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Buccal Fat Nerve Wrapping in Peripheral Trigeminal Nerve Repair Surgery: A Retrospective Case Series

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Abstract

Post-traumatic trigeminal neuropathy is a debilitating condition that may occur after dental, oral, and maxillofacial procedures. In this retrospective case series study, we describe the clinical and patient reported outcomes on 13 patients with trigeminal nerve injuries that occurred after various interventions who underwent surgical exploration and subsequent surgical treatment with buccal fat nerve wrapping. We observed both positive and negative neuropathic symptoms preoperatively. Postoperative pain and quality of life was measured with the Brief Pain Inventory. Medication use was recorded pre- and postoperatively. Surgical exploration of the inferior alveolar or lingual nerve was performed in all patients. The median time between the injury and the exploration surgery was 21 weeks. The actual treatment of the lesion depended on its nature. Upon closing the wound, buccal fat was wrapped around the damaged nerve to facilitate nerve regeneration and provide protection. Overall improvements in negative and/or positive symptoms was observed in 12 patients during a mean follow-up time of 36 months. All patients that experienced pain before surgery reported pain reduction, and 2 patients reported complete pain resolution. On the BPI questionnaire, six patients reported persistent pain. In conclusion, surgery and the use of buccal fat grafts successfully reduced positive and negative symptoms, including pain symptoms, after iatrogenic trigeminal nerve injuries. In addition, medication use was reduced postoperatively. Future research should evaluate whether the use of a fat graft might provide a more protective nerve regeneration environment, compared to conventional treatments.

Keywords: Iatrogenic trigeminal nerve injury; Neuropathic pain; Nerve repair; Buccal fat; Inferior alveolar nerve; Lingual nerve

Introduction

Postoperative pain is a clinical problem frequently encountered in all surgical fields. Most types of pain can be successfully treated with adequate pain medication. Neuropathic pain, including painful post-traumatic neuropathy, is a more cumbersome type of pain that poses a clinical challenge. Neuropathic pain is defined by the International Association for the Study of Pain as 'pain arising as a direct consequence of a lesion or disease affecting the somatosensory system' [1]. Iatrogenic injury is a frequent cause of neuropathic pain. In oral and maxillofacial procedures, the trigeminal nerve is at risk of injury, particularly the lingual and inferior alveolar nerves [2,3]. Iatrogenic injuries can be inflicted during common oral interventions, like third molar removal or implant surgery [4]. To prevent nerve injury, it is essential to conduct preoperative planning, which might include imaging modalities and perioperative measures. When nerve injury, and consequently, neuropathic pain occurs, a swift, adequate response is crucial to obtain optimal results in pain management and to prevent the development of chronicity with pain centralization [5].

The treatment of a trigeminal nerve injury requires a holistic approach, which considers the substantial psychological burden and focuses on the quality of life (QoL) [6]. Drug treatment includes analgesics, opioids, antipsychotics, antidepressants, and antiepileptics. However, a significant group of people will never fully recover from their symptoms or might stop the treatment, due to side effects. With the right indications, microsurgical repair can help to prevent this chronicity and restore normal sensory function [5,7-9]. Indications for microsurgery include suspected nerve transection, non-improving anesthesia, progressively decreasing sensation, increasing pain or pain due to neuroma, or entrapment of a foreign body [10]. Here, we present a retrospective analysis of clinical and patient reported outcomes of patients that received buccal fat pad nerve wrapping in the surgical treatment of post-traumatic neuropathy of the lingual and inferior alveolar nerves.

Case Series and Methodology

Patient selection and data collection

This study was part of a large retrospective cohort study, which was approved by the Ethics Committee of the University Hospitals Leuven (S62333) and conducted in compliance with Good Clinical Practice standards and the Declaration of Helsinki. We conducted a retrospective case series of 13 patients diagnosed with iatrogenic trigeminal neuropathy. All patients received nerve surgery, and upon closing the surgical wound, a buccal fat pad was wrapped around the repaired nerve. Patients were selected by analysing all patient records of the Department of Oral and Maxillofacial Surgery at the University Hospitals, Leuven, Belgium. We identified 380 patients that were diagnosed with trigeminal neuropathy between 2013 and 2018. Of these, 75 patients underwent a surgical intervention. Further inspection of the surgical reports identified 13 patients that underwent nerve repair with buccal fat pad wrapping.

We extracted the following data from patient records: demographic data, including age and gender; cause of injury; time between injury and surgery; observations made during surgery and type of surgery. We defined reported symptoms as positive or negative and assessed these before and after surgical intervention. Positive symptoms were hyperesthesia, allodynia, paraesthesia, hyperalgesia, and dysesthesia. Negative symptoms were hypoesthesia, anaesthesia, and loss of taste.

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Follow-up assessments were conducted in consultation, by phone, or through email. Neurosensory improvement was scored on an ordinal scale, with responses of: "a lot", "some" or "none". The use of medications was recorded before and after the surgical intervention, based on notes that indicated when the medications were started, stopped, or prescribed at a reduced dose. Postoperative pain and its impact on daily functioning were assessed with the Brief Pain Inventory (BPI), administered on the last available follow-up appointment or by telephone. This attempted not to confuse the direct postoperative pain with possible post-traumatic neuropathic pain. The date of the last recorded BPI was used to calculate the follow-up time. No BPI was conducted preoperatively.

Case	Gender	Age	Cause	Neg Sx	Pos Sx	Nerve	Time
1	F	71	Imp	1	1	IAN	23
2	M	67	M3	1	1	IAN	67
3	F	54	Imp	1	1	IAN	18
4	M	51	Other	1	1	LN	3
5	F	48	BSSO	0	1	LN	181
6	F	43	Imp	1	1	IAN	421
7	F	38	M3	0	1	IAN	20
8	F	36	M3	1	0	LN	21
9	F	34	M3	1	1	IAN	37
10	F	30	Endo	1	1	IAN	6
11	M	29	BSSO	0	1	IAN	1
12	M	28	M3	1	0	LN	25
13	M	25	M3	1	1	LN	8

IMP: Implant Surgery; M3: Third Molar Surgery; BSSO: Bilateral Sagittal Split Osteotomy; ENDO: Endodontic Treatment; Neg Sx: Negative Symptoms (Anesthesia, Hypoesthesia); Pos Sx: Positive Symptoms (Hyperesthesia, Allodynia, Paresthesia, Hyperalgesia, Hyperpathia); IAN: Inferior Alveolar Nerve; LN: Lingual Nerve; 1: Present; 0: Absent; Time: Duration in Weeks Between Moment of Injury and Surgery

Table 1: Pre-operative patient characteristics.

	Observation during surgery						Surgical intervention						
Case	Complete Transection	Partial transection	Neuroma	Compression	Fibrosis	Intact nerve	Buccal fat wrapping	Decompression	Microsurgical Repair	Fibrin glue	Local Corticoids	Neuroma resection	Neurolysis
1	0	0	0	0	1	1	1	1	0	0	0	0	0
2	1	0	0	0	0	0	1	0	1	0	1	0	0
3	0	1	0	0	1	0	1	1	0	0	1	0	0
4	0	1	0	0	1	0	1	0	1	1	1	0	0
5	0	0	0	1	1	0	1	0	0	0	1	0	1
6	0	0	0	1	1	0	1	1	0	0	0	0	1
7	0	1	0	0	0	0	1	0	0	1	1	0	0
8	0	1	0	0	0	0	1	0	1	1	0	0	0
9	0	1	1	0	0	0	1	0	0	0	1	1	0
10	0	1	0	0	0	0	1	0	1	0	1	0	0
11	0	0	0	1	0	0	1	1	0	1	0	0	1
12	1	0	1	0	0	0	1	0	1	1	0	1	0
13	0	0	0	0	0	1	1	0	0	0	1	0	0

0: Absent or not performed; 1: Present or performed

Table 2: Pre-operative characteristics of the cases were recorded.

Pre-surgery					Post-surgery		
Case	Nerve	Neg Sx	Pos Sx	Pain	General Improvement	Symptoms Improved	Pain
1	IAN	1	1	1	Some	Positive and Negative	Less
2	IAN	1	1	1	Some	Positive and Negative	Less
3	IAN	1	1	0	None	NA	NA
4	LN	1	1	0	A Lot	Positive and Negative	NA
5	LN	0	1	1	A Lot	Positive	Less
6	IAN	1	1	1	A Lot	Positive	Less
7	IAN	0	1	0	A Lot	Positive	NA
8	LN	1	0	0	A Lot	Negative	NA
9	IAN	1	1	1	Some	Positive and Negative	Resolved
10	IAN	1	1	0	Some	Positive	NA
11	IAN	0	1	1	A Lot	Negative	Resolved
12	LN	1	0	0	A Lot	Negative	NA
13	LN	1	1	1	Some	Positive	Less

1: Present; 0: Absent; Neg Sx: Negative Symptoms; Pos Sx: Positive Symptoms; IAN: Inferior Alveolar Nerve; LN: Lingual Nerve; NA: Not Applicable

Table 3: Postoperative outcomes compared to preoperative symptoms.

Surgical procedure

A specific surgical intervention was conducted after nerve exploration, and the type of intervention depended on the inflicted injury. The interventions included microsurgical nerve repair, nerve decompression, and/or neurolysis. After the intervention, a buccal fat pad was harvested. Briefly, an incision was made in the upper posterior vestibule; then, a dissection was performed along the buccinator muscle to identify and mobilize the buccal fat pad. A 1.5 cm² portion of the adipose tissue was extracted. This fat pad was wrapped around the treated nerve, and a layered closure technique was performed without compressing the area of injury (Figure 1).

Results

This study included five males (38%) and eight females (62%) with a mean age of 43 years. The sites of injury included the inferior alveolar nerve in 8 patients (62%) and the lingual nerve in five patients (38%). The main causes were third molar surgery (6 patients, 48%), implant injuries (3 patients, 23%), bilateral sagittal split osteotomies (2 patients, 15%), endodontic treatment (1 patient, 7%), and periodontology pocket reduction surgery with a distal wedge incision (1 patient, 7%). Preoperatively, three patients (23%) had only positive symptoms. Two patients (15%) had only negative symptoms. Eight patients (62%) had both positive and negative symptoms (Table 1).

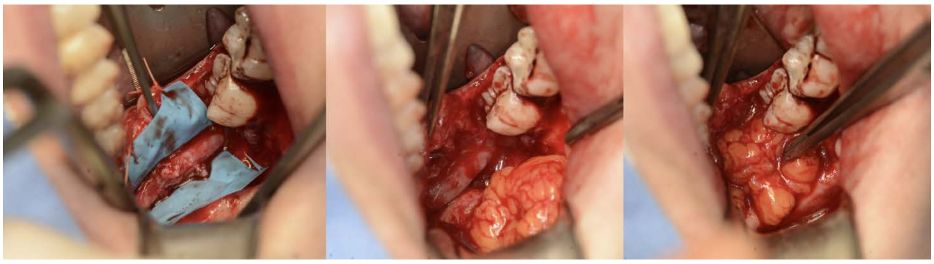

Figure 1: Exploration and microsurgical repair of the lingual nerve, with buccal fat wrapping (Case number 8): (Left) The lingual nerve; (centre) excising the buccal fat pad; (right) wrapping the fat pad around the lingual nerve.

Case	Q1	Q3	Q4	Q5	Q6	Q9A	Q9B	Q9C	Q9D	Q9E	Q9F	Q9G
1	Yes	9	5	8	9	8	8	0	0	1	1	8
2	Yes	8	8	7	8	5	6	5	5	5	4	8
3												
4	Yes	5	0	3	0	3	3	0	0	1	1	3
5	Yes	7	7	7	4	0	0	0	0	0	0	0
6	Yes	6	3	4	6	7	9	4	10	10	10	10
7	No	0	0	0	0	0	0	0	0	0	0	0
8	No	0	0	0	0	0	0	0	0	0	0	0
9												
10	Yes	3	2	3	2	2	3	2	1	4	4	3
11	No	0	0	0	0	0	0	0	0	0	0	0
12	No	0	0	0	0	3	3	0	0	0	0	3
13	No	1	1	1	1	0	0	0	0	0	0	0

Cases 3 and 9 did not complete the BPI. Q1: Have you had pain today; Q2: Other than everyday pains? Q3: Rate your pain by the number that best describes your pain at its worst; Q4: Rate your pain by the number that best describes your pain at its weakest; Q5: Rate Your pain by the number that best describes your pain on average; Q3-5: Scores range from 0 (no pain) to 10 (pain as bad as you can imagine); Q9: Rate how much the pain interferes with the following; on a scale of 0=none to 10=complete interference: A: General Activity; B: Mood; C: Walking Ability; D: Normal Work; E: Relations; F: Sleep; G: Enjoyment in life

Table 4: Brief pain inventory results.

Case	Pre-surgery				Post-surgery			
	Analgesics	Opioids	Anti-epileptics	Anti-depressants	Analgesics	Opioids	Anti-epileptics	Anti-depressants
1	1	0	0	0	0	0	0	1
2	1	0	1	1	1	0	2	2
3	1	0	0	0	0	0	0	0
4	1	0	0	0	0	0	0	0
5	1	1	1	0	0	2	0	0
6	1	1	1	1	0	0	0	2
7	1	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0
9	1	1	1	0	0	0	0	1
10	1	0	0	0	0	0	0	0
11	1	1	0	1	0	0	0	0
12	0	0	0	0	0	0	0	0
13	1	0	0	0	0	0	0	0

0: Not Used; 1: Used; 2: Used; but at a dose reduced from the preoperative dose. Green boxes indicate a dose reduction or complete termination of the medication postoperatively. Red boxes indicate medications that were started postoperatively or did not change from the preoperative dose.

Table 5: Medication use before and after surgery.

The time between injury and surgery varied between 1 and 181 weeks; the mean time to surgery was 34 weeks (median time: 21 weeks). We also defined one outlier that underwent surgery at 421 weeks after the injury. Surgery was performed within 3 months after the injury in four patients, and in total ten patients were operated on within one year after the injury. Exploration of the nerve showed a complete transection in two patients and partial transections in six patients. Other observations made during surgery were fibrosis (5 patients), compression (3 patients), and neuroma (2 patients). The type of repair surgery performed depended on the cause of the injury and the observations made during the exploration. Microsurgical repairs were performed 5 times, decompression 3 times, neurolysis 3 times, and neuroma resections 2 times. Local corticosteroids were applied 8 times and fibrin glue was applied 5 times (Table 2). No severe postoperative complications were reported. Three patients (cases 2, 3, and 8) received postoperative antibiotics.

The mean follow-up time after surgery was 36 months, with a median follow-up time of 27 months and a variation of 2 to 76 months. Neurosensory improvement was observed in 12 patients (92%); only one patient did not show any improvement. Seven patients reported "a lot" of improvement, and five others reported "some" improvement. The observed improvement concerned negative symptoms in three patients, positive symptoms in five patients, and both in four patients. Post-traumatic neuropathic pain was diagnosed in seven patients (54%) preoperatively. After the intervention, all seven patients reported pain improvements, and two patients became pain free (Table 3). No patients reported worse outcomes in either neurosensory deficit or pain.

The Brief Pain Inventory (BPI) was conducted in 11 patients postoperatively, at the last follow-up visit. We found that six patients reported persistent pain caused by the nerve injury. When asked to rate their pain on a visual analogue scale (VAS: from 0, no pain, to 10, worst imaginable pain) scores were: 3, 3, 4, 7, 7, and 8. The response to "how much has the pain interfered with your general activity?" (VAS: from 0, not at all, to 10, complete interference) scores were: 0, 2, 3, 5, 7, and 8. Lastly, pain interference with enjoyment in life was scored: (VAS) 0, 3, 3, 8, 8, and 10. All VAS scores from the BPI questionnaire are reported in Table 4. The highest pain scores were reported by patients with the longest intervals between the injury and the surgical intervention. Future research should include a preoperative baseline BPI to assess surgical outcomes on pain and its impact on QoL. Although this data is only available post-operatively, it can nevertheless serve as a benchmark for future studies.

Before the surgical intervention, 11 patients took analgesics, 4 took opioids, 4 took antiepileptics, and 3 took antidepressants. Drug use significantly declined after surgery. One patient continued to use analgesics at the last follow-up visit and one patient continued to use opioids, but at a reduced dose. Another patient continued to use anti-epileptics, but at a reduced dose. Two patients stopped using antidepressants, and two continued to use them, but at a reduced dose. However, two patients started taking antidepressants after the intervention (Table 5).

Discussion

This case study showed that surgical treatment of the nerve and the use of a buccal fat graft wrapping successfully reduced positive and negative symptoms after iatrogenic trigeminal nerve injury. Pain symptoms were reduced and, consequently, medication use was reduced postoperatively. The varying etiology of the injuries and the different surgical interventions limited statistical analysis, as mentioned previously [8]. However, it is useful to report surgical outcomes of this rare pathology, because buccal fat wrapping could be an important treatment option in acute trigeminal nerve injuries. Additionally, this treatment might prevent evolution towards chronic post-traumatic trigeminal neuropathy [11]. Despite the fact that no study has clearly demonstrated the ideal time for intervention, most studies have indicated that rapid intervention, in select cases, could increase the chance of successful neurosensory recovery and limit development of neuropathic pain, compared to the natural course of these injuries [5,8]. In the present study, the median time to surgery was 21 weeks, which was beyond the 3-month "window of opportunity". Nevertheless, the outcomes remained favourable in most cases, even when the surgery was performed at more than one year after the injury. Twelve out of thirteen patients (92%) reported improved neurosensory function. However, six patients experienced persistent pain postoperatively, when measured with the Brief Pain Inventory questionnaire. Of these, the four cases with highest pain scores at follow-up had the longest durations between the injury and the surgical intervention. Again, this result illustrates the trend that an early intervention could increase the chance of a successful recovery. Factors that play a role in successful recovery are yet to be unravelled in well-designed studies, assessing preoperative, perioperative and postoperative predictors. Two patients (15%) that received surgery within one month after the injury were completely relieved of their symptoms. We found that 54% of patients reported no pain or reduced pain symptoms postoperatively. Moreover, all patients that had pain preoperatively reported improvements postoperatively. In literature, 36-100% of patients report complete recurrence of neuropathic pain [5,12-14]. No patients became worse. However, when we assessed postoperative pain scores with the BPI questionnaire, six patients reported persistent pain. Of these, three patients had an average score of 7 or higher, which clearly impacted the QoL, particularly enjoyment in life.

In our experience, patients often perceive that neuropathic pain is a worse symptom than merely a neurosensory deficit (e.g., negative symptoms). However, the distinction between negative (non-painful symptoms) and positive symptoms (without paraesthesia) is rarely reported in literature; thus, it is difficult to make comparisons with other studies. In our opinion, after nerve repair, a useful sensory recovery (i.e., a two-point discrimination below 15 mm) should not be considered a surgical success, when it is accompanied by a complaint of debilitating neuropathic pain and a severe impact on the QoL. Therefore, patient reported outcomes, including QoL measures, should be included as part of the routine pre and postoperative evaluations.

Our measurements of sensory function recovery showed that one patient with preoperative anaesthesia experienced no improvement postoperatively. However, three patients reported improvements in negative symptoms, five patients reported improvements in positive symptoms. and four patients reported improvements in both negative and positive symptoms. No patients reported worsening of neurosensory deficits after the surgical intervention. These results suggested that demyelination injuries and the "irritable nociceptor" type of injury could be either reversed or improved with this surgical technique.

In addition, we demonstrated a general reduction in the need for medication after the surgical intervention. Three patients that had received opioids preoperatively stopped taking them postoperatively, and one patient continued taking opioids, but at a reduced dose.

These reductions in medication might have been due to the success of the surgical intervention; however, it could also have been due to intolerance, poor adherence, or therapy fatigue. Nevertheless, this result illustrated a positive effect of the intervention, because in chronic pain conditions, it is believed that many patients become medication dependent [15]. Unfortunately, hard data are lacking on medication use in patients with chronic orofacial neuropathic pain.

The use of an autologous fat graft, like the buccal fat pad, could contribute to creating the required environment for nerve regeneration. Previous studies showed that using fat grafts for nerve repair was successful in other regions of the body [16]. Moreover, recent advances in molecular research have shown that adipose-derived stem cells, which are abundant in fat grafts, might play an important role in peripheral nerve repair [17-19]. The buccal fat pad is easily accessible, and it is well known in our specialty, due to its application in closing oro-antral communications. To the best of our knowledge, this study was the first to report on the practical use of buccal fat in trigeminal nerve repair. However, the present study was not designed to evaluate the beneficial effects of this fat graft wrapping technique for trigeminal nerve repair. Therefore, that avenue of investigation should be studied in the future [20].

Conclusion

Despite our small study population, we could conclude that trigeminal nerve repair with buccal fat wrapping was a safe treatment. In addition, its effects were non-inferior compared to the effects of conventional surgical repair reported in previous studies. Postoperative outcomes remained unpredictable, but improvement was achieved, even when the injury had been present for a long time. Our patients reported improvements in both neurosensory disturbances and neuropathic pain. No patient reported worse symptoms after surgery compared to before surgery. Large prospective studies with standardized clinical and patient self-reported outcome measures are needed for further assessments of nerve repair outcomes. We hypothesize that fat wrapping might provide an adequate environment for nerve regeneration. However, randomized studies or a multiple cohort randomized controlled trial is needed to compare this technique with conventional surgical repair or with the natural history of the injury.

Conflict of Interest

The authors declare no conflict of interest, financial or otherwise.

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