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Impact of lower motor neurone facial palsy on oro-motor function and its remediation

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Summary *Introduction:* Lower motor neurone facial paralysis (LMNFP) is often viewed by the general public and wider non-facial palsy fraternity as a cosmetic issue rather than a functional one. In this article, we sought to determine the severity and frequency of oro-motor dysfunction in LMNFP and assess the benefits of physical therapy and rehabilitation in this cohort.
Patients and methods: A prospective study at our institute was conducted for a one-year period (2015–2016), involving adult patients with LMNFP with significant oro-motor dysfunction. The exclusion criteria were (i) pre-existing oro-motor dysfunction, (ii) within six months of facial palsy onset. The assessment tools used were (i) The Facial Disability Index (FDI), (ii) IPREDD or Inventory of Patient-Reported Eating and Drinking Dysfunction for mastication and (iii) a bespoked Visual Analogue Scale (VAS) based on focus group discussions.
Results: Of the 183 new clinic referrals, FDI identified that 14% of patients with LMNFP had significant oro-motor dysfunction. IPREDD analysis showed that 74% of this cohort had masticatory problems, while the VAS indicated significant oro-motor dysfunction as well in those with LMNFP. Following speech and facial therapy, IPREDD-focused symptoms were reduced from 74% to 43% (shown to be significant), while VAS similarly showed a significant reduction in symptoms (two-tailed, paired Student's t-test $p < 0.01$).
Discussion: Oro-motor function is a significant sequel of facial paralysis. Facial rehabilitation, both physical and psychological, can help reduce patients' distress and improve oro-motor function, without the need for surgical intervention in the first instance.

Introduction

The facial nerve is perennially associated with facial expression, but with regard to swallowing, a lot depends on optimal lip function and courtesy of the orbicularis oris and buccinator muscles. The key anatomical dimensions of the lip are inter-commissural distance, soft tissue gap, lip height and lip flexibility.[1] In normal circumstances, this allows for an adequate oral seal, and in coordination with the buccinator muscle, it forms the first part of a voluntary masticatory response before the food bolus is transferred to the posterior oropharynx for the involuntary reflex of swallowing.[2] The smooth translation of the bolus is facilitated by saliva, which is contributed by the parasympathetic nerve fibres travelling along the facial nerve.

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While mastication/swallowing abnormalities affect overall nutrition and physical well-being, the inability to communicate clearly has psycho-social ramifications. Compounded with the effects of facial asymmetry and dysfunction of facial expression, facial paralysis constitutes a potent mix, often sending patients into a negative vicious cycle.

Methods

In a prospective study conducted for a 12-month period (2015–2016), 183 new facial paralysis cases were referred to our tertiary care centre, The Queen Victoria Hospital, East Grinstead. In a preliminary screening test, we identified patients with lower motor neurone facial paralysis (LMNFP) who have oro-motor difficulties at their initial multidisciplinary team (MDT) clinic using the Facial Disability Index (FDI), where it was pre-determined that patients with composite scores of 4 or less for questions 1, 2 and 5 in the index (which relate to eating, drinking and oro-motor function) would be included in this study. The other inclusion criteria were (i) minimum age of 18 years, (ii) clinical evidence of unilateral LMNFP with no antecedent history of eating and drinking problems, (iii) more than six months post-onset of facial paralysis, which was done to rule out the confounding factor of spontaneous recovery, and (iv) chronic facial palsy characterised by synkinesis and pan-facial tightness of the affected side. Twenty-six patients with oro-motor dysfunction ($n = 26$) were identified using these inclusion criteria.

Baseline

In the selected cohort, objective analysis of oro-motor function was performed using the IPREDD (Inventory of Patient-Reported Eating and Drinking Problems), a patient-related outcome measure (PROM).[3] Patients were also asked to score whether each symptom was experienced frequently or occasionally.

Non-masticatory function was assessed using the Visual Analogue Scale (VAS), a scale consisting of eleven questions, which include one question on the psychosocial impact of eating and drinking difficulties. Patients were required to place a mark on a 100 mm horizontal line that corresponded to their perception of how much difficulty they had or how often they encountered a given symptom. Zero represented 'no difficulty' or 'never' and 100 represented 'extreme difficulty' or 'most of the time'. To select the relevant question for the VAS, a focus group was held at the facial palsy support group, and the questions used on the VAS reflect the problems patients encountered. The one symptom that was not included was 'tearing when eating and drinking', as this was considered a related problem rather than a direct result of oro-motor dysfunction.

Treatment

Based on our screening protocol, 26 patients with LMNFP ($n = 26$) were eventually referred for physical therapy to be treated with a combination of specific massages, stretches, relaxation and neuro-muscular training. In the acute flaccid phase of facial palsy, the emphasis is on corneal protection, contralateral stretching and gentle massage to maintain tissue mobility as well as circulation. Once some innervation begins to return, patients are taught how to perform trigger point release alongside isometric and isotonic exercises sequentially. On completion of this, mirror therapy is initiated. During the longer term (beyond 12 months post-onset), when patients are in the synkinetic phase, neuromuscular retraining using surface electromyographic (sEMG) feedback is used to reduce synkinesis. The patients who then reach a plateau point are then given chemodenervation to release thixotropic facial muscles.[4]

During the period of data collection, none of the participants were referred for surgery. Therapists gave relevant advice and strategies to help remediate symptoms of dry mouth, increased salivation, dental health and drinking aids. Patients were also given information leaflets about eating and drinking containing general advice and strategies.

Analysis

Patients with LMNFP were evaluated post-therapy in terms of FDI, IPREDD and VAS scores to compare pre- and post-operative results. Data collected included diagnosis, number of months since the onset of their facial palsy and commencing therapy and whether or not they received chemo-denervation.

Additional data from the FDI, a reliable and valid measure for use in patients with disorders of the facial neuromuscular system,[5] were used wherein, and questions related to oro-motor function and psychosocial impact of these disabilities on everyday life were used to ascertain oro-motor dysfunction. With reference to the VAS, the average score was calculated for each question pre- and post-treatment. Given the relatively small sample size, a non-parametric test for significance, that is, two-tailed Student's *t*-test, was used on each set of results to reveal the effect of the physical therapy on masticatory and non-masticatory oro-motor functions.

Results

Of the 26 patients ($n = 26$) included in the study, all presented in the chronic phase of recovery. The main aetiologies were Bell's palsy (46%), post-vestibular schwannoma excision (23%) and Ramsay-Hunt syndrome (19%). Other causes were trauma, ear surgery and following parotid tumour removal. The FDI, IPREDD and VAS scores showed improvement in outcomes post-treatment (two-tailed paired Student's *t*-test) as illustrated below.

Facial disability index (FDI)

The FDI relates to speech and psycho-social function. As reported by Gelder et al.,[6] consonants requiring lip rounding or closure, that is, '*/p/,/b/,/m/,/w/,/wh/*', and vowels requiring lip rounding or spreading, that is, '*/i/,/u/,/o/*', were the most likely sounds to be impaired in patients with

Table 1 Statistical analysis of specific questions with the FDI comparing patients' responses pre- and post-remediation.

Specific questions	Statistical significance
Q1: How much difficulty did you have keeping food in your mouth, moving food around your mouth or getting food stuck in your cheek while eating?	$p = 0.0002$ (significant)
Q2: How much difficulty did you have drinking from a cup?	$p = 0.0001$ (significant)
Q3: How much difficulty did you have saying specific sounds?	$p = 0.0001$ (significant)
Q5: How much difficulty did you have with brushing your teeth or rinsing your mouth?	$p = 0.0001$ (significant)
Q10: How often has your facial function kept you from going out to eat, shop or participate in family or social activities?	$p = 0.0003$ (significant)

Table 2 Summary of the IPREDD inventory, sub-classified into 'frequently' and 'occasionally' reported questions.

IPREDD	All reported questions	Frequently reported questions	Occasionally reported questions
Pre-treatment	11.3	4.69	6.69
Post-treatment	6.69	1.35	5.35
p-value	<0.01 (0.0026)	<0.01 (0.002)	ns (0.929)

unilateral facial weakness. Specifically, question 3 is related to speech and question 10 to social function, while orofacial functions such as mastication and swallowing are assessed in questions 1, 2 and 5. The statistical data are summarised in Table 1.

Inventory of patient-reported eating and drinking difficulties (IPREDD)

The IPREDD is a qualitative analysis of questions (Figure 1), specifying mastication and swallowing. Seventy-five per cent of the questions relate to oral preparatory and voluntary swallowing phase and the remaining 25% to the reflex phase of swallowing.[7] While all questions were analysed, subsets studied included 'frequently reported' and 'occasionally reported' questions. These subsets are illustrated in Table 2.

Significant improvement in oro-facial function following therapy was seen in those with severe symptoms but not so with milder ones. The most common symptoms were related to achieving lip seal and remnant residue in the cheeks after eating. The most difficult problem to remediate was 'residue of food in the affected cheek', with 69% of patients continuing to experience these problems post-therapy, albeit only occasionally. This is graphically illustrated in Figure 2. To overcome this disability, these patients chew on the unaffected side, which paradoxically removes the incentive for stretching and relaxing the affected buccinator muscle, thereby compounding the problem.

Visual analogue scale (VAS)

At initial assessment, the three activities that caused the greatest difficulty were blowing up balloons, whistling and puckering the lips for kissing. The average score for these functions in terms of difficulty were 93%, 87% and 73%, respectively, wherein 0% alludes to being 'asymptomatic' and 100% representing extreme difficulty Table 3. The mean score of the 26 responses ($n = 26$) for each of the eleven questions were calculated and compared pre- and post-treatment. Using a two-tailed paired 't' test, the *p*-values for all component questions of the VAS were observed to be highly significant ($p < 0.01$).

Discussion

Patients with LMNFP can be broadly classed into two categories, namely, the majority in the synkinetic and thixotropic muscle group and the more commonly associated paretic facial palsy (PFP) group.

Paretic patients

Difficulty in controlling a bolus in the mouth was found in 79% of all paretic patients, and a dysphagia limit was encountered in 55% of them. Their recovery coincident with clinical improvement indicates that there is a benign swallowing disorder in PFP, and this disorder was related to the oral phase of swallowing. The paretic orbicularis oris and buccinator account for poor lip seal[8] and the loss of the oral valve mechanism.[10,11] Furthermore, this allows the accumulation of food in the anterior and posterior sulci, resulting in drooling and the phenomenon of second swallowing. Fortunately, aspiration is rare, as the sensory-motor integration of the larynx and cough reflexes are retained in unilateral PFP.

A change in bolus taste has been shown to affect swallowing physiology,[9] but we could not find any relation between hypogeusia and the incidence of swallowing disorders in PFP. Theoretically, salivary reduction can also impede swallowing, but this has to be bilateral, which accounts for the paucity of these symptoms. Why are swallowing abnormalities more widespread in the oral cavity and even bilateral in some patients? The answer may be the physiological bilaterality of swallowing function. Pharyngeal swallowing is represented bilaterally in the cortex[11-15] and in the bulbar centres.[11,16] In acute unilateral facial palsy, the abnormalities of the paretic side cannot be compensated for within the first few days or weeks and the non-paretic side can also be affected by the paresis of the opposite side.

Inventory of Patient Reported Eating and Drinking Difficulties.

Name: _____ Date: _____ V No:_____

Do you have problems with the following? Please circle as appropriate

Enclosing lips around a cup	yes	no	Frequently/Occasionally
Wet lips after drinking	yes	no	Frequently/Occasionally
Residue of food on lips	yes	no	Frequently/Occasionally
Residue of food in cheek	yes	no	Frequently/Occasionally
Residue behind lower lip	yes	no	Frequently/Occasionally
Residue in oral cavity	yes	no	Frequently/Occasionally
Dribbling saliva	yes	no	Frequently/Occasionally
Dribbling liquids	yes	no	Frequently/Occasionally
Dribbling food	yes	no	Frequently/Occasionally
Chewing/biting cheek and or lip	yes	no	Frequently/Occasionally
Choking on liquids	yes	no	Frequently/Occasionally
Choking on solids	yes	no	Frequently/Occasionally
Coughing during drinking	yes	no	Frequently/Occasionally
Coughing during eating	yes	no	Frequently/Occasionally
Coughing after eating	yes	no	Frequently/Occasionally
Residue non affected cheek	yes	no	Frequently/Occasionally
Dribbles along cup	yes	no	Frequently/Occasionally
Chewing on unaffected side only	yes	no	Frequently/Occasionally
Transferring food from front to back of mouth	yes	no	Frequently/Occasionally
Difficulty drinking continuously	yes	no	Frequently/Occasionally

Figure 1 The IPREDD inventory focusing on the functional aspects of mastication and swallowing.

Synkinetic patients

The most common symptom in the synkinetic group is oral stage dysphagia. Starting with a weak lip seal or contracted cheek muscle, on the affected side, the following symptoms can develop: difficulty enclosing lips round a cup, wet lips after drinking and dribbling of liquids/saliva. Additionally, cheek tightness, especially the buccinator muscle in combination with a weak lip seal, can cause problems with chewing and bolus control. A tight buccinator muscle will rest against the teeth encouraging pocketing of food and also in difficulty removing food that is collected in the buccal sulcus. Patients then prefer to chew on the unaffected side, as this is more efficient and reduces the chance of biting the cheek. A weak lower lip lies flat against the lower teeth; hence, patients experience frequent biting of the lower lip during mastication.

Although the least commonly reported symptom in synkinetic patients, pre-and post-treatment, was residue in the non-affected cheek, a small proportion reported pharyngeal stage dysphagia symptoms (e.g. coughing after eating and coughing on liquids), probably as a result of digastric weakness. Alternatively, it may be that oral stage problems have an impact on the timing of the pharyngeal stage of the swallow, resulting in coughing during or after eating and drinking. However, only 8% reported coughing after eating and 15% after coughing on liquids. This diminished further, post-treatment.

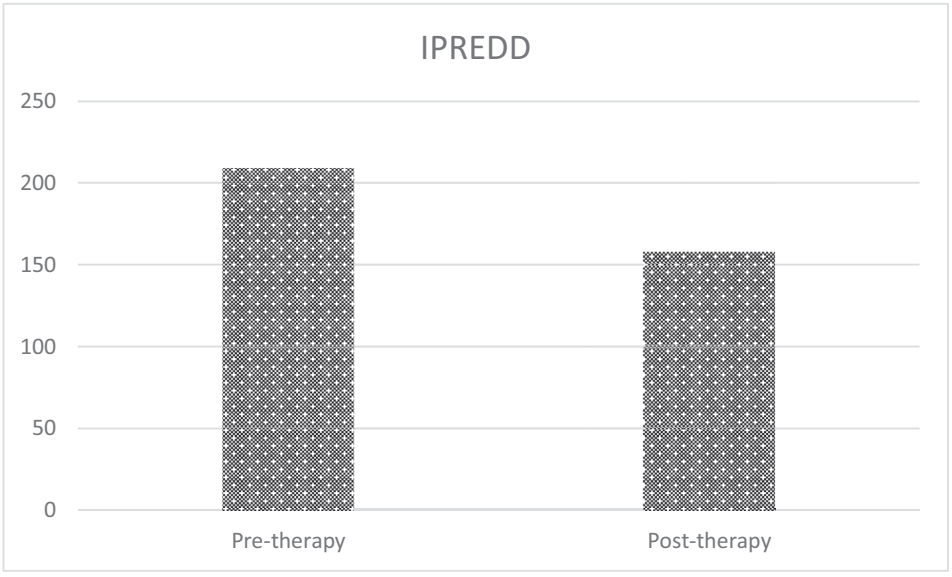

Figure 2 IPREDD analysis comparing pre- and post-therapy scores, which showed a statistically significant drop in symptoms (two-tailed Student's *t*-test; $p < 0.001$).

Table 3 Summary results of the VAS.

VAS questions	Average % score or level of difficulty experienced pre-treatment	Average % score or level of difficulty experienced post-treatment	Percentage (%) of improvement in post-treatment scores
Difficulty blowing up a balloon	93	74[b]	19
Difficulty whistling	87	60[b]	27
Difficulty puckering lips	73	41[b]	38[a]
Difficulty with food pouching in cheek	56	30	26
Difficulty eating out in public or in social situations	51	23	28[a]
Difficulty eating chewy food	48	26	22
Difficulty drinking from a cup	44	18	26
Biting lip/cheek	44	25	19
Dribbling	43	13	30[a]
Difficulty brushing teeth or spitting out	40	19	21
Difficulty eating sloppy food	38	14	24

[a] Problems that have improved the most post-treatment.
[b] Problems that persist to cause significant difficulties despite improvement in scores post-treatment.

Lip strength and mobility required for whistling, blowing up balloons and puckering continued to be problematic for patients even though improvements were made. Current therapy takes a cautious approach to strengthening exercises, as this increases synkinesis (involuntary movements), which can be distressing for patients. First, it may be that therapy needs to focus on a more graded approach to strengthening exercises to address these issues. Second, during the period of data collection, treatment to the buccinator muscle, using chemo-denervation, had only just been introduced to our injecting programme. We have seen positive results from relaxing very tight buccinators muscles, especially with regard to improvement of lip mobility and improved lip seal.

However, whilst improvements were highly significant, some patients continued to experience problems once active treatment was complete. The three functions on the VAS that caused the greatest level of difficulty continued to do so once treatment had been completed. This is most likely related to either poor innervation to the affected orbicularis oris and/or buccinator muscle or because the cheek muscles remain persistently short, tight and retracted, hence making lip sealing and rounding much harder to achieve.

Conclusion

All participants experienced a range of oro-motor dysfunction pre-treatment. Major concerns reported by patients relate to functions associated with lip rounding, lip sealing and impaired buccinator function, as well as feeling less able or willing to participate in activities of daily living. All patients improved using the standard treatment programme in all aspects of oro-motor function, including speech, and these improvements also promoted social engagement.

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Conflict of interest

Not applicable.

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