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ASSESSMENT OF PREDICTING SUCCESS FACTORS OF MICROVASCULAR COMPOSITE FIBULA FLAP IN RECONSTRUCTION OF HARD AND SOFT TISSUE DEFECTS IN MAXILLOFACIAL AND ORAL CAVITY DUE TO PREVIOUS BALLISTIC TRAUMA

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Abstract

Background and objective

Reconstruction with fibula free-flap is one of the routine treatments in head and neck surgeries. The present research was done to determine the predictor factors of success of vascular anastomosis in composite free fibula microvascular flaps or fibula free flaps used in the reconstruction of traumatic/ballistic oral and maxillofacial defects among the patients referring to Taleghani hospital in Tehran in 2022 and 2023.

Materials and methods

The present research was done via a prospective cohort method on 14 patients. The demographic information, characteristics related to trauma surgery, characteristics associated with the treatment outcomes including success of the flap, incidence of infection, hematoma, and thrombosis at the transplantation site, as well as the site of arterial and venous anastomosis were recorded. Comparison of the quantitative variables was done using independent t-test and Mann-Whitney U test, with the results of qualitative variables judged via chi-square test.

Results

The success of flap was observed in 78.6% (n=11) subjects. Bleeding was seen in two cases (14.3%), surgical site infection in five patients (35.7%), hematoma in one patient (7.1%), and thrombosis in five patients (35.7%). Considering the site of venous and arterial anastomosis, 13 cases (92,9%) were in the form of end to end, and one case (7.1%) was in the form of end to side. No significant

difference was observed in terms of frequency of the cases of flap success, infection, hematoma, thrombosis per the transplant and site of arterial anastomosis, type of artery, and anastomosis vein at the recipient site, location of defects, gender, and time between trauma and surgery. Nevertheless, the values of systolic blood pressure ($p<0.001$), diastolic blood pressure ($p<0.001$), as well as oxygen saturation percentage ($p=0.001$) were significantly higher in successful flap cases. Furthermore, smoking tobacco had caused significant reduction in flap success ($p=0.02$).

Conclusion

Overall, transplantation of composite microvascular flap or fibular free flap has been associated with successes in reconstruction of oral and maxillofacial traumatic defects. However, there are some concerns about the role of some variables such as systolic blood pressure, diastolic blood pressure, as well as oxygen saturation percentage, and smoking tobacco in this regard.

Keywords Vascular anastomosis, microvascular fibula flap, traumatic defects, reconstruction, confounding factors.

Introduction

Reconstruction of bony and soft tissue defects is one of the important challenges in oral and maxillofacial surgery. These defects develop due to different reasons, and become further important in traumatic injuries resulting from traumatic/ballistic incidents because of the wide extent of degeneration that occurs, degradation of vascular and tissue structures in the transplant recipient region, damage to vital organs, as well as direct injury to the functional parts of mastication, respiration, swallowing, speaking, and face aesthetics. Due to the wide extent of degenerations that occur in these defects as well as the impaired recipient matrix (wide vascular damages, impaired lymphatic drainage, scar, as well as deficient transplant covering tissue during the healing period), reconstruction with autologous transplants, as well as allogenic, xenogeneic materials, plus conventional synthetic biomaterials is impossible in these defects. The golden standard treatment for reconstruction and rehabilitation of these defects is use of microvascular grafts through fibula hard and soft tissue composition (1). Vascularized fibular transplantation has had more optimal outcomes compared to use of osteotomy, non-vascularized grafts, as well as pedicle vascularized bone transplants. Thus, their application has attracted attention especially in younger patients [2-4].

The common complications of these operations include incidence of surgical site hematoma and thrombosis, infection, flap failure, and even death. Furthermore, the flap success fully depends on the continuous input venous flow and venous output flow until neo-vascularization occurs. Flap failure is also multifactorial and indicates a potentially reversible flap up to a necrotic irreversible flap, which requires debridement, long-term wound care, and eventually decision-making about future reconstruction.

Vascularized bone grafting requires exposure of the lateral hip, core decompression of the femoral neck and head, insertion and fixation of the fibula and its pedicle of the peroneal artery and vein, and their microanastomosis to suitable local vessels [5].

Oxygen saturation percentage and blood flow are among the important factors predicting complete reconstruction of the free grafts and their anastomosis [6]. The ability of identifying essential changes in the free flap grafts has attracted attention in recent years [7-9]. Neo-vascularization causes independence of flaps from the blood flow resulting from the graft stem within the short-term [10]; this establishes changes in the bloodstream.

These reconstructions are performed limited in the oral and maxillofacial region in our country, and given the considerable statistical population of these patients especially in military, traumatic/ballistic, and Armed Forces accidents, the importance of this type of surgeries is remarkable. Precise investigation of confounding and predictive factors is required to provide optimal scientific and structural settings required for a successful reconstruction.

The present research was done to determine the predictive factors of success of microvascular anastomosis in fibula composite flaps or fibula free flap used in reconstruction of traumatic/ballistic

defects of oral and maxillofacial region among the clients referring to Taleghani hospital in Tehran in 2022 and 2023.

Materials and methods

The present research was done using a prospective cohort method. For this purpose, all patients that had undergone fibula composite microvascular flap surgery or fibula free flap surgery in 2022 to 2023 following oral and maxillofacial traumatic/ballistic defects in Taleghani hospital in Tehran, were included as 14 subjects after applying the inclusion and exclusion criteria. The inclusion criteria were as follows:

- traumatic/ballistic trauma to the face
- use of the fibula composite microvascular flap or fibula free flap
- complete patient file information
- consent to participation in the study

The exclusion criteria included:

- nontraumatic/ballistic trauma to the face
- usage of flaps other than fibula for the patient reconstruction
- no need to bony free flap
- impossibility of using fibula composite microvascular flap or fibula free flap
- history of oral and dental malignancies
- history of extensive febrile facial and mandibular trauma
- history of extensive oral and maxillofacial surgery requirement
- Diabetes
- Osseous diseases or any drug consumption contributed to osseous metabolism
- death

The patients who had undergone fibula composite microvascular flap surgery or fibula free flap surgery following traumatic/ballistic defects of the oral and maxillofacial region in Taleghani hospital, Tehran in 2022 and 2023 were recruited in the study based on inclusion and exclusion criteria. The patients were followed up for six months post-surgery; during this period, the necessary data were collected and recorded. The required information of patients included demographic information (age, gender, weight, body mass index (BMI), smoking, alcohol consumption, and drug abuse), vital signs of the patient (systolic blood pressure, diastolic blood pressure, oxygen saturation percentage), trauma-associated features (trauma region, extent of trauma based on involvement of the skin, bone, and mucus), surgery-related factors (such as duration of surgery, interval between trauma and surgery, bleeding during surgery, use of PC), and surgical complications (failure/success of flap, formation of hematoma and thrombosis post-operation, surgical site infection).

The postoperative flap success was defined as existence of a suitable blood flow in the flap post-surgery, absence of dehiscence, infection, or need for debridement post-surgery. The flap success six months post-surgery has also been defined as existence of live bone with the ability of dental implant placement as well as performing dental reconstructions. The flap failure was regarded as failure to achieving each of the afore-mentioned points post-surgery or six months after it. The file of patients and images during operation were used for calculating the length and site of the bone defect as well as the area of the skin paddle. Furthermore, the site of defect was classified as four regions of anterior maxilla, anterior mandible, lateral mandible without crossing the midline, and lateral and anterior mandible. The quantitative data were analyzed by mean and standard deviation, while the qualitative ones were reported based on number and percentage. Independent t-test and Mann-Whitney U test were employed for statistical comparison of the quantitative variables, while the findings of qualitative variables were judged using chi-square test.

Results

Overall, 14 patients were investigated in the research, with 10 (71.4%) being male and four (28.6%) being female. Out of this number, five (35.7%) were non-smokers, two (14.3%) were passive smokers, three (21.4%) were previous smokers, and four (28.6%) were active smokers. Further, one patient (7.1%) had drug addiction, while the other 13 (92.9%) did not have such addiction. Meanwhile, two (14.3%) had alcohol addiction while 12 (85.7%) did not have alcohol addiction. The mean age of the patients was 34.93 years and the standard deviation of their age was 5.17 (age range: 27-42 years). The position of the damages incurred to the examined patients is presented in Table 1.

The components of the flap in 10 cases (71.4%) included bone, while in four cases (28.6%), it included osseo-cutaneous components. Bleeding (loss of blood) was observed in two cases (14.3%), while the infection of the graft recipient area was found in five patients (35.7%). The recipient area hematoma was observed in one patient (7.1%), and recipient area thrombosis was reported in again five patients (35.7%). The flap success was observed in 11 cases (78.6%). Table 2 reports the mean, standard deviation, and some other central distribution of some quantitative variables such as age, the harvested bone length, the length of the used flap, etc. in patients.

In two patients (14.3%) packed cell (PC) had been used for compensation of bleeding, while in 12 cases (85.7%) this had not been done. Regarding the arterial anastomosis site, 13 cases (92.9%) were as end to end, while one case (7.1%) was in the form of end to side.

Regarding the name of the anastomosis artery at the recipient site, one case (7.1%) was the superior thyroid, 12 (85.7%) was facial, and one case (7.1%) was lingual. Regarding the position of the venous anastomosis site, 13 cases (92.9%) were as end to end while one case (7.1%) was observed as end to side.

Concerning the name of the anastomosis vein at the recipient site, external, internal, or anterior jugular vein was recorded in six patients (42.9%), retromandibular in one case (7.1%) and facial in seven cases (50.0%).

According to the results of student t-test, the values of systolic blood pressure ($p<0.001$), diastolic blood pressure ($p<0.001$), and oxygen saturation percentage ($p=0.001$) were significantly higher in successful cases of flap compared to unsuccessful ones. In other variables, no significant difference was observed regarding success or failure of the flap. No significant difference was observed either regarding the values of quantitative variables considering the flap recipient area infection. However, regarding thrombosis of the flap recipient area, the weight of patients ($p=0.04$) and their BMI ($p=0.04$) were significantly larger in the cases of flap recipient area thrombosis. No significant difference was found regarding the area thrombosis in other variables (Tables 3-5). Based on the results of Mann-Whitney U nonparametric test, significant differences were not observed in terms of time between trauma and surgery regarding success or failure of the fibula flap ($p=0.72$). Furthermore, no significant difference was found in terms of time between trauma and surgery regarding thrombosis of the transplant recipient area ($p=0.21$). These findings were also observed regarding time between trauma and surgery considering the transplant recipient area infection ($p=0.94$).

No significant differences were observed regarding the variables of flap success ($p=0.84$), surgical site infection (0.48), surgical site hematoma ($p=0.51$), and flap recipient area thrombosis regarding gender distribution ($p=0.59$) (Table 6). However, significant differences were found regarding the extent of flap success per every status of cigarette smoking of the patients ($p=0.02$). From among the four active smokers, three experienced flap failure. Nevertheless, no significant difference was observed regarding the variables of the flap recipient site infection ($p=0.14$), recipient site hematoma ($p=0.59$), and flap recipient site thrombosis ($p=0.23$) in terms of cigarette smoking in patients (Table 7). Based on the results of chi-square tests, no significant differences were found regarding success of flap ($p=0.72$), flap recipient site infection ($p=0.85$), the flap recipient site hematoma ($p=0.59$), and flap recipient site thrombosis ($p=0.85$) in terms of the site of defects (Table 8). Meanwhile, no significant difference was observed either regarding flap success ($p=0.22$),

recipient site infection (p=0.59), recipient site hematoma (p=0.1), and recipient site thrombosis (p=0.08) regarding the flap components (Table 9).

Table 10 compares variables in patients undergoing fibula composite microvascular flap surgery or fibula free flap per bleeding. No significant differences were observed regarding success or failure of the flap (p=0.43), recipient site infection (p=0.26), and recipient site thrombosis (p=0.26) per injection or lack of injection of PC for compensation of bleeding. However, the frequency of recipient site hematoma showed significant differences in terms of whether PC had been injected or not (p=0.01).

Significant differences were not found regarding frequency of flap success (p=0.59), flap site infection (p=0.44), hematoma (p=0.77), and thrombosis of the flap site (p=0.44) regarding the arterial anastomosis site (Table 12). In addition, no significant differences were observed either regarding success of flap (p=0.73), flap site infection (p=0.52), recipient site hematoma (p=0.91), and recipient site thrombosis (p=0.30) considering the type of anastomosis artery at the recipient site (Table 13). Meanwhile, according to the chi-square test results, no significant differences were observed regarding flap success (p=0.59), recipient site infection (p=0.44), recipient site hematoma (p=0.77), and recipient site thrombosis (p=0.44) (Table 14). Finally, significant differences were not observed either regarding the flap success (p=0.75), recipient site infection (p=0.69), recipient site hematoma (p=0.49), and recipient site thrombosis (p=0.69) per the name of anastomosis vein at the recipient site (Table 15).

Discussion

In this research, the success of flaps was recorded in 11 out of 14 patients, which is a remarkable value (78.57%). In addition, bleeding was recorded in 14.3% of patients, infection in 35.7%, hematoma in 7.1%, and thrombosis of the flap site in 35.7%. Lodders et al. (2021) reported success rate of reconstruction treatments with vascularized free fibula flaps in radiotherapy-free areas as 96% [11]. Corbitt et al. (2014) also reported the success rate of free flap treatments as 96.4% [12]. Meanwhile, Goker et al. (2020) reported 85.7% as the success rate of reconstruction of the maxillofacial region with fibula free flaps [13]; Goker et al. (2020) reported this value as 97.7% [14], while Attia et al. (2018) reported the survival rate of 34 fibula flaps implanted following surgical reconstructions as 97% [15]. The survival rate of the fibula transplantation in the research by Parbo et al. (2013) was also reported 97%, which was within the range of previous studies [16] and greater than the present research. Some problems such as loosening of the osteosynthesis material, gingival hyperplasia, fistula, and exposure of the gum can lead to flap failure. In one case, the extent of flap survival in 60 patients with 39-month follow-up was 98% [17], in 42 patients with five-year follow-up was 93% [18], and in 18 patients with 10-year follow-up was 94% [19]. The final success rate of flaps in the research by Chang et al. (2017) was equivalent to 69.9%, which has been lower compared to the present research [20]. The acceptable success of the fibula transplantation in the present research can be due to its limited follow-up period, since the patients were followed up for only six months and their long-term outcomes had not been evaluated. The fibula transplant material can degrade because of infection, vessel pressure, vessel thrombosis, or observability and osteosynthesis [18]. In spite of some reports about complications associated with fibula transplantation, this type of surgery is considered a valid and safe method [21].

Other factors also influence the extent of survival of fibula transplantation and the implants placed in it. These include skill of the surgeon, bone quality, bone topography and radiotherapy dose, general health, oral and mental health, cigarette smoking, and alcohol consumption [22]. One of the problems related to free fibula flaps is incidence of infection, hematoma, and thrombosis of the transplanted area. According to the results of the present research, frequency of hematoma has been significantly higher in patients with a history of bleeding. Further, frequency of hematoma showed significant differences in terms of whether PC had been injected or not.

Fibula free flaps rarely fail in the head and neck regions [23, 24]. Concurrently, failure of these flaps often occurs due to perfusion, which is itself because of problems associated with blood flow in the

flap. Failed flaps are treatable, in case the reasons behind the failure are identified [25, 26]. These treatments have their own challenges due to the micro blood flow that decreases slowly as well as the problems in identifying slow processes in relation to explosive incidents. In case the relevant problems are detected early, failure of free flaps can be prevented [27]. Failure of flaps often occurs due to incidence of thrombosis in the pedicle and hematoma or bleeding [27].

Osseocutaneous fibula flap was first introduced by Taylor (1975) [28], while Hidalog (1989) reported its first application for mandibular reconstruction [29]. Since then, this method has been a conventional and selected technique for mandibular reconstruction following trauma or tumor incisional surgeries.

Due to the large volume of the bone and good skin paddle, Osseocutaneous free fibula flap is also a primary treatment option for reconstruction of mandibular segmental surgeries. Following recent advances, the mandibular reconstruction treatments have acquired high success rates using fibula free flaps, and there is limited risk of incidence of complications in them [30]. Simultaneously, loss of the free fibula flap may occur due to some unidentified variables in preoperative assessments. In some cases, preoperative evaluations in free fibula flap treatments include examining the patency of vessels, in order to see whether harvesting of the vessels of the tibia external part causes incidence of ischemia in the graft donor sites or not. The venous flow has also been one of the reasons associated with failure of flap treatments [31]. In an investigation on free flaps of the head and neck region, venous insufficiency was reported as a major cause of repetition of surgeries [32]. Meanwhile, significant differences have been reported in terms of the repeated second fibula flap surgeries in comparison to soft tissue flaps alone [33]. Venous thrombosis has also been another complication; in the investigation by Chang et al. (2017), based on the results of recent research, the vein was a major cause of flap failure, and the researchers propose that for identifying a vein with the best blood flow, first arterial anastomosis should be done. In this regard, the success rate of fibula free flaps in the research by Chang et al. (2016) was 96.9%, which has been close to previous studies [20], while being larger than the present research.

According to the present study findings, the effects of tobacco smoking on the success rate of flap treatments have been significant. Indeed, all of the three patients with flap failures were active smokers, and from among 11 patients with successful flap report, only one was an active smoker. Meanwhile, tobacco smoking had no significant effect on infection, hematoma, and thrombosis of the recipient site.

Considering the effects of tobacco smoking on the success of flap treatments, it can be stated that tobacco smoking can affect the outcomes of restorations in this way. Nevertheless, it should be noted that due to the fewer number of samples examined in this research, no standard protocol based on the obtained findings can be designed and used for treating eligible patients. These findings suggest the possible effects of tobacco smoking on incidence of complications of reconstruction with fibula flaps, and patients should receive the necessary warnings in this regard. Further, the site of defects did not show significant effects on the success of flap or incidence of infection, hematoma, and thrombosis of the recipient site.

Burgess et al. (2017) indicated that active smokers (72%) and previous smokers (78%) had a lower success rate of fibula transplantation compared to non-smokers (94%) [34]. Investigation of the history of smoking before graft preparation process is important, through which one can perform more interventions to enhance the success rate of flap treatments in high-risk individuals. In this regard, Lodders et al. (2021) considered tobacco smoking and radiotherapy at the site of free fibula flap as the predictive variables for failure of implants [11]. Khadembaschi et al. (2021) in investigating the files of patients receiving free fibula transplants, indicated that tobacco smoking, aging, male gender, and radiotherapy all were effective in failure of treatments [35]. Eisenschenk et al. (1998) also investigated the outcomes of bone reconstruction and its hypertrophy among 81 patients receiving vascularized bony transplants. They concluded that transplants without history of infection had better outcomes compared to those with infection, where specific differentiation of the

fibula hypertrophy behavior was greater in younger individuals (1-18 years) compared to those with higher ages (35-60 years) [36]. These findings were not observed in the present research.

In this research, no significant differences were seen regarding the frequency of flap success, infection, and hematoma, and thrombosis per each site of arterial anastomosis, type anastomosis artery at the recipient site, anastomosis vein at the recipient site, location of defects, gender, and interval between trauma and surgery. Nevertheless, significant differences were observed between values of systolic blood pressure, diastolic blood pressure, and oxygen saturation percentage in successful flap cases compared to failed cases. Furthermore, the weight of patients and their BMI were significantly higher in cases of the flap recipient area thrombosis. Based on these findings, necessary warnings should be given to patients about the factors associated with failure of fibula flap treatments. The oxygen saturation percentage and blood flow are important factors concerning complete healing of anastomosis of free flaps, and attention should be paid to this issue [6].

Normal anastomosis refers to a normal and biological graft inside the body. Surgical anastomosis is indeed done through surgery and by a surgeon, and under conditions where part of vessels has been blocked. The risks of anastomosis include development of blood clot, bleeding, scar formation, duct obstruction, abnormal narrowing of the duct, damage to surrounding tissues, infection, anastomosis leakage, etc. [37]. In this research, regarding arterial anastomosis site, 92.9% had been done as end to end and 7.1% as end to side. Regarding the site of venous anastomosis, again 92.9% had been done as end to end and 7.1% as end to side. In some cases, numerous advantages have been noted for end to side anastomosis in the reconstruction surgery, though it warrants further investigations and consideration of the patient's underlying diseases [38-61]. In this research, the patients were followed up for six months post-surgery. Studies about the research subject have evaluated different periods post-operation, and thus the success rate of free fibula surgeries has diminished over time. The reduction of the therapeutic success rate over time can be associated with factors such as age, changes in the health status, or long-term effects of radiotherapy. Subsequent studies should also emphasize the importance of long-term follow-up periods for examining the success rate of vascularized free fibula transplants. Screening and reporting the therapeutic success rates at different stages of the follow-up periods can identify the possible challenges in this regard and proposed suitable interventions for resolving them.

Conclusion

Overall, transplantation of composite microvascular flap or fibular free flap has been associated with successes in reconstruction of oral and maxillofacial traumatic defects. However, there are some concerns about the role of some variables such as systolic blood pressure, diastolic blood pressure, as well as oxygen saturation percentage, and smoking tobacco in this regard.

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Table 1. The site of overall and maxillofacial traumatic/ballistic defects in patients undergoing fibula composite microvascular flap surgery or fibula free flap in 2022 and 2023

Site	No.	Percentage
Anterior maxilla	2	3.14%
Anterior mandible	5	7.35%
Lateral mandible without crossing the midline	1	1.7%
Lateral and anterior mandible	6	9.42%
Total	14	0.100%

Table 2. Central distribution indices of the quantitative variables among patients undergoing fibula composite microvascular flap surgery or fibula free flap in 2022 and 2023

Variable	Mean	SD	Min.	Max.
Age	93.34	17.5	27	42
Obtained bone length	79.16	12.2	15	20
Used fibula length	86.12	38.2	10	18
Delay between trauma and surgery	14.102	86.24	90	180
Duration of surgery	86.6	95.0	6	9
Weight	71.77	91.10	60	95
BMI	93.23	84.2	19	29
SBP	79.121	48.9	100	135
DBP	07.78	30.7	61	89
Oxygen saturation percentage	86.96	03.1	95	98

Table 3. The mean and standard deviation of the quantitative variables in patients undergoing fibula composite microvascular flap surgery or fibula free flap in 2022 and 2023 per flap success

Flap success Variable	Unsuccessful	Successful	P value
Age	13.5±67.33	37.5±27.35	65.0

Used fibula length	31.2±33.11	33.2±27.13	22.0
Duration of surgery	58.0±67.6	04.1±91.6	71.0
Weight	09.12±67.85	06.10±55.75	16.0
BMI	22.3±67.26	36.2±18.23	06.0
SBP	11.6±67.106	7.4±91.125	001.0<
DBP	93.4±67.66	84.3±18.81	001.0<
Oxygen saturation percentage	58.0±33.95	65.0±27.97	001.0

Table 4. The mean and standard deviation of the quantitative variables in patients undergoing fibula composite microvascular flap surgery or fibula free flap in 2022 and 2023 per transplant recipient site infection

Recipient site infection Variable	No	Yes	P value
Age	81.5±33.35	27.4±20.34	71.0
Used fibula length	55.2±33.13	0.2±0.12	34.0
Duration of surgery	12.1±0.7	55.0±60.6	47.0
Weight	61.10±0.75	74.10±60.82	23.0
BMI	52.2±11.23	05.3±40.25	16.0
SBP	74.4±0.126	63.11±20.114	09.0
DBP	24.4±0.81	12.9±80.72	12.0
Oxygen saturation percentage	60.0±11.97	52.1±40.96	36.0

Table 5. The mean and standard deviation of the quantitative variables in patients undergoing fibula composite microvascular flap surgery or fibula free flap in 2022 and 2023 per transplant recipient site thrombosis

Recipient site thrombosis Variable	No	Yes	P value
Age	62.5±44.34	71.4±80.35	66.0
Used fibula length	49.2±22.13	28.2±20.12	46.0
Duration of surgery	12.1±0.7	55.0±60.6	47.0
Weight	96.9±44.73	56.8±40.85	04.0
BMI	44.2±78.22	45.2±0.26	04.0
SBP	86.4±89.125	78.11±40.114	09.0
DBP	18.4±22.81	71.8±40.72	09.0
Oxygen saturation percentage	60.0±11.97	52.1±40.96	36.0

Table 6. Comparison of variables in patients undergoing fibula composite microvascular flap surgery or fibula free flap in 2022 and 2023 regarding gender

Variables	Gender Categories	Male	Female	Total	P value
Flap success	No Yes Total	2 (67.66%) 8 (73.72%) 10 (43.71%)	1 (33.33%) 3 (27.27%) 4 (57.28%)	3 (0.100%) 11 (0.100%) 14 (0.100%)	84.0
Recipient site infection	No Yes Total	7 (78.77%) 3 (0.60%) 10(43.71%)	2 (22.22%) 2 (0.40%) 4 (57.28%)	9 (0.100%) 5 (0.100%) 14 (0.100%)	48.0
Recipient site hematoma	No Yes Total	9 (23.69%) 1 (0.100%) 10 (43.71%)	4 (77.30%) 0 4 (57.28%)	13 (0.100%) 1 (0.100%) 14 (0.100%)	51.0
Recipient site thrombosis	No Yes Total	6 (67.66%) 4 (0.80%) 10 (43.71%)	3 (33.33%) 1 (0.20%) 4 (57.28%)	9 (0.100%) 5 (0.100%) 14 (0.100%)	59.0

Table 7. Comparison of variables in patients undergoing fibula composite microvascular flap surgery or fibula free flap in 2022 and 2023 considering tobacco smoking

Variables	Cigarette Categories	No	Passive smoker	Previous smoker	Current smoker	Total	P value
Flap success	No Yes Total	0 5 (45.45%) 5 (71.35%)	0 2 (18.18%) 2 (29.14%)	0 3 (27.27%) 3 (43.21%)	3 (0.100%) 1 (1.9%) 4 (57.28%)	3 (0.100%) 11 (0.100%) 14 (0.100%)	02.0
Recipient site infection	No Yes Total	3 (33.33%) 2 (0.40%) 5 (71.35%)	2 (23.22%) 0 2 (29.14%)	3 (33.33%) 0 3 (43.21%)	1 (11.11%) 3 (0.60%) 4 (57.28%)	9 (0.100%) 5 (0.100%) 14 (0.100%)	14.0
Recipient site hematoma	No Yes Total	4 (77.30%) 1 (0.100%) 5 (71.35%)	2 (38.15%) 0 2 (29.14%)	3 (08.23%) 0 3 (43.21%)	4 (77.30%) 0 4 (57.28%)	13 (0.100%) 1 (0.100%) 14 (0.100%)	59.0
Recipient site thrombosis	No Yes Total	4 (45.44%) 1 (0.20%) 5 (71.35%)	2 (22.22%) 0 2 (29.14%)	2 (22.22%) 1 (0.20%) 3 (43.21%)	1 (11.11%) 3 (0.60%) 4 (57.28%)	9 (0.100%) 5 (0.100%) 14 (0.100%)	23.0

Table 8. Comparison of variables in patients undergoing fibula composite microvascular flap surgery or fibula free flap in 2022 and 2023 regarding site of defects

Variables	Defect site Categories	Anterior maxilla	Anterior mandible	Lateral mandible without section	Lateral and anterior mandible	Total	P value
Flap success	No Yes Total	1 (33.33%) 1 (1.9%) 2 (29.14%)	1 (33.33%) 4 (0.36%) 5 (71.35%)	0 1 (1.9%) 1 (14.7%)	1 (34.33%) 5 (8.45%) 6 (86.42%)	3 (0.100%) 11 (0.100%) 14 (0.100%)	72.0
Recipient site infection	No Yes Total	1 (11.11%) 1 (0.20%) 2 (29.14%)	3 (33.33%) 2 (0.40%) 5 (71.35%)	1 (11.11%) 0 1 (14.7%)	4 (45.44%) 2 (0.40%) 6 (86.42%)	9 (0.100%) 5 (0.100%) 14 (0.100%)	85.0
Recipient site hematoma	No Yes Total	2 (0.15%) 0 2 (29.14%)	4 (0.31%) 1 (0.100%) 5 (71.35%)	1 (00.8%) 0 1 (14.7%)	6 (0.46%) 0 6 (86.42%)	13 (0.100%) 1 (0.100%) 14 (0.100%)	59.0
Recipient site thrombosis	No Yes Total	1 (11.11%) 1 (0.20%) 2 (29.14%)	3 (33.33%) 2 (0.40%) 5 (71.35%)	1 (11.11%) 0 1 (14.7%)	4 (45.44%) 2 (0.40%) 6 (86.42%)	9 (0.100%) 5 (0.100%) 14 (0.100%)	85.0

Table 9. Comparison of variables in patients undergoing fibula composite microvascular flap surgery or fibula free flap in 2022 and 2023 concerning flap components

Variables	Flap components Categories	Bone	Osseocutaneous	Total	P value
Flap success	No Yes Total	3 (0.100%) 7 (0.64%) 10 (0.71%)	0 4 (0.36%) 4 (0.29%)	3 (0.100%) 11 (0.100%) 14 (0.100%)	22.0
Recipient site infection	No Yes Total	6 (0.67%) 4 (0.80%) 10 (0.71%)	3 (0.33%) 1 (0.20%) 4 (0.29%)	9 (0.100%) 5 (0.100%) 14 (0.100%)	59.0
Recipient site hematoma	No Yes Total	10 (0.77%) 0 10 (0.71%)	3 (0.23%) 1 (0.100%) 4 (0.29%)	13 (0.100%) 1 (0.100%) 14 (0.100%)	1.0
Recipient site thrombosis	No Yes Total	5 (0.56%) 5 (0.100%) 10 (0.71%)	4 (0.44%) 0 4 (0.29%)	9 (0.100%) 5 (0.100%) 14 (0.100%)	08.0

Table 10. Comparison of variables in patients undergoing fibula composite microvascular flap surgery or fibula free flap in 2022 and 2023 considering bleeding

Variables	Bleeding Categories	No	Yes	Total	P value
Flap success	No Yes Total	3 (0.100%) 9 (0.82%) 12 (0.86%)	0 2 (0.18%) 2 (0.14%)	3 (0.100%) 11 (0.100%) 14 (0.100%)	43.0
Recipient site infection	No Yes Total	7 (0.78%) 5 (0.100%) 12 (0.86%)	2 (0.22%) 0 2 (0.14%)	9 (0.100%) 5 (0.100%) 14 (0.100%)	26.0
Recipient site hematoma	No Yes Total	12 (0.92%) 0 12 (0.86%)	1 (0.8%) 1 (0.100%) 2 (0.14%)	13 (0.100%) 1 (0.100%) 14 (0.100%)	01.0
Recipient site thrombosis	No Yes Total	7 (0.78%) 5 (0.100%) 12 (0.86%)	2 (0.22%) 0 2 (0.14%)	9 (0.100%) 5 (0.100%) 14 (0.100%)	26.0

Table 11. Comparison of variables in patients undergoing fibula composite microvascular flap surgery or fibula free flap in 2022 and 2023 concerning PC injection for bleeding compensation

Variables	PC injection Categories	No	Yes	Total	P value
Flap success	No Yes Total	3 (0.100%) 9 (0.82%) 12 (71.85%)	0 2 (0.18%) 2 (29.14%)	3 (0.100%) 11 (0.100%) 14 (0.100%)	43.0
Recipient site infection	No Yes Total	7 (78.77%) 5 (0.100%) 12 (71.85%)	2 (22.22%) 0 2 (29.14%)	9 (0.100%) 5 (0.100%) 14 (0.100%)	26.0
Recipient site hematoma	No Yes Total	12 (31.92%) 0 12 (71.85%)	1 (69.7%) 1 (0.100%) 2 (29.14%)	13 (0.100%) 1 (0.100%) 14 (0.100%)	01.0
Recipient site thrombosis	No Yes Total	7 (78.77%) 5 (0.100%) 12 (71.85%)	2 (22.22%) 0 2 (29.14%)	9 (0.100%) 5 (0.100%) 14 (0.100%)	26.0

Table 12. Comparison of variables in patients undergoing fibula composite microvascular flap surgery or fibula free flap in 2022 and 2023 regarding site of arterial anastomosis

Variables	Arterial anastomosis site Categories	End to end	End to side	Total	P value
Flap success	No Yes Total	3 (0.100%) 10 (91.90%) 13 (86.92%)	0 1 (09.9%) 1 (14.7%)	3 (0.100%) 11 (0.100%) 14 (0.100%)	59.0
Recipient site infection	No Yes Total	8 (89.88%) 5 (0.100%) 13 (86.92%)	1 (11.11%) 0 1 (14.7%)	9 (0.100%) 5 (0.100%) 14 (0.100%)	44.0
Recipient site hematoma	No Yes Total	12 (31.92%) 1 (0.100%) 13 (86.92%)	1 (69.7%) 0 1 (14.7%)	13 (0.100%) 1 (0.100%) 14 (0.100%)	77.0
Recipient site thrombosis	No Yes Total	8 (89.88%) 5 (0.100%) 13 (86.92%)	1 (11.11%) 0 1 (14.7%)	9 (0.100%) 5 (0.100%) 14 (0.100%)	44.0

Table 13. Comparison of variables in patients undergoing fibula composite microvascular flap surgery or fibula free flap in 2022 and 2023 regarding type of anastomosis artery at the recipient site

Variables	Type of anastomosis at the recipient site Categories	Superior thyroid	Facial	Lingual	Total	P value
Flap success	No Yes Total	0 1 (09.9%) 1 (14.7%)	3 (0.100%) 9 (82.81%) 12 (72.85%)	0 1 (09.9%) 1 (14.7%)	3 (0.100%) 11 (0.100%) 14 (0.100%)	73.0
Recipient site infection	No Yes Total	1 (11.11%) 0 1 (14.7%)	7 (78.77%) 5 (0.100%) 12 (72.85%)	1 (11.11%) 0 1 (14.7%)	9 (0.1000%) 5 (0.100%) 14 (0.100%)	52.0
Recipient site hematoma	No Yes Total	1 (69.7%) 0 1 (14.7%)	11 (62.84%) 1 (0.100%) 12 (72.85%)	1 (69.7%) 0 1 (14.7%)	13 (0.100%) 1 (0.100%) 14 (0.100%)	91.0
Recipient site thrombosis	No Yes Total	1 (11.11%) 0 1 (14.7%)	8 (89.88%) 4 (0.80%) 12 (72.85%)	0 1 (0.20%) 1 (14.7%)	9 (0.100%) 5 (0.100%) 14 (0.100%)	30.0

Table 14. Comparison of variables in patients undergoing fibula composite microvascular flap surgery or fibula free flap in 2022 and 2023 regarding site of venous anastomosis

Variables	Venous anastomosis site Categories	End to end	End to side	Total	P value
Flap success	No Yes Total	3 (0.100%) 10 (91.90%) 13 (86.92%)	0 1 (09.9%) 1 (14.7%)	3 (0.100%) 11 (0.100%) 14 (0.100%)	59.0
Recipient site infection	No Yes Total	8 (89.88%) 5 (0.100%) 13 (86.92%)	1 (11.11%) 0 1 (14.7%)	9 (0.100%) 5 (0.100%) 14 (0.100%)	44.0
Recipient site hematoma	No Yes Total	12 (31.92%) 1 (0.100%) 13 (86.92%)	1 (69.7%) 0 1 (14.7%)	13 (0.100%) 1 (0.100%) 14 (0.100%)	77.0
Recipient site thrombosis	No Yes Total	8 (89.88%) 5 (0.100%) 13 (86.92%)	1 (11.11%) 0 1 (14.7%)	9 (0.100%) 5 (0.100%) 14 (0.100%)	44.0

Table 15. Comparison of variables in patients undergoing fibula composite microvascular flap surgery or fibula free flap in 2022 and 2023 regarding name of the anastomosis vein at the recipient site

Variables	Anastomosis vein at the recipient site Categories	Jugular	Retromandibular	Facial	Total	P value
Flap success	No Yes Total	1 (33.33%) 5 (45.45%) 6 (86.42%)	0 1 (1.9%) 1 (14.7%)	2 (67.66%) 5 (45.45%) 7 (0.50%)	3 (0.100%) 11 (0.100%) 14 (0.100%)	75.0
Recipient site infection	No Yes Total	4 (44.44%) 2 (0.40%) 6 (86.42%)	1 (12.11%) 0 1 (14.7%)	4 (44.44%) 3 (0.60%) 7 (0.50%)	9 (0.100%) 5 (0.100%) 14 (0.100%)	69.0
Recipient site hematoma	No Yes Total	5 (46.38%) 1 (0.100%) 6 (86.42%)	1 (69.7%) 0 1 (14.7%)	7 (85.53%) 0 7 (0.50%)	13 (0.100%) 1 (0.100%) 14 (0.100%)	49.0
Recipient site thrombosis	No Yes Total	4 (44.44%) 2 (0.40%) 6 (86.42%)	1 (12.11%) 0 1 (14.7%)	4 (44.44%) 3 (0.60%) 7 (0.50%)	9 (0.100%) 5 (0.100%) 14 (0.100%)	69.0