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Cost-Effectiveness of CM-LOC Attachment versus Ball Attachment Retaining Single Implant Mandibular Overdentures

Amr Ahmed Naguib*, Nada Sherin El Khourazaty, Ashraf Abd El Monaem

Department of Removable Prosthodontics, Faculty of Dentistry, Cairo University, Cairo, Egypt

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***Correspondence:** Amr Ahmed Naguib. Department of Removable Prosthodontics, Faculty of Dentistry, Cairo University, Cairo, Egypt. E-mail: amr_naguib@hotmail.com

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Abstract

AIM: To investigate the cost-effectiveness of the novel CM-LOC attachment compared to the gold standard ball attachment in single implant mandibular overdenture.

MATERIAL AND METHODS: Fifty-two completely edentulous patients (50 to 69 years old) seeking to improve the retention of their complete mandibular dentures by installing a single implant in the midline of the mandible were recruited for this study. The patients were equally divided into two groups. The first group received a ball attachment abutment over the implant and the second group received CM-LOC attachment abutment. The initial cost and aftercare (maintenance) cost were calculated for each attachment and compared to each other.

RESULTS: The initial cost of the CM-LOC attachment was 2.2 times that of the traditional ball attachment. The after-care cost of the CM-LOC attachment was 2.39 times more than the ball attachment. The total cost of the CM-LOC attachment was 2.22 times that of the ball attachment.

CONCLUSION: The ball attachment system showed better cost-effectiveness compared to the CM-LOC attachment from the beginning of the study and throughout all the treatment period during the first year.

Introduction

Nowadays, edentulous patient's expectations and needs are very high, and by using complete denture as a prosthetic option large number of patients may not be satisfied. There are high potentials for problems to arise after the use of complete dentures.[1]The prosthodontic rehabilitation with implant-retained overdentures represents a superior treatment option to overcome these problems.

Implant overdenture (IOD) improves stability, retention and patient-reported outcomes compared to conventional complete dentures. On the other hand, its higher cost causes some concerns, as most of the completely edentulous patients are senior citizens and may have limited financial abilities and would prefer cost-effective procedures.

Up till now, the two (IOD) is the first choice as a standard of care for the edentulous mandible in most cases, but a single (IOD) was raised as a more cost-effective treatment with comparable patient satisfaction levels [1].

In a single (IOD) ball attachments are very commonly used because they are solitary, simple, and easier to use and less technique sensitive. However, ball attachment is known for their susceptibility to wear and their nylon matrix has to be exchanged after a certain time of clinical service, which causes a financial burden on the patients [2].

The Cendres Metaux Locator (CM-LOC) attachment was recently introduced into the market as an alternative to the ball attachment. It is claimed that its new design and materials may significantly reduce wear and subsequently less matrix exchange and less maintenance, which should lead to better cost-efficiency. However, the clinical performance of this

attachment regarding single IOD is not tested yet [3].

This study was conducted to compare the difference in cost-effectiveness between the most commonly used ball attachment and the new CM-LOC attachment in retaining single (IOD).

Material and Methods

Study setting

The randomised clinical trial was conducted in the Removable Prosthodontics Department, Faculty of Dentistry, Cairo University.

Patient selection

The 52 patients fulfilled the following criteria: - Completely edentulous male or female patients between the ages of 50 to 69; - Patients with no systemic or local contraindications for implant placement; - Patients with a mandibular denture height more than 6 mm between the base of the denture and the incisal edge of the central incisors; - Sufficient bone quality and quantity; and - Only compliant and cooperative patients were included.

All patients had a thorough examination including a check on medical and dental history, laboratory investigations, clinical and radiographic examination.

A complete denture was made conventionally and then duplicated into a radiographic stent to be used during the cone-beam C.T. the duplicate was also, used as a guide for implant placement in the midline. An implant fixture was placed conventionally. Three months later, the implant abutment was placed. The patients received either a traditional ball abutment or the novel CM-LOC abutment and direct pick up was performed with the complete denture.

A one year follow up with maintenance was made for every patient after the pick-up. Maintenance included occlusal adjustment, denture relining, denture repair (if fracture) and changing the nylon cap.

Measuring the outcome

Cost analysis was made to the whole study in United States American dollars. The total direct cost was calculated throughout the study by adding the sum of the initial cost and the aftercare cost throughout the follow-up period in an excel sheet.

The statistical analysis

The collected Data were statistically described in terms of mean ± standard deviation (± SD), or frequencies (number of cases) and percentages when appropriate. Comparison of numerical variables between the study groups was made using the Mann Whitney U test for independent samples. For comparing categorical data, Chi-square (χ^2) test was performed. Exact test was used instead when the expected frequency is less than 5. P values of less than 0.05 were considered statistically significant. All statistical calculations were done using computer program IBM SPSS (Statistical Package for the Social Science; IBM Corp, Armonk, NY, USA) release 22 for Microsoft Windows.

Results

Cost analysis was divided into initial cost and aftercare cost. The initial cost is concerned with all the cost of the treatment until the end of the prosthetic phase, which is the attachment pick – up. The aftercare cost is concerned with any costs after that phase which is mainly the prosthetic maintenance cost.

The cost of the ball attachment system was used as a standard unit on which other costs were related, and its value was given the mark X. This was done to avoid any currency changes at different times and to have a set value. At the time of the study, the cost of the ball attachment was (75$).

The initial cost

Due to the similarity between the treatment modalities in the initial cost, all common costs were excluded. The initial cost was focused on the attachment system. All other initial costs were completely equal between the two groups (the complete denture construction cost, the radiographic cost, the surgery cost, etc.).

Table 1: initial cost

The ball attachment cost	x
The CM-LOC COST	2.2x

The initial cost of the CM-LOC attachment mechanism was 2.2 more expensive than the traditional ball attachment mechanism, which made the CM-LOC attachment group less cost-effective in terms of the initial cost.

The aftercare cost

The aftercare cost is directly related to the

annual prosthetic maintenance done by each patient. Prosthetic maintenance cost was mainly divided between the attachment system maintenance cost and the denture maintenance cost, which is essentially the lab fees.

The after-care costs are the sum of the attachment system maintenance costs and the denture maintenance costs throughout 1 year follow up for in both groups per patient.

The after-care costs = (the attachment system maintenance cost) + (the denture maintenance costs).

Table 2: The after-care cost

	The aftercare cost of the attachment system maintenance	The aftercare cost of the denture maintenance	The total aftercare cost of the attachment system and denture maintenance
CM-LOC	0.138x	0.255x	0.393x
BALL	0.029x	0.135x	0.164x

The after-care cost of the CM-LOC attachment was 2.39 times more than the ball attachment, which made the CM-LOC attachment group less cost-effective in terms of the after-care cost.

The total cost

The Total cost is the sum of the initial treatment costs and the after-care costs throughout 1 year follow up for in both groups per patient.

Total costs = (initial treatment costs) + (the after-care costs).

Table 3: The total cost

	The initial cost	The aftercare cost	The total cost
CM-LOC	2.2x	0.393x	2.593x
BALL	1x	0.164x	1.164x

The total cost of the CM-LOC attachment was 2.22 times more than the ball attachment.

Discussion

The methods and results for cost analysis are different among multiple studies due to differences between settings in terms of the availability and affordability of dental care and dental supplies, varying pricing policies and type of dental implants and taxes differences. Also, to express the accumulation of costs over the remaining life of the patient about the average life in each country [7].

In literature, Cost is mainly divided into total clinical cost and patient time cost. The patient time cost is very specific for each patient and the large difference between patients. The total clinical cost is divided into initial treatment cost and the aftercare (maintenance) cost. The initial treatment costs include the cost of the implant itself and prosthesis construction-related cost. Maintenance costs includes those associated with remakes, relines, hardware replacement, professional services provided by the Prosthodontists and the required annual recall visits [8].

Ball and ball-like attachments have been used for many years to retain IODs with high success rate and patient satisfaction. They are known to be cost-effective, simple, hygienic and easy to handle [9].

Different studies have reported a loss of retention which required replacement of the matrix (mostly nylon cap) as one of the most common prosthetic maintenance required. With the CM-LOC, it is claimed that multiple improvements have been made in both the design and the materials used to decrease prosthetic maintenance required and subsequently, the after-care cost [11].

There are two main differences between the ball attachment and the CM-LOC attachment, the material of the cap and the design of the attachment and the cap.

In terms of material the manufacturer claim that PEKK material which is used for the cap in CM-LOC attachment is known to have high-quality characteristics such as good dimensional stability, high chemical and mechanical resistance against wear, and high tensile, fatigue and flexural strengths [12]. The difference of resiliency between the PEKK cap and the more resilient polyethylene nylon cap of the ball can be the cause of more PEKK cap change. The PEKK material has a higher ratio and sequence of keto groups which increase the rigidity of the polymer chain. PEKK is a less resilient material may tend to have more wear due to friction during denture movement which may lead to loss of retention and require more frequent cap change [12].

In terms of design, the CM-LOC attachment matrix is similar to the design of the locator attachment but The PEKK matrix has an oval C shaped design which provides a slot in the matrix. This slot is intended to allow expansion of the cap and might act as a buffer, which is claimed by the manufacturer to reduce the deterioration of the matrix surface resulting in a reduced wear of the material [11]. The expansion of the PEKK cap might be questionable due to its rigidity and being surrounded by a metal housing which limits its expansion. Also, multiple expansions in and out from the undercut may increase friction and wear of the cap. Also, the design of the CM-LOC is similar to the design of the locator attachment which is known for the regular replacement of cap due to constant wear and tear [4]. On the opposite side, the nylon cap of the ball attachment has other privileges; being completely round decrease friction during rotational denture movement and having vertical resiliency which decrease friction during tissue ward movement which

decrease wear of the nylon cap [11].

The cost-effectiveness plays the main role in decision making of the treatment plan for both the patient and the prosthodontist. The initial cost and The after the cost of the CM-LOC attachment was higher than that of the ball attachment. So, CM-LOC showed less cost-effectiveness compared to the ball attachment.

The main cause of the cost difference is due to the higher cost of the CM-LOC attachment parts itself than the ball attachment.

There is a great difference in the initial cost in favour of the ball attachment. In addition to that that the CM-LOC group had a slightly higher rate of maintenance compared to the ball attachment which was opposite to what was proposed by the manufacture of the CM-LOC. The rate of change of the CM-LOC cap was generally higher than that of the ball attachment. The manufacture assumed that CM-LOC would need a few maintenances, which would decrease the cost, but this research found the opposite.

In conclusion, the ball attachment system showed better cost-effectiveness compared to the CM-LOC attachment from the beginning of the study and throughout all the treatment period during the first year.

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