Original Article

Efficacy of Custom-Made Appliance by the Method of CAD/CAM Compared with Conventional Dressing for Reducing Facial Swelling after Maxillofacial Surgery

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KEY WORDS
Face;
Truma;
Orthognathic surgery;
Custom;

ABSTRACT

Statement of the Problem: Swelling of the surrounding tissue of surgical site is one of the most common, devastating effects after maxillofacial surgery and can have an effect on quality of life and the patients' satisfaction.

Purpose: The purpose of this study was to investigate the effect of a custom-made appliance by the method of Computer-aided design/Computer-aided manufacturing (CAD/CAM) compared with conventional dressing for reducing facial swelling after maxillofacial surgery.

Materials and Method: This clinical trial accomplished in 14 patients voluntarily referred to the Department of Oral and Maxillofacial Surgery at Bahonar hospital in Kerman. These patients were the candidate for surgical treatment of similar bilateral facial fractures (10 patients) and orthognathic surgery (4 patients). Facial computed tomography (CT) scans of the patients were taken to build up a custom-made appliance. Based on three-dimensional reconstruction from facial CT scan data, custom-made appliance was designed and built. Swelling on one side with custom-made appliance and on the opposite side with conventional dressing measured with paper tape graded before surgery, immediately after surgery, 24 hours, 48 hours, and 7 days later, we divided the patients into two groups of trauma and orthognathic surgical procedures

Results: Based on the defined landmarks, all of the measurements were performed on both sides. Statistical analyses do not show any asymmetry before surgery (p= 0.48). In addition, there was no significant difference between two methods of dressing on the day of surgery and a day later (p= 0.084, p= 0.09), but there was a significant difference between two methods of dressing on second and seventh days. The swelling has decreased faster and further in our new method.

Conclusion: Regarding the exact adaptation to the surgical site on facial skin, using custom-made appliance by the method of CAD/CAM could be an effective tool that reduces swelling after maxillofacial surgery.

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Introduction

Maxillofacial surgery and any type of surgical intervention on facial structures can play a role as a dynamic factor on draining lymphatic of the surgical site [1]. Inflammation, edema and swelling can develop in the postoperative period and they reach their maximum

extent between 48 and 72 hours after operation [2-3]. Inflammation is a protective response to the damaging stimuli, and the vasodilatation marks, increased capillary permeability, the presence of inflammatory cells and the release of inflammatory mediators from these cells, if inflammation is not controlled, the disadvantage of this phenomenon is much more devastating from its biological benefits [4-5].

There are many different ways to control swelling after surgery, one method is to prescribe drugs such as corticosteroids, nonsteroidal anti-inflammatory drugs (NSAIDs), the combination of corticosteroids and NSAIDs and enzyme preparations as Serrapeptase [2-3]. In addition, manual lymph drainage, cryotherapy, soft laser and local application of ice bags have been suggested for controlling the postoperative swelling [2-3].

After surgery, there is the risk of bleeding and hematoma that could exacerbate swelling in the surgical site, and the use of pressure dressing in the management of these side effects is more effective than other methods. The use of pressure dressings and bandages in oral and maxillofacial surgery is associated with some drawbacks that include difficulty in applying accurate and constant pressure in the location of the surgery and displacement of the dressing during the patient movement, especially in recovery time. Moreoever, the pressure is reduced by time [6].

Several techniques have been proposed to measure facial swelling, such as stereo-radiographs, photographic techniques, computed tomography (CT), and magnetic resonance imaging (MRI), ultrasonography, facial plethysmograph, laser scanning and direct facial measurement [4]. Indirect facial method determined the points used for the measurement. These points included tragus-lip junction, tragus-pogonion, mandibular angle-external corner of the eye; mandibular angle-ala nasi, mandibular angle-lip junction, and mandibular angle-midpoint of chin [4].

Computer-aided design/ Computer-aided manufacturing (CAD/CAM) method is based on the three-dimensional data, which has been used to design facial prostheses. This system is a fast, accurate and convenient method for design and manufacture of the prostheses that will match well to the patient's appearance [7]. Therefore, the purpose of this study was to investigate the effect of custom-made appliance by the method of CAD/CAM compared with the conventional dressing for reducing facial swelling after maxillofacial surgery.

According to the scientific research by using motor searches such as Google Scholar, PubMed, Science Direct, Scopus, this technique has not been used until now.

Materials and Method

The study was approved by the Ethics Committee of Kerman University of Medical Sciences, (code: IR.KMU.REC.1393.541) and registered in the Iranian Registry of Clinical Trials (code: IRCT2106040427214 N1).

The population of the present study included 14 voluntary patients who were referred to the oral and maxillofacial surgery department at Bahonar hospital in Kerman. We performed the investigation on two series of patients including 10 patients with jaw fractures, and 4 patients that received orthognathic surgery.

Inclusion criteria of the study were patients who have similar soft tissue incisions during surgery for treatment of bilateral fractures of the upper or lower jaw, those who need surgery for incising soft tissue similar in both sides, and patients who need orthognathic surgery with similar osteotomy of the upper or lower jaw.

Exclusion criteria were: patients who had facial asymmetry (if patients had facial fractures that lead to facial asymmetry we excluded them from the study), those who had a previous history of oral and maxillofacial surgery, and patients with systemic diseases such as diabetes mellitus due to affecting the healing process and swelling.

We requested axial, coronal and sagittal sections of CT-Scan with two millimeters cuts, and then three-dimensional reconstruction of soft tissue was performed for patients by using software Mimics 17.0 and 3-Matic 9.0 researches (Materialize Co.). Then, Digital ABS (Acrylonitrile Butadiene Styrene) plastic appliance was designed based on the three-dimensional reconstruction (Figure 1). Finally, the appliance was built based on the CAD/CAM method and printer model Object 260 Connex.

Nearly, similar operations were done on case side and control side due to selected similar fractures type, and similar surgical technique on both sides for orthognathic patients. The operation time for both cases sides

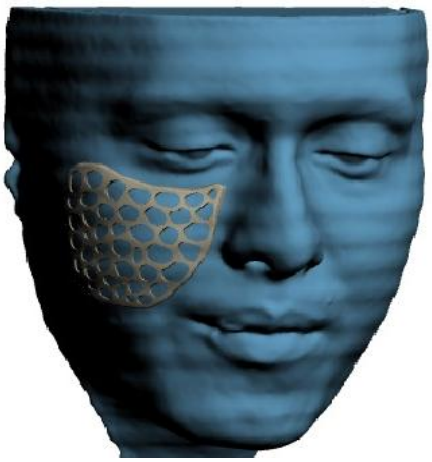

Figure 1: The appliance built based on CAD/CAM method and printer model Object 260 Connex

Figure 2: Custom-made appliance was placed on one side and gauze pressure dressing was applied on the opposite side.

and control sides was nearly equal, due to similar surgical procedures, the trauma patients consisted of 5 LeFort II fractures, 3 Lefort III fractures, and 2 angle fracture of mandible. All of them were operated by open reduction and fixation of both right and left sides of fractured area. The dressing on both the control side and the case side made by the traditional gauze pack was secured on the face by tape. We used nearly equal pressure by taping on both case and control sides.

We marked reference points with a permanent marker before surgery, and then the amount of swelling measured with paper tape and a millimeter ruler prior of the surgery (baseline), immediately after the surgery, 24 h, 48 hours, and the seventh day of postoperative period [8]. All of the clinical measurements were performed by a single examiner. All the patients had been operated by one of the postgraduate students of oral and maxillofa cial surgery under the supervision of the first author. Randomly, custom-made appliances were used on one side and on the opposite side gauze pressure dressing were applied (Figure 2).

Results

Considering the inclusion criteria, we could perform the investigation on only ten patients that had nearly similar bilateral fractures in about 2 years (71/4%), which was a very difficult procedure for finding these types of patients and performing the study on four orthognathic-surgery patients who were signed our informed consent for enrolling in this study (28/6%).

In patients with bilateral jaw fractures after comparing the mean values of the swelling of face by using conventional and custom-made appliance, the results showed that we have no obvious asymmetry between two sides of face before surgical procedures (p= 0.40). In addition, the mean values of swelling in both methods has no statistical differences immediately after surgery (p= 0.65). The mean values of swelling were statistically significant for both methods in 1, 2, and 7 days after operation and the swelling in patients with new CAD-CAM appliance was less than the conventional method of dressing (Table 1).

The mean value of swelling before surgery and seven days after surgery in patients with bilateral jaw fractures with new dressing had no statistically difference. In other words, the mean value of swelling measurements in these patients after seven days reached approximately to the values of before surgery(p= 0.64). However, in patients with conventional gauze dressing, the mean value of swelling in seven days after operation has significant difference in comparing to measurements of before surgical procedures (Figure 3). Furthermore, in orthognathic surgery patients, we have no obvious asy-

Table 1: The mean difference between two methods of dressing during study in patients with bilateral facial fractures

Time	Method		Mean Difference (mm)	Std. Error	*p* Value
before	C	CM	1.88	2.20	0.40
Day 0	C	CM	1.11	2.48	0.65
Day 1	C	CM	4.96	2.44	0.05*
Day 2	C	CM	5.30	2.29	0.03*
Day 7	C	CM	4.81	2.26	0.04*

*. The mean difference is significant at the 0.05 level.
C: current method of dressing
CM: CAD- CAM method

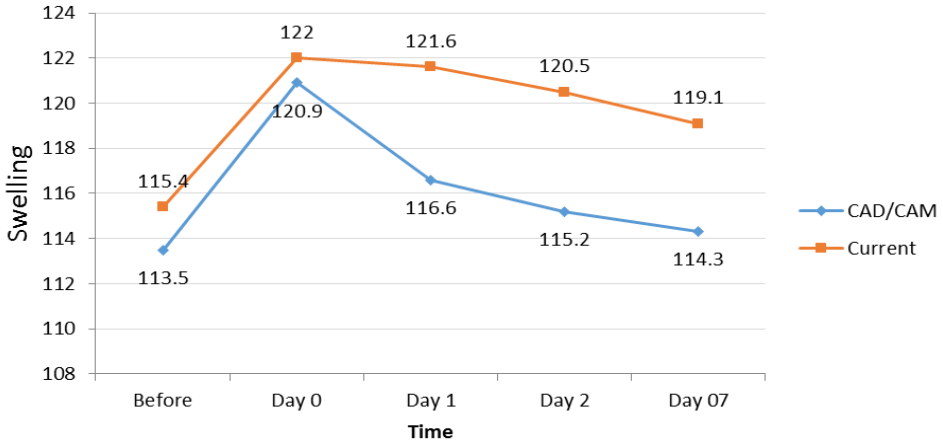

Figure 3: Changes in the swelling in two methods of dressing in bilateral facial fractures

mmetry before surgical procedures between the two sides of faces (p= 0.78).

There was somehow higher degree of swelling in appliance method in comparison to the conventional dressing method in orthognathic patient group immediately after surgery, but the differences were not statistically significant (p= 0.88). The mean value of swelling in 1, 2, and 7 days after operation was lower in dressing with custom-made appliance than in conventional dressing, and all of these differences were not statistically significant. In addition, we noticed that the swelling has reduced faster and higher in custom-made method of dressing than in conventional type during 2 days after surgery (Figure 4).

The swelling has reduced significantly in orthognathic patients with custom-made appliance in 1, 2, and 7 days after operation, but the differences between the swelling degree before and 7 days after operation were not significantly different (p= 0.86), which showed the swelling has reduced in 7 days after operation and the measured data has reached to the values of before surgery.

In the conventional dressing method, the degree of swelling significantly raised immediately after surgery (p= 0.0001), and then reduced in 1, 2 and 7 days after surgery, and in comparing with the measurements of indices in 7 days after operation was significantly higher than before surgery. This showed that by using conventional dressing, the swelling has remained and had not reduced significantly (Figure 4).

Discussion

Every surgeon wants to provide patients with comfort during the recovery period after surgery. Swelling is a consequence of oral and maxillofacial surgery that needs to be controlled [9].

To increase the patients' satisfaction after a surgical procedure, it will be necessary to minimize the subsequent swelling [10].

So we tried on a new method proposed for the man-

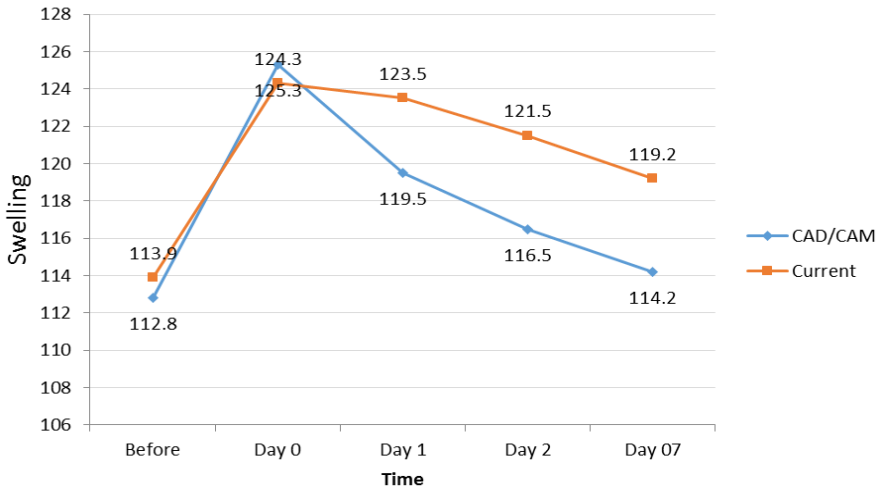

Figure 4: Changes in the swelling in two methods of dressing in orthognathic patients

agement of this consequence by a custom-made appliance via CAD/CAM method and compared it with a conventional gauze pressure dressing. Based on our knowledge, it is the first preliminary research to evaluate the effect of custom-made appliance by the method of CAD/CAM on reducing the facial swelling. The results of this study showed that swelling decreased almost entirely on the seventh day on the side of custom-made appliance, but there is no significant difference with using conventional method at any times.

Some studies [1, 3, 11] have been performed for evaluation of swelling reduction after maxillofacial surgeries. For example, Lietz-kijak *et al.* [11] used kinesio taping on facial swelling after bilateral sagittal split ramus osteotomy (BSSO) mandibular surgery (16 patients) and concluded that it had a beneficial effect on the reduction of swelling. In another study by Szoloky *et al.* [1] manual lymphatic drainage (MLD) was used for reducing facial swelling after mandibular impacted third molar surgeries (10 patients) and demonstrated that a significant reduction in facial swelling and pain can be obtained using MLD after removal of impacted third molars. Another study by Rana *et al.* [3], compared two different cooling therapy methods for swelling reduction in 32 patients with bilateral mandibular fractures and concluded that Hilotherm system represent a simple, easy-to-use and cost effective treatment, which can be an alternative to the use of cold compress. They also used the Hilotherm method for reducing swelling after orthognathic surgery in 42 patients and concluded that Hilotherm cooling device reduces postoperative swelling, pain, and duration of hospitalization in compared to conventional cooling.

Overall, all of the efforts in researches done for reducing swelling after oral and maxillofacial surgery including our research had some benefits for this purpose and it is better to perform further studies to compare and evaluate the effectiveness of them on reducing the devastating effects of swelling.

Several factors can affect tissue repair and postoperative complications after maxillofacial surgery including patient factors such as age and gender, and operative factors like surgical technique, surgeon's experience, and duration of surgery [12]. A number of studies have shown that the duration of surgery and surgical techniques as two determining factors of difficulty and increased risk of complications after surgery [13-15]. In the present study, we found that swelling after orthognathic surgery was higher, because this procedure requires more time and techniques that are more complex.

Based on the results of this study, the custom-made appliance exerts appropriate pressure on facial skin due to strict matching with the surgical site. Therefore, it had a favorable impact in seven days period and swelling has decreased significantly.

Conclusion

The results of this study showed that custom-made appliance by the method of CAD/CAM; due to the exact adaptation with facial skin of the surgical site can be an effective tool to reduce swelling after maxillofacial surgery. This appliance can improve the quality of care of patients after surgery.

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Conflict of Interest

None declared.

References

[1] Szolnoky G, Szendi-Horváth K, Seres L, Boda K, Kemény L. Manual lymph drainage efficiently reduces postoperative facial swellingand discomfort after removal of impacted third molars. Lymphology. 2007; 40: 138-142.

[2] Rana M, Gellrich NC, Joos U, Piffkó J, Kater W. 3D evaluation of postoperative swelling using two different coolingmethods following orthognathic surgery: a randomised observer blind prospective pilot study. Int J Oral Maxillofac Surg. 2011; 40: 690-696.

[3] Rana M, Gellrich NC, von See C, Weiskopf C, Gerressen M, Ghassemi A, et al. 3D evaluation of postoperative swelling in treatment of bilateralmandibular fractures using 2 different cooling therapy methods: a randomized observer blind prospective study. J Craniomaxillofac Surg. 2013; 41: e17-e23.

[4] Thaer AL, Salwan YH, Jamal AM. The influence of prophylactic dexamethasone on postoperative swelling and trismus following impacted mandibular third molar surgical extraction. J Bagh Colls Dentistry. 2010; 22: 85-90.

[5] Villafuerte-Nuñez AE, Téllez-Anguiano AC, Hernández-Díaz O. Facial Edema Evaluation Using Digital Image Processing. Discrete Dynamics in Nature and Society. Available at: https://www.hindawi.com/journals/ddns/2013/927843/

[6] Hirai M, Niimi K, Iwata H, Sugimoto I, Ishibashi H, Ota T, Nakamura H. A comparison of interface pressure and stiffness between elastic stockings and bandages. Phlebology. 2009; 24: 120-124.

[7] Feng Z, Dong Y, Zhao Y, Bai S, Zhou B, Bi Y, Wu G. Computer-assisted technique for the design and manufacture of realistic facial prostheses. Br J Oral Maxillofac Surg. 2010; 48: 105-109.

[8] de Santana-Santos T, de Souza-Santos A, Martins-Filho PR, da Silva LC, de Oliveira E Silva ED, Gomes AC. Prediction of postoperative facial swelling, pain and trismus followingthird molar surgery based on preoperative variables. Med Oral Patol Oral Cir Bucal. 2013; 18: e65-e70.

[9] Gasperini G, Rodrigues de Siqueira IC, Rezende Costa L. Does low-level laser therapy decrease swelling and pain resulting from orthognathic surgery? Int J Oral Maxillofac Surg. 2014; 43: 868-873.

[10] Ristow O, Hohlweg-Majert B, Kehl V, Koerdt S, Hahnefeld L, Pautke C. Does elastic therapeutic tape reduce postoperative swelling, pain, and trismus after open reduction and internal fixation of mandibular fractures? J Oral Maxillofac Surg. 2013; 71: 1387-1396.

[11] Lietz-Kijak D, Kijak E, Krajczy M, Bogacz K, Łuniewski J, Szczegielniak J. The Impact of the Use of Kinesio Taping Method on the Reduction of Swelling in Patients After Orthognathic Surgery: A Pilot Study. Med Sci Monit. 2018; 24: 3736-3743.

[12] Modabber A, Madiha R, Ghassemi A, Marcus G, Nils-Claudius G, Frank H, Majeed R. Three-dimensional evaluation of postoperative swelling in treatment of zygomatic bone fractures using two different cooling therapy methods: a randomized, observer-blind, prospective study. Trials. 2013; 14: 238.

[13] Barbosa-Rebellato NL, Thomé AC, Costa-Maciel C, Oliveira J, Scariot R. Factors associated with complications of removal of third molars: a transversal study. Med Oral Patol Oral Cir Bucal. 2011; 16: e376-e380.

[14] Akadiri OA, Obiechina AE. Assessment of difficulty in third molar surgery--a systematic review. J Oral Maxillofac Surg. 2009; 67: 771-774.

[15] Gbotolorun OM, Arotiba GT, Ladeinde AL. Assessment of factors associated with surgical difficulty in impactedmandibular third molar extraction. J Oral Maxillofac Surg. 2007; 65: 1977-1983.