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A customized postoperative wound management model tailored to the healing dynamics of the upper lip: a retrospective cohort study

Yanjun Diao[1], Xian Liu[1], Hanghang Liu[1], Xuefeng Zhang[1], Xiaorong Zhou[1] and Yongle Shi[1*]

Abstract

Background Clinical observations suggest that upper lip injuries often exhibit prolonged healing and reduced healing efficacy. The unique anatomical and physiological characteristics of the lips make them particularly susceptible to infection and delayed recovery, posing significant challenges for postoperative management. The aim of this research, grounded in the anatomical and physiological subtleties of the upper lip, was to contrast the wound management outcomes between patients treated with a conventional wound management approach and those treated with a customized wound management model. Additionally, it aimed to explore the efficacy of a dynamic model in the assessment and treatment of upper lip wounds.

Method It is a retrospective cohort study. Patients with maxillofacial injuries who attended the Emergency Department of West China Hospital of Stomatology of Sichuan University were selected for retrospective analysis. Between February and August 2023, 89 out of 783 patients with maxillofacial injuries who had upper lip injuries formed the control group. From February to August 2024, 84 patients with upper lip injuries, selected from 643 patients with maxillofacial injuries, constituted the experimental group. The control group applied the traditional wound management method, while the experimental group implemented the customized wound management model, which involved optimizing the team, devising a wound-healing model, improving dressings, innovating in both the timing and method of dressing changes, and providing customized care for complex wounds. The outcomes of upper lip wound management between the two groups were compared, including the wound infection rate, the Vancouver Scar Scale (VSS) score 30 days after surgery, and patients' satisfaction. Data analysis was conducted using SPSS 23.0 software.

Results There were no statistically significant differences in the demographic variables between the two groups ($P > 0.05$). The upper lip infection rates were 18% (16 out of 89) in the control group and 1.2% (1 out of 84) in the experimental group, respectively. Notably, the incidence of wound complications and wound infection rates differed significantly between the control and experimental groups, with the experimental group showing lower figures for both ($P < 0.001$). Compared to the control group, the experimental group had a lower VSS score and a higher patients' satisfaction score, with these differences being statistically significant ($P < 0.001$).

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Conclusion The customized wound management model demonstrated superior clinical efficacy in treating upper lip injuries. Patients gain advantages from a customized postoperative wound management model designed according to the upper lip healing kinetics. By aligning postoperative care with the unique healing kinetics of the upper lip, this approach significantly reduces infection rates and enhances patient satisfaction. These findings advocate for wider adoption of this personalized wound management model in the clinical treatment of upper lip injuries.

Trial registration Clinical Trial Registration No. ChiCTR2300079287, Registration Date 29 December 2023.

Keywords Maxillofacial injury, Upper lip, Wound management, Wound healing

Introduction

Maxillofacial injuries are among the most common types of injuries worldwide, with approximately 150,000 cases reported annually in the United States alone. These injuries account for 7 ~ 10% of all emergency department visits, a prevalence echoing that is similarly reflected in China [1–3]. Maxillofacial injuries encompasses a wide spectrum of injuries, including abrasions, contusions, penetrating wounds, and tissue loss, primarily resulting from motor vehicle accidents, sports-related incidents, interpersonal violence, and mechanical impacts [4, 5]. The scarring that follows such injuries is often unavoidable, frequently necessitating subsequent cosmetic and functional interventions. Beyond the physical implications, maxillofacial injuries can lead to significant physiological and psychological challenges, adversely affecting self-perception and increasing the risk of anxiety and depression [6–8]. The healing trajectory of maxillofacial wounds varies widely, largely influenced by the anatomical location and nature of the injury Upper lip wounds, in particular, present unique clinical challenges due to their heightened susceptibility to infection and slower healing compared to wounds overlying bony structures, such as those on the forehead and chin. This disparity is also evident when comparing congenital cleft lip repair, which lacks standardized postoperative protocols, with non-congenital upper lip injuries. Homogenized and debrided under local anesthesia but heavily contaminated, these injuries complicate recovery [9]. Despite these complexities, existing literature tends to generalize maxillofacial injuries, frequently overlooking the distinct healing dynamics of different facial regions.

The concept of facial aesthetic subunits, first introduced by Burget and colleagues in 1986, underscores the importance of anatomical variations in facial reconstruction [10, 11]. This classification is based on key skin characteristics, including color, thickness, subcutaneous fat composition, and hair distribution, dividing the face into distinct regions such as the forehead, orbital area, and lips. The lips, in particular, exhibit a unique anatomical composition, lacking both the multilayered structure and bony support found in other facial regions [12–14]. Xie et al. (2021) [15] further highlighted that complex facial injury frequently involves the perilabial region, where injuries such as abrasions, tissue loss, and deep penetration exacerbate postoperative management challenges. Given these complexities, there is an urgent need to refine maxillofacial wound care by adopting personalized treatment approaches tailored to the unique healing properties of upper lip injuries. This study aims to advance clinical wound management by evaluating a customized approach specifically designed for infected upper lip wounds, thereby improving healing outcomes and setting new standards for maxillofacial injury management.

Materials & methods

Study design

It is a retrospective cohort study. This retrospective cohort study adhered to the ethical guidelines of the Declaration of Helsinki: Ethical Principles for Medical Research Involving Human Subjects and received ethical approval from the Medical Ethics Committee of West China Hospital of Stomatology of Sichuan University (WCHSIRB-CT-2023–362), approval date 22 September 2023.

Study population

Patients with maxillofacial injuries who attended the Emergency Department of West China Hospital of Stomatology of Sichuan University were selected for retrospective analysis. Between February and August 2023, 89 out of 783 patients with maxillofacial injuries who had upper lip injuries formed the control group. From February to August 2024, 84 patients with upper lip injuries, selected from 643 patients with maxillofacial injuries, constituted the experimental group (Fig. 1). The selection was based on the inclusion and exclusion criteria presented here. The inclusion criteria were as follows: i) acquired upper lip injury; ii) completion of standardized fine debridement and suturing in the emergency department; iii) ability of patients and caregivers to adhere to treatment and follow-up protocols; and iv) informed consent and voluntary participation. The exclusion criteria were as follows: i) age less than 12 months; ii) coexisting conditions such as diabetes, psoriasis, or vitiligo that

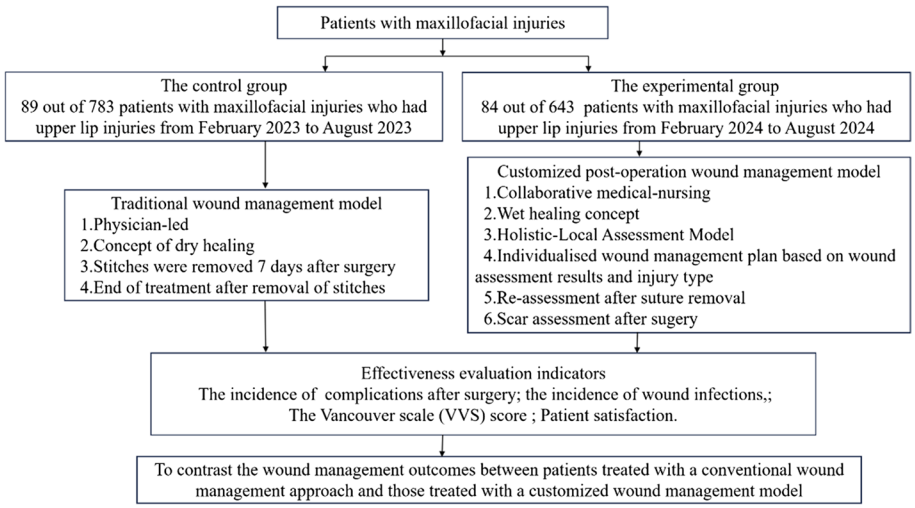

Fig. 1 Flow chart of the study

impede wound healing; iii) severe organic diseases; and iv) loss to follow-up.

Methods of wound management in both groups

Control group

Postoperative care was carried out via the traditional wound management method, which tends to be uniform. This technique is dominated by maxillofacial surgeons, whose sutures are removed routinely for 7 ~ 10 days after surgery. The traditional concept of dry healing focuses more on the physical characteristics of the wound and the level of exudation. During that period, the wound was kept clean and dry, and the consultation was concluded after suture removal.

Experimental group

A customized postoperative wound management model was implemented in the experimental group, incorporating multidisciplinary team collaboration between maxillofacial surgeons and wound specialist nurses, the moist healing concept, the Holistic-Local Assessment Model (HLAM), advanced dressing techniques, individualized timing of dressing changes, and personalized care strategies for complex wounds. HLAM provided a structured approach to wound evaluation, integrating both holistic and local assessments Holistic wound evaluation under HLAM involves a comprehensive analysis of the following aspects: i.) medical history of comorbidities, such as immune system, haematological. ii.) patient medical history. iii.) nutritional status. iv.) psycho-social factors. v.) individual demographics such as age, educational background, treatment adherence, and lifestyle habits. Local wound evaluation under HLAM involves a comprehensive analysis of the following aspects: i.) wound presentation, measuring length; depth; and the presence of submersion, sinus tracts, and fistulas. ii.) the injured site's skin structure and composition of the injured site. iii.) basal tissue injury severity and coloration. iv.) the intricacy of suturing—both level and type. v.) the nature of wound exudation, considering its color, quantity, and consistency. vi.) the subjective experience of wound-related pain and itching. vii.) risk assessment for postoperative complications, such as infection, hemorrhage, wound dehiscence, and restrictions in upper lip mobility. viii.) the pattern of local wound scarring was evaluated after suture removal to gauge the healing process (Fig. 2).

The initial dressing changes was performed within 48 h postoperatively, with subsequent adjustments on the basis of the HLAM. The timing of dressing changes is underpinned by a comprehensive approach, informed by clinical evidence and patient-specific factors such as medical history, nutritional status, and exudation. On the basis of the results of the HLAM assessment, different dressings such as nonwoven dressings, hydrocolloid materials, alginate dressings, foam dressings, and hydrogel dressings, were selected. Scars were evaluated via the Vancouver scar scale 30 days after surgery. The activity of the upper lip scar was objectively evaluated via color Doppler ultrasound (CDU), which includes assessing scar thickness, vascular distribution, and blood flow velocity.

Evaluation of indicators

Patient demographics and baseline variables

Patient demographic variables including age, sex, BMI, cause of injury, and the interval between injury and treatment, was collected and analyzed.

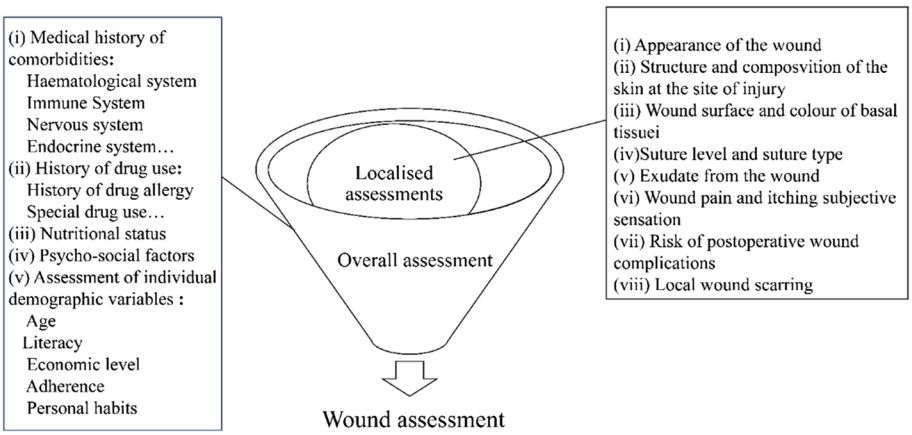

Fig. 2 Holistic-Local Assessment Model (HLAM)

Primary and secondary outcome measures

The primary outcome measures were the incidence of postoperative upper lip complications and wound infections, and the secondary outcomes measures included Vancouver Scar Scale (VSS) scores and patient satisfaction scores.

Assessment of wound complications and infection

Wound complications were evaluated by the attending physician in conjunction with the wound status. Currently, there are 5 types of wound complications: wound infection, wound dehiscence, wound scabbing, wound bleeding, and periwound redness and swelling. A 'yes' is given to the presence of any of these complications, and a 'no' is given to the opposite. The Therapeutic Index for Local Infections (TILI) score criteria were used to assess wound infection [16]. The Therapeutic Index for Local Infections consists of 9 items across 2 dimensions: no direct indication and direct indication. It contains 9 items referring to erythema to surrounding skin, heat, edema, induration or swelling, spontaneous pain or pressure pain, stalled wound healing, increased and/or changed color or smell of exudate, the presence of wound pathogens, surgical septic wounds, and the presence of free pus. If the criteria of the TILI score are met, this indicates a manifest local wound infection.

Scar assessment using the Vancouver Scar Scale (VSS)

The Vancouver scar scale(VSS) was used to evaluate scars comprehensively [17]. It contains 4 items referring to scar pigmentation, vascularity, pliability, and height. The pigmentation ranged from 0 (the color of the scar is similar to the color of the skin on normal parts of the body) to 3 (darker color). The vascularity ranged from 0 (scar skin color approximates normal body parts) to 3 (rich purple or dark red blood supply). The pliability from 0 (normal) to 5 (contracture). The height ranged from 0 (normal) to 3 (>5 mm). The total score of the scale ranged from 0 ~ 14, where 0 indicated normal skin and higher scores indicated more severe scarring.

Patient satisfaction assessment

The patients' satisfaction questionnaire was used to assess both groups of patients, which based on literature review. The satisfaction questionnaire consists of 5 items: medical environment, service attitude, medical quality, health education and follow-up quality. A score of 0 was assigned for responses indicating 'lack of knowledge or dissatisfaction', whereas a score of 20 was given for responses indicating 'satisfaction or knowledge'. The questionnaire was pretested on a sample of 100 standardized patients. The Cronbach's alpha coefficient for the questionnaire exceeded 0.7.

Statistical analysis

The Kolmogorov–Smirnov test was employed to analyze the distribution characteristics of continuous variable data. For normally-distributed data, the mean and standard deviation (SD) were used for statistical description, and the t-test was adopted for statistical inference. In the case of non-normally distributed data, the median and inter-quartile range (IQR) were employed for statistical description, and the rank-sum test was used for statistical inference. Regarding categorical variables, rates or percentages were utilized for statistical description, and the chi-square test was applied for statistical inference.

Results

Normality tests for continuous variables

Normality tests indicated that variables including age, body mass index (BMI), Vancouver Scar Scale (VSS)

score, and patient satisfaction score followed skewed distributions ($P < 0.001$) (Table 1).

Comparison of demographic variables between the two groups

89 patients were included in the control group, and 84 were included in the experimental group. The control group consisted of 48 males (53.9%) and 41 females (46.1%), whereas the proportions of males and females in the experimental group were 64.3% (54/84) and 35.7% (30/84), respectively ($P = 0.166$). The median ages of the patients in the two groups were 13.0 points and 12.5 points, respectively ($P = 0.945$). There were no statistically significant differences in the demographic variables between the two groups ($P > 0.05$) (Table 2).

Comparison of patient outcome indicators between the two groups

The incidence of wound complications rates in the two groups were 61.8% and 13.1%, respectively. The incidence of wound infection rates in the two groups were18.0% and 1.2%, respectively. Notably, the incidence of wound complications and wound infection rates differed significantly between the control and experimental groups, with the experimental group showing lower figures for both ($P < 0.001$).

The median VSS 30 days after surgery in the control group was 8.0 points, while in the experimental group, the median VSS score was 5.0 points. Regarding patient satisfaction, the median scores 30 days after the surgery were 90.0 points for the control group and 92.5 points for the experimental group. Significantly, compared to the control group, the experimental group had a lower

Table 1 Normality test for continuous variables

Variable	Median	P_{50} (P_{25}, P_{75})	T	*P*
Age (years old)	13.0	19.0 (4.0, 23.0)	0.165	< 0.001
BMI (kg/m^2)	19.0	3.7 (17.0, 20.7)	0.104	< 0.001
The interval between injury and medical consultation (h)	3.0	2.0 (2.0, 4.0)	0.234	< 0.001
Vancouver Scar Score (VSS) at 30 days after surgery	5.0	4.0 (4.0, 8.0)	0.199	< 0.001
Patients' satisfaction 30d after surgery	90.0	10.0 (85.0, 95.0)	0.221	< 0.001

Table Length: P stands for percentile. (One-sample Kolmogorov–Smirnov Test)

Table 2 Comparison of demographic information of the two groups of patients

Variable	Control group (*N* = 89)	Experimental group (*N* = 84)		Z/X^2	*P*
	Median(P_{50})/ n(%)				
Age	13.0(19.0)	12.5(19.5)	-0.068		0.945
BMI	19.49(3.47)	18.30(4.11)	-1.771		0.077
The interval between injury and medical consultation (h)	3.00(1.75)	3.00(2.00)	-0.968		0.333
Sex					
Male	48(53.9)	54(64.3)	1.914		0.166
Female	41(46.1)	30(35.7)			
Past medical history of maxillofacial injury					
No	83(93.3)	79(94.0)	0.045		0.832
Yes	6(6.7)	5(6.0)			
With symptoms of craniocerebral injury					
No	85(95.5)	77(91.7)	1.070		0.301
Yes	4(4.5)	7(8.3)			
Causes of injury					
Accidental injuries	47(52.8)	58(69.0)	6.680		0.083
Sports injuries	25(28.1)	11(13.1)			
Traffic Accidents	7(7.9)	7(8.3)			
Others	10(11.2)	8(9.5)			

VSS score and a higher patients' satisfaction score, with these differences being statistically significant ($P<0.001$) (Table 3).

Special cases in the experimental group

Soft tissue abrasions

Soft tissue abrasions mainly affected the epidermis and the outer layer of the dermis of the skin. Generally superficial, they lead to full-thickness damage to these layers. It is crucial to thoroughly remove all foreign substances from the wound area and apply topical antibiotics to keep the wound moist during the crucial re-epithelialization process, which facilitates the migration of keratinocytes. The first dressing change took place in 24 h after surgery. Saline-soaked compresses were used to gently clean the abrasions and get rid of any surface exudate. Subsequently, a layer of mupirocin ointment was applied, followed by the placement of a non-woven dressing over the wound to create an optimal healing environment. The figures showed that 3 cases had multiple sites of facial tissue abrasions, which demonstrated the comprehensive management strategy employed (Figs. 3 and 5).

Upper lip penetrating injuries

Penetrating injuries of the upper lip are highly prone to infection due to the inherent connection between the lip's skin and the bacteria-laden oral cavity. Integrated medical and nursing management was implemented on the 3rd, 5th, and 7th days after surgery, with a focus on wound assessment, exudate management, and antibiotic prophylaxis.

Topical mupirocin ointment was applied under a nonwoven dressing, complemented by a systemic antibiotic regimen lasting 3 to 5 days. The removal of sutures was initially assessed on the 5th day after surgery, and the staged removal process was finalized by the 7th day. For internal mucosal wounds, patients are advised to consume warm or cool liquids and avoid the use of straws to prevent thermal or mechanical interference with healing. Patient II presented with penetrating wounds to the upper lip, illustrating the management protocol (Fig. 4).

Tissue defect wounds

Among the experimental group, 9 patients sustained upper lip injuries accompanied by soft tissue defects. Soft tissue defects present a significant risk of postoperative scarring because of the influence of skin tension during closure on healing duration. Owing to the lip's aesthetic significance and the delicate nature of the surrounding muscles and soft tissues, the first dressing was applied within 24 h after surgery, instead of waiting for 48 h as initially planned. Subsequent changes were guided by assessing exudate Wound care duration was extended from the standard 5 ~ 7 days to 10 ~ 14 days to monitor for dehiscence. Mupirocin ointment and growth factor gel were applied to the wound at intervals depending on the degree of infection and defect. The wound was then covered with oil gauze to create a moist healing environment under a nonwoven dressing, which prevented scab formation and promoted healing beneath the scab. Among these cases, 5 patients developed varying degrees of scarring on the upper lip, highlighting the necessity of meticulous wound management and the potential complications associated with tissue defects (Fig. 5).

Discussion

The results demonstrated that there were statistically significant differences in the incidence of wound complications and wound infection rates between the control and experimental groups. Specifically, the experimental group had lower values for both aspects ($P<0.001$). Additionally, when compared with the control group, the experimental group boasted a lower VSS score and a higher patient satisfaction score, and these differences were statistically significant ($P<0.001$). This indicates that the customized wound management model can remarkably

Table 3 Comparison of wound management outcomes between the two groups of patients

Variable	Control group ($N=89$) n(%) /Median(P_{50})	Experimental group ($N=84$)	Z/X^2	P
Wound complication				
No	34(38.2)	73(86.9)	43.440	< 0.001
Yes	55 (61.8)	11 (13.1)		
Wound infection				
No	73(82.0)	83(98.8)	13.743	< 0.001
Yes	16(18.0)	1(1.2)		
Vancouver Scar Score (VSS) at 30 days after surgery	8.0 (4.0)	5.0 (3.0)	-5.231	< 0.001
Patients' satisfaction 30d after surgery	90.0 (5.0)	92.5 (5.0)	-4.543	< 0.001

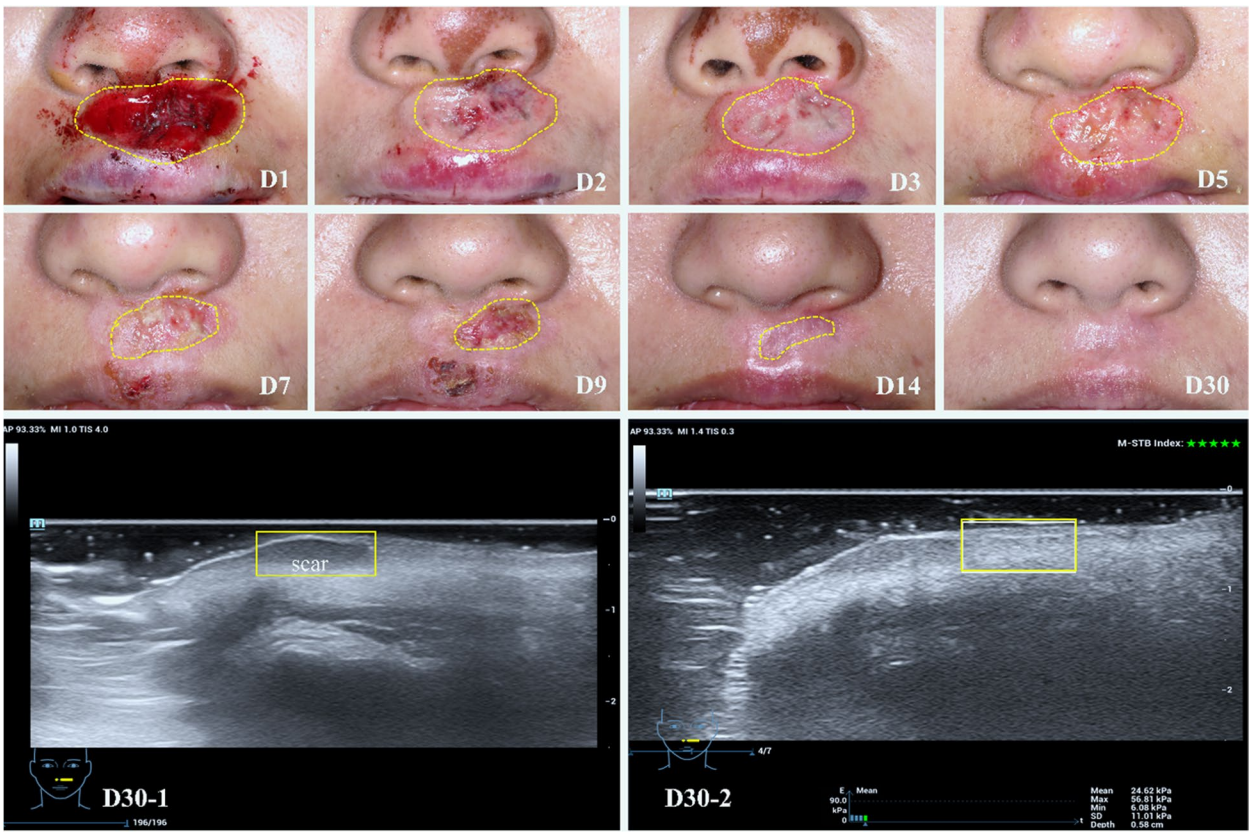

Fig. 3 Case I A 23-year-old female with abrasions on the upper lip. D1, before operation. D2, the first dressing change on the second day after surgery. D3, the third dressing change on the 3rd day after surgery. D5, the 4th dressing change on the 5th day after surgery. D7, the 5th dressing change on the 7th day after surgery. D9, the 7th dressing change on the 9th day after surgery. D14 and D30, postoperative follow-up on the 14 and 30 days after surgery. D30-1, scar of upper lip in CDU results. D30-2, normal skin of the upper lip

decrease the incidence of wound infection, mitigate scar formation, and boost patient satisfaction.

The lip, occupying the lower third of the maxillofacial region and bordered by the subnasal and chin sulci as well as the nasolabial folds, is anatomically divided into upper and lower sections. It encompasses vital structures such as the philtrum, vermilion border, and tubercle. The upper lip is controlled by the orbicularis oris muscle, which is supported by the muscles responsible for lifting the lips and corners of the mouth, as well as the buccinator muscle, all of which are crucial for facial expression and aesthetic function [15, 18, 19]. On the basis of these anatomical and physiological insights, meticulous suturing is employed to meet the high aesthetic and functional requirements of the upper lip. However, clinical experience suggests that upper lip injuries generally take longer to heal. This phenomenon may stem from the unique anatomical and physiological characteristics of the lip. These include the absence of underlying bone, high water loss near the mouth and nose, active sebaceous glands, and the risk of wound contamination during meals as well as vascular related factors [20, 21]. Moreover, the skin of the upper lips, which is abundant in hair follicles, sebaceous glands, and sweat glands, is strongly influenced by hormonal levels and environmental factors such as humidity which can increase sebum production [22]. The stratum corneum, despite functioning as a barrier, has compromised water retention in the upper lip and nasolabial folds due to the high density of sebaceous glands, making it more susceptible to rapid absorption of external substances [23]. This condition facilitates the rapid penetration of substances through the skin, which leads to the displacement of wound dressings and consequently prevents a moist environment that is conducive to healing. Collectively, these factors pose distinct challenges in the healing process of upper lip injuries.

In this study, detailed analysis of 16 cases from the control group with postoperative infections provided insights that contributed to several key improvements in wound management. Traditionally, wound management has been primarily physician-led, with limited nursing involvement. The first key change involved transitioning

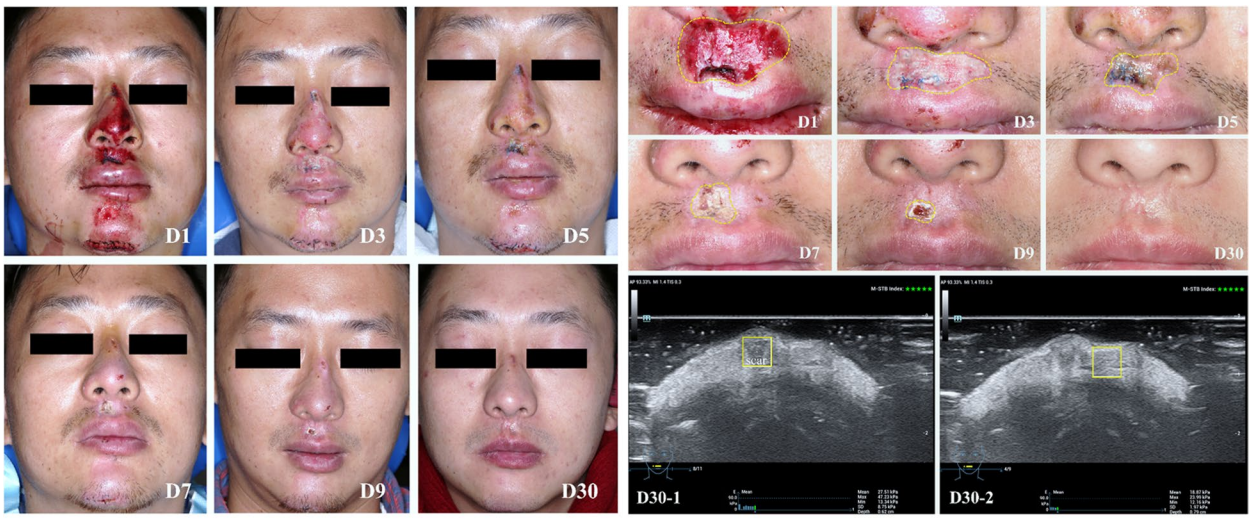

Fig.4 Case II A 43-year-old male patient presented with a penetrating wound on the upper lip, which resulted in tissue defect and multiple facial abrasions. D1, before operation. D3, the first dressing change on the 3rd day after surgery. D5, the second dressing change on the 5th day after surgery. D7, the third dressing change on the 7th day after surgery. D9, the first suture removal on the 9th day after surgery. D30, removing stitches for the second time on the 30 days after surgery. D30, postoperative follow-up. D30-1, scar of upper lip in CDU results. D30-2, normal skin of the upper lip

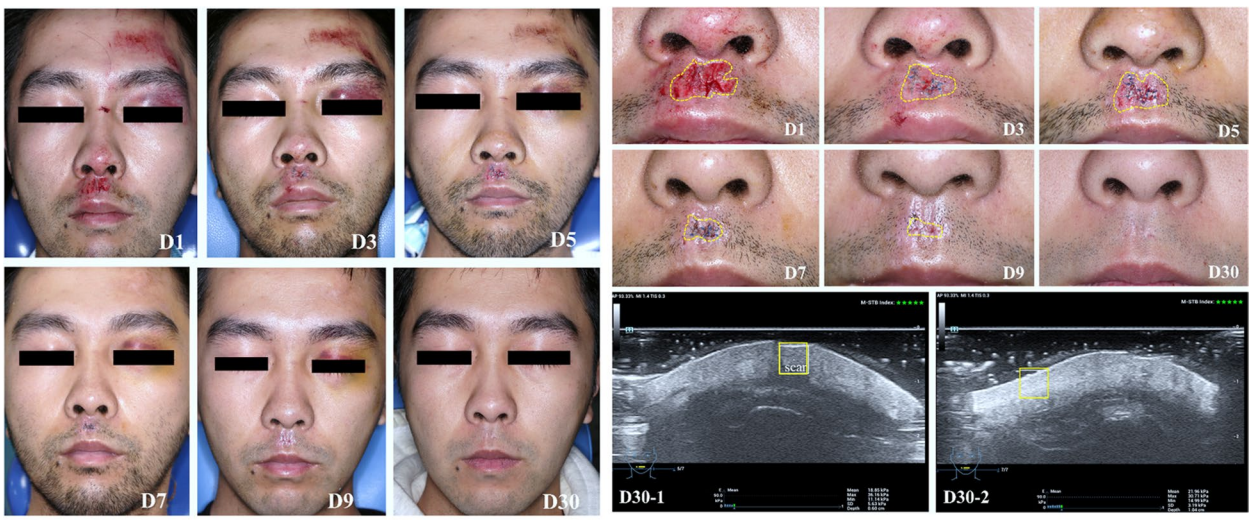

Fig.5 Case III A 26-year-old male patient presented with a soft tissue defect of the upper lip with multiple facial abrasions. D1, before operation. D3, the first dressing change on the 3rd day after surgery. D5, the second dressing change on the 5th day after surgery. D7, the first suture removal on the 7th day after surgery. D9, removing stitches for the second time on the 9th day after surgery. D30, postoperative follow-up. D30-1, scar of upper lip in CDU results. D30-2, normal skin of the upper lip

from a physician-dominated model to an integrated doctor-nurse management approach, fostering multidisciplinary collaboration to improve patient safety and care quality [24]. The second major improvement was revising the wound assessment methodology. Instead of a localized evaluation, the Holistic-Local Assessment Model (HLAM) was implemented, incorporating broader systemic factors such as endocrine and metabolic disorders, cardiovascular diseases, hematological and immune system dysfunctions, and comorbidities that elevate infection risk [25]. This model also considers the patient's nutritional status, psychosocial factors, and demographic

characteristics—such as age, literacy level, and adherence to medical guidance—which are crucial for preemptive nursing interventions.

Informed by the wound healing process, initial wound assessments and management strategies are dynamically conducted 48 h after surgery. These assessments include evaluating the appearance of the wound, the structural integrity and composition of the skin, the condition of the underlying tissue, the amount and quality of wound exudate, local wound scarring, etc. [25]. In light of the principles of moist healing, our approach posits that maintaining a moist environment on the skin surface aids in accelerating the migration of epithelial cells. Accordingly, different dressings were selected based on wound type, including nonwoven, alginate, and silver-ion dressings to support natural healing [26]. Specifically, nonwoven dressings were used for dry, superficial wounds; hydrocolloid dressings for wounds with minimal exudate; alginate dressings for heavily exuding wounds, active bleeding sites, or sinus tracts; foam dressings for wounds with moderate-to-heavy exudation; and hydrogel dressings for wounds with complete epidermal loss, eschars, or necrotic tissue. Scar assessment was conducted using color Doppler ultrasound (CDU), a noninvasive and objective method for evaluating scar thickness, vascular distribution, and blood flow velocity [27]. The Vancouver Scar Scale was applied alongside CDU to monitor upper lip scar progression, with individualized scar management strategies provided when necessary. Psychological support was also integrated into the care process, addressing the emotional impact of wound healing, particularly for patients with higher VSS scores [28].

Personalized management strategies were developed for wounds involving multiple abrasions, tissue defects, or penetration injuries, incorporating aesthetic subunit considerations to optimize healing outcomes. In addition to best practices, wound irrigation and meticulous debridement are imperative for effectively managing these injuries [29]. For upper lip soft tissue abrasions, debridement was followed by the application of antibiotic ointment and oil gauze to maintain a moist healing environment and promote epithelialization. Povidone-iodine, diluted at a 1:1 ratio, was used to disinfect the periwound area to eliminate surface bacteria and oils. Dressing changes were scheduled based on the basis of individual assessments during the initial phase, allowing for a dynamic and responsive approach to wound care. The management of penetrating upper lip injuries is preemptive, emphasizing the early prevention of infection through both systemic and topical antibiotics. Tara L. et al. [30] showed that saline irrigation via an 18G needle syringe can increase the flushing pressure, aiding in the removal of debris and reducing infection risk. Eliya-Masamba et al. [31] recommended oral antibiotics for mild to moderate infections and intravenous antibiotics for more severe cases. Mupirocin ointment is highly recommended as a topical antibiotic ointment for infected wounds [32, 33]. Lip defects under 30% can typically be repaired with primary sutures; however, larger defects often require more complex closure techniques such as skin grafts or local flaps owing to the increased risk of dehiscence caused by suture tension [30, 34]. For minor defects measuring less than 2 mm, secondary intention healing may be appropriate [23]. Enhanced care includes more frequent dressing changes for complications such as infections or dehiscence. We also evaluated upper lip mobility, considering its impact on essential functions such as opening the mouth and chewing.

In summary, the findings of this study support an evidence-based, personalized wound management model that effectively addresses the unique challenges associated with upper lip injuries. Despite its strengths, this study has certain limitations. The relatively small sample size may limit the generalizability of the findings to other injury sites. Additionally, the patient satisfaction questionnaire had inherent limitations in scope and applicability. Future research should focus on expanding the sample size and diversifying the patient population to confirm the validity of these results. Furthermore, current literature lacks comprehensive data on postoperative functional training for the upper lip, highlighting the need for further clinical investigations to explore rehabilitation strategies aimed at improving functional and aesthetic outcomes.

Conclusion

This study highlights the benefits of a multidisciplinary wound management model, which enhances team synergy by integrating a comprehensive wound assessment framework and personalized wound care strategies. Key advancements include refining dressing application techniques, proactively preventing and managing complications, optimizing care for complex wounds, and systematically evaluating scar formation. The implementation of this model has led to a significant reduction in upper lip infection rates and an increase in patient satisfaction, demonstrating substantial clinical improvements. These findings advocate for wider adoption of this personalized wound management model in the clinical treatment of upper lip injuries. Looking forward, it's essential to explore functional rehabilitation strategies for the upper lip after surgery. This will deepen our comprehension of upper lip injury, especially when it coincides with dental injuries, and optimize our treatment protocols accordingly.

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Authors' contributions
Yanjun DIAO: Writing – review & editing; Writing – original draft; Project administration; Methodology; Investigation; Funding acquisition; Formal analysis; Conceptualization. Xian LIU: Writing – review & editing; Conceptualization. Hanghang LIU: Writing – review & editing; Validation; Supervision; Methodology; Formal analysis; Conceptualization. Xuefeng ZHANG: Writing – review & editing. Xiaorong ZHOU: Writing – review & editing. Yongle SHI: Writing – review & editing; Validation; Supervision; Project administration; Methodology; Funding acquisition; Formal analysis; Conceptualization.

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Data availability
No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate
The study adhered to the ethical guidelines of the Declaration of Helsinki: Ethical Principles for Medical Research Involving Human Subjects and Ethical approval to report this case was obtained from the Medical Ethics Committee of West China Stomatological Hospital of Sichuan University (WCHSIRB-CT-2023–362), approval date 22 September 2023. All patients gave informed consent and participated voluntarily. For participants that are aged under 18-years-old, informed consent have been obtained from a parent and/or legal guardian.

Consent for publication
For all the images related to an individual person, the written informed consent for the publication was obtained.

Competing interests
The authors declare no competing interests.

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