 54 soft liner bulbs were constructed for 10 patients suffering from maxillectomy. The patients were searched for in Maadi Armed Hospital, Kobry al Kobba Military Hospital, with the following patients selection criteria: maxillectomy cases with remaining dentulous intact side, absence of any large mucosal septum in the patient bulb defect. Patients were either not subjected to radio or chemotherapy or completed treatment successfully, and ranged from 20-70 years old, including both sexes and both defect sides. Flexible acrylic (Flex-thermopress400) was used for the construction of the

obturator's frames. Two different linings were used, a medium acting soft-liner (Mollosil Detax long term) and a long acting one (Multisil Bredent). Locally prepared silver nano particles were used as an antimicrobial agent. The patients were classified into 3 main categories, namely adequate, deep and superior defects.

A dead-weight dislodging device [5] and a digital one were used either separately or connected together for more accurate outcomes and result comparison.

i. Obturator Fabrication

The obturators were formed in 2 sections, with 2 paths of insertion. One section in the defect side, formed from the soft liner and engaging its grooves and undercuts to accurately capture the dimension and configuration of the obturator bulbs [6]. The other section represented the missing teeth and palate formed from flexible acrylic resin, attached to the silicone bulbs mechanically. A flexible acrylic obturator frame was designed and remained (Fig. 1).



Fig. 1: Case 8: Undercut superior, impression and constructed obturator

ii. Biosynthesis of silver nanoparticles

Silver nanoparticles were prepared locally biologically by *Candida albicans*, as described by [7].

iii. Measurement of retention

Measurement were done by a digital and a dead-weight

dislodging device either separately or connected together (Fig. 2) for more accurate outcomes and result comparison. Data were collected in grams and monthly recorded for each of the 10 patients over 2 years. In the first year, this was done on the Mollosil obturators in the first 6 months without application of silver nano particles as an antimicrobial agent, while in the second 6 months with silver nano particles. The same was repeated in the second year on Multisil obturators



Fig.2: Retention measurement using the deadweight frame and the digital device

iv. Data management.

Data were collected, tabulated and statistical analyzed by SPSS 14 (2006) and Microsoft Office 2010 (Excel) [8].

3. Results

Retention measurements

i. Retention measurements for Mollosil obturator bulbs without AgNPs decontamination

Patients in phase 1 used the Mollosil obturators, which were rinsed by tap water, could not continue with the obturators during the first phase and required new linings after 2-3 months. The retention measurements on the first month varied among these patients and ranged from 550-1100 gm. During the subsequent months there was an increase in the retention in the range of 50-150 gm. This increase was insignificant. All patients complained of discomfortability and irritation starting from 2-3 months with the main complaint of difficulty during insertion and removal as well as bad odour and discolouration of the obturator.

Variations in retention measurements were clearly demonstrated in (Fig.3) that was observed almost monthly in

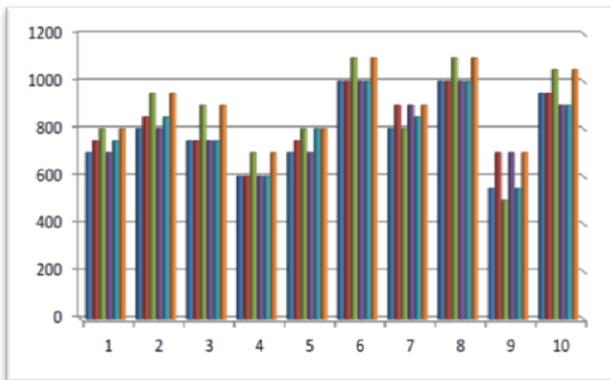


Fig 3. Retention measurements for Mollosil bulbs without AgNPs decontamination

iii. Retention measurements for Multisil obturator bulbs without decontamination by AgNPs

In phase 3, some patients using Multisil decontaminated with tap water felt annoyed toward the end of this phase, but continued irrespective of the bad odour and slight discolouration and irritation. The remaining patients completed the whole phase without complaint. The retention measurements ranged from 1000-1500 gm, and remained without changes.

iv. Retention measurements for Multisil obturator bulbs decontaminated by AgNPs

most of the patients, while it was almost constant in cases (3, 4, 6 and 8). Retention values of the Mollosil did not exceed 1000 gm except in only two cases (6 and 8), where they reached 1100 in patients with superior defect undercut. After 2-3 months the gradual increase in retention was observed in all patients within range reaching an increase value of 150 gm in 3 patients (cases 2, 3 and 9).

ii. Retention measurements for Mollosil obturator bulbs decontaminated by AgNPs

All patients in phase 2 received new Mollosil linings on the same obturator frame and a bottle of 50 ml stock solution of 600 µg/ml AgNPs, with the strict instruction to immerse the Mollosil bulb in the AgNPs overnight and wash it with tap water before insertion in the mouth. Eight patients continued the phase 2 without the need for the renewal of the lining. The retention measurements showed almost the same range as in phase 1, only 2 patients required new linings after 5 months. All patients were satisfied through the whole phase period. It was evident from (Fig.4) that, the measurements values were almost stable in the last 4 months in almost all patients, except cases 7 and 9, who required new linings at the last month. Almost the same gradual increase took place and the maximum value did not exceed 1100 g. The most stable retention value increase was in case 5, while a gradual increase took place in cases 1 and 10

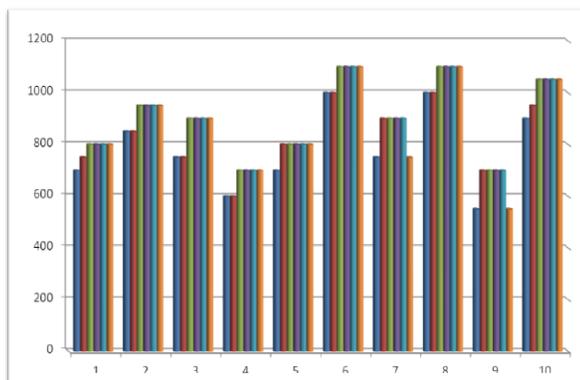


Fig 4: Retention measurements for Mollosil bulbs with AgNPs decontamination

In phase 4, all patients using Multisil decontaminated with AgNPs continued without complaint. The retention measurements were the same as in phase 3. The values of retention were almost constant during the half of the whole phase in cases numbers 2 and 8. In the last 2 months in cases numbers 5, 6 and 9 and in the last month only in cases numbers 3, 4 and 10 there were a constant increase, while in the first case the values of retention measurements were the same during the whole six months (Fig. 5).

v. Comparison of retention between Mollosil and Multisil obturator bulbs

As shown in Fig. 6, the retention measurements of Multisil bulbs were clearly higher than that of the Mollosil bulbs in all patients throughout the 2 years period. The highest

difference was observed in cases numbers 2, 3 and 8. Statistical analysis of Mollosil and Multisil retention measurements revealed that, Multisil obturators showed much better retention than Mollosil obturator, irrespective of

the application of AgNPs. The difference between the retention of the two types of linings was highly significant ($p=0.001$).

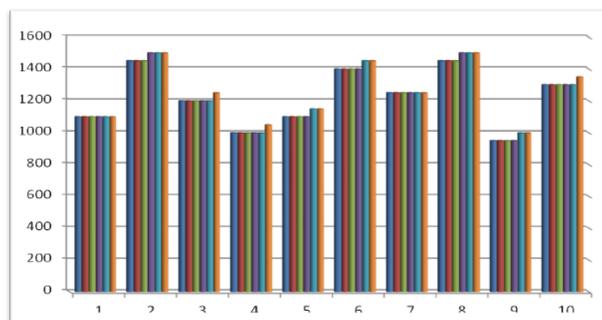


Fig. 5: Retention measurements for Multisil bulbs with AgNPs decontamination

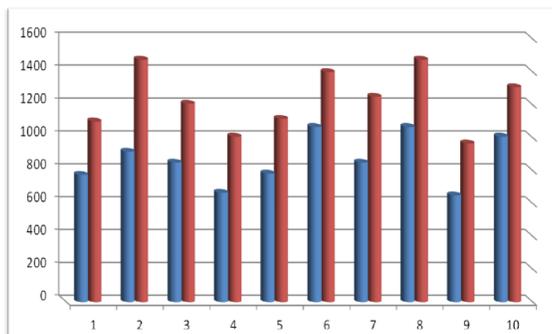


Fig. 6: Comparison of mean retention between Mollosil and Multisil obturator bulbs

5. Discussion

The silicone obturator constructed in the present thesis was formed in two-piece giving the prosthodontist a better and easy way to face cases with limited mouth opening, which may result after the tumour resection. The use of two-piece obturators was also favoured by several authors [9]- [12].

New methods have been recently adopted to make the bulb hollow especially with silicone material, which is easier to fabricate reducing the danger of leakage and discoloration [13]. A moderate soft liner, which is commonly used as a short-term relining material, was used in the present work head by head in comparison with a long acting-silicone, based on its much better suitability in patients with high degree of mucosal sensitivity, either naturally or temporally post radio or chemotherapy, where the patient could not withstand the pressure of the initial application of the harder soft liners and the relining material was relatively much thicker, larger and isolated in the nasal cavity and were not in direct contact with the oral microflora [14].

Apart from their many advantages, they are easily colonized by the oral microflora and hence become a predisposing factor to denture-induced stomatitis secondary to *C. albicans* overgrowth [15]. Tissue microtrauma and traumatic injury can reduce tissue resistance to infection and increase epithelial permeability to soluble *Candida* antigens and toxins. This situation may worsen in the case of poor oral hygiene and defective denture cleansing [16]. A solution to the problem of the high microbial invasion of the soft liners was suggested in modification of soft liner materials with silver nano particles (AgNPs) [17]. Many of the recent reports indicated that silver and its compounds have strong inhibitory and microbicidal effects [18]. To avoid any possible side effect of AgNPs, the patients were instructed to keep the soft liner bulbs overnight in the AgNPs solution as recommended by [19], who mentioned that the purpose of immersing dental prostheses in a disinfectant solution is to inactivate infectious microorganisms without damaging the dental prostheses. In such case no direct contact was

present between the flexible acrylic piece of the obturator and the antimicrobial agent used. AgNPs was used successfully to decontaminate the soft liner, moreover no alterations were observed during the use of AgNPs solution either on the Mollosil bulbs during the second phase or the Multisil bulbs during the fourth phase of the study with regard to the retention values.

This is in agreement with [20], who applied nano silver coating directly to the surface of a silicone-based maxillofacial prosthetic material to investigate the biocompatibility and antifungal properties of the coating and concluded that, AgNPs formed a stable antifungal coating on medical grade silicone and the biocompatibility of the prosthetic material was maintained. Irrespective of the short survival time of the Mollosil linings and continuous need for renewal, yet its softness and highly acting cushion effect are still in favour of using this material by most of the patients, especially in those suffering from sensitive mucosal tissues, either naturally or postoperatively. Some patients, though could withstand firmer long acting lining material, yet they preferred a softer material like Mollosil, especially at the beginning of the treatment. A major advantage of using soft liners is the significant comfort that they bring to the patients, who would otherwise suffer from chronic discomfort [21]. In phase 1, the above-mentioned criteria of the Mollosil linings influenced the sequence of treatment. The retention measurements varied among the patients and ranged from 550-1100 gm. This accepted value of retention is related to the degree of material firmness, which is ranked moderately between other soft liners in the manufacture [22]. During the subsequent months there was a gradual limited increase in the retention in the range of 50-150 gm. The increased values in 3 patients (cases 2, 3 and 9) reached 150 gm, while it was 100 gm in the remaining cases. This could be explained by the hardening effect, which took place in the inner configuration of the material due to chemicals release. This conforms to the findings of [23], who mentioned that, by time soft lining materials exposed to the continual influence of a humid environment can lose their soluble components and absorb water.

Eight patients asked for renewal of the lining after 3 months and 2 patients required 3 new linings within this short period. This became marked, probably due to the insufficient decontamination of the material by tap water, as confirmed in the laboratory study done by [7]. These findings are also in agreement with the opinion of [24], who mentioned that soft liners are highly porous allowing bacteria and fungi to penetrate inside. This can lead to bad-smelling dentures and irritable gums. Soft liners harden with time due to their gradual disintegration resulting in rough surfaces, sharp projections and high affinity to microbial colonization, which necessitate periodical relining. In phase 2 of the present study, AgNPs was used as a decontaminating agent of the Mollosil bulbs. AgNPs, as coating, or even impregnated on the medical device are thus emerging as a next-generation of antimicrobial agents. Although, some studies have raised some concerns regarding silver NPs biosafety, there are studies demonstrating the efficacy of silver NPs in reducing or preventing biofilm formation on catheter-materials both *in vitro* and in animal models[25].

Retention measurement values were almost the same as in phase 1 and were stable in the last 4 months in almost all patients. This could be explained by the stability of the silicone-base nature of the material as mentioned by several authors [26]-[28]. The statistical analysis of the retention measurements of the Mollosil obturators revealed that the direct AgNPs effect on retention was insignificant, as it was not integrated in the soft liner material in addition to the daily wash and the removal of any remnants as instructed to the patients. Although time prolongation for the lining was evident in almost all patient over the whole phase, the relatively increased values in retention did not continue to rise as expected. This may be explained by the laboratory studies that have documented an increases in ALTSDL (acrylic-based long-term soft denture linings), hardness by as much as 150% during the initial six months of aging in distilled water, while, the hardness of SLTSDLs (silicone-based long-term soft denture linings), that were aged in distilled water was altered by no more than 63%, or it remained unchanged [29], [30].

All patients in phases 3 and 4 received new linings of Multisil material on the same frame. The degree of microbial growth on Multisil, as the discoloration and the offensive odour, were remarkably lower than that of the Mollosil in phase 1, although present but with significant difference in Multisil than that by the Mollosil bulbs, especially in phases 3 and 4. Phase 4 was the best for all patients with significant difference in all compared items, especially in the degree of discoloration and surface roughness felt by the patient. The retention measurements was higher than that in the previous phases, ranged from 950-1500 gm, and remained without significant changes throughout the two phases. Statistical analysis of Mollosil and Multisil retention measurements revealed that, Multisil obturators showed much better retention than Mollosil obturators, irrespective of the application of AgNPs. The

difference between the retention values of the two types of obturators was highly significant. These findings are in agreement with [31], who examined six types of soft liner materials (including hard Ufi Gel C) and analyzed colonization and penetration by *Candida albicans*. None of the examined materials showed inhibition of *Candida albicans* compared with a positive control. There was also no observed difference in adhesion of *Candida albicans* between these various materials. Ufi Gel C was proved to be less resistant to penetration by *Candida* blastospores than the other tested materials, which was explained by the effect of material porosity. The absence of hyphal forms of *Candida albicans* inside the materials was associated with higher hardness; all remaining materials that were classified as soft were also penetrated to a significant extent by hyphal forms of *Candida albicans*.

The values of retention were almost constant during the both phases of six months, and the patients continued to use the obturators without requesting renewal of the lining. This was expected due to the firmer nature of the Multisil in comparison to Mollosil, as illustrated by [22].

The main factors which can be incriminated for the variations in retention values among the patients in general, in the present study, are probably the defect size configuration and the sensitivity of the mucosal lining of the defect. The defect classification used in this study corresponded to the 3 classes in the classification of [32]. The adequate defects had the lowest retention values with a mean of 693.75 gm in Mollosil bulbs, while the mean of retention of the same material in cases of superior defects was 1014.3 gm. This could be explained by the discrepancies in the defect size, shape, amount of undercut present and availability to be utilized by the patient as well as the operator, which is responsible for the impression of the defect upon which all subsequences are dependable. This was enforced by the technique used in the present study to construct the obturator lining, which added a mushroom-like extension on the acrylic frames, that carried the silicone-base material inside the defect to accurately capture all configuration and undercuts present even with the minimal accepted impression configuration.

The other factor influencing retention was the mucosal sensitivity which, on the contrary to the first factor, had a negative effect on the degree of retention. The negative effect of both factors combined together was observed in cases 1,2 and 5, but it was more obvious in case number 9, who showed the lowest retention measurements throughout the whole period. The mucosal sensitivity is variable among patients and may be attributed to many reasons as the general and oral health condition, as mentioned by [33] or idiopathic as a nature of the tissues and apparently resides in conjunction with the postsurgical chemo- or radiotherapy, as in cases numbers 1,2,5 and 6 or may be natural as in cases, 7 and 9. As mentioned by [34], chemotherapy and radiation therapy may directly damage and break down oral tissue, salivary glands, and bone and may cause changes in the

lining of the mouth and the salivary glands, resulting in reduction of saliva, leading to upset of the healthy balance of bacteria, causing mouth sores, infections, and increase of the mucosal sensitivity. It should be noted that the sensitivity, not only affects the retention, but also necessitates frequent renewal of the bulb linings, as recorded in those 2 patients, who consumed 7 renewals in 2 years, with consequent more expenses and efforts.

6. Conclusion

- It is necessary to daily decontaminate the obturator bulbs overnight in antimicrobial agents to prevent colonization and discoloration of the lining material.
- The short life span and frequent relining of the Mollosil, could be relatively overcome by the application of AgNPs, which had no direct effect on the retention of the obturator linings.
- The preferable protocol for construction of definitive obturators for maxillectomy patients is to use flexible acrylic frames lined with soft liners starting with a moderate soft liner as (Mollosil), followed by a firmer soft liner as (Multisil), combined with decontamination of the lining by an antimicrobial agent.

7. Acknowledgement

The authors are grateful to Prof. Dr. Atef Hassan, AHRI, Dokki Giza for the supply of required amounts of silver nanoparticles, which he prepared it biologically in his laboratory.

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