The use of a palatal support appliance in the management of hypernasal speech

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Abstract

A patient was referred from Speech and Language Therapy because of marked hypernasal speech. Following construction of a palatal appliance and measurement of nasal airflow a marked improvement in speech intelligibility was demonstrated. This case emphasises the importance of interdisciplinary work and value to quality of life from this intervention.

Aim: To assess the effectiveness of a palatal support appliance in the management of hypernasal speech.

Objectives: To provide: numerical and qualitative account of an oral appliance on hypernasal speech and demonstrate the value of interdisciplinary work and the role of medical technology in management of speech therapy.

Methodology: Case study involving single patient for whom a palatal lift appliance was constructed. Evaluation was by quantitative and qualitative methodology. Nasal airflow was assessed by medical electronics technology.

Results: Average increase in speech intelligibility over a period of four months from 27%

(3 out of 10 words) to 49% (8 out of 10 words) was achieved by use of palatal lift appliance. Speech therapy, carers and patient assessment of qualitative intelligibility effect was very favourable.

Conclusion: This case report has demonstrated the importance of interdisciplinary involvement in the care of people with disability. The construction of a simple oral appliance helped to have a significant benefit on the quality of life of this patient. The use of medical electronics technology provided an extremely valuable tool for assessment and the potential for further innovation in this field is clearly shown.

Key words: *Hypernasal speech , oral appliance, evaluation*

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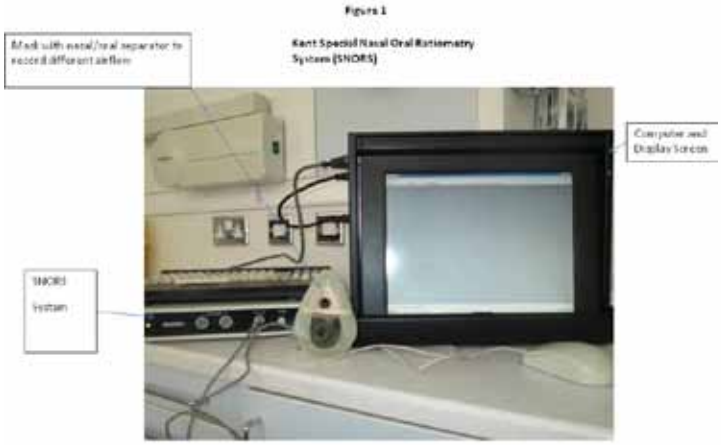
Introduction

A patient attending the Royal Hospital for Neuro-disability, Putney, London with history of a stroke (Basilar thrombosis with pontine infarction) was referred to the hospital dental department by Speech and Language Therapy. The young lady referred was 33 years of age with history of a stroke one year prior to admission to the hospital. She presented with a moderate generalised speech dysarthria with reduced speech clarity and volume. There was absence of soft palate elevation and complete non-response to touch or pressure of the soft palate. This resulted in marked hypernasal speech and reduced volume of speech. She had excessive nasal airflow on all words but particularly those involving plosive sounds. She has good dentition with all thirty two teeth erupted with no restorations or caries.

Report of case

The main concern for this patient and reason for referral by the Speech and Language Therapist was the difficulty in communication between patient, hospital

staff, carers and friends, and the subsequent embarrassment and distress experienced by the patient. This was caused by severe hypernasality (nasal rather than oral air escape) which was measured at average on all test words as 57% by the University of Kent SNORS multi parameter system (*Figure 1*). This system was developed by a collaborative innovation between the Medical Electronics Department at the University of Kent (Kelly *et al.,* 1994) and the present author (MCG Manley) and involved the comparative measurement of nasal and oral airflow emission, the amount of nasal airflow being measured and expressed as a percentage of total airflow. That is nasal airflow% = nasal airflow ÷ (nasal airflow + oral airflow) × 100.



Figures 1: Kent Special Nasal Ratiometry System (SNORS)

Options for management of such a condition would normally involve conventional Speech and Language Therapy, however in some extreme cases surgical intervention involving a pharyngoplasty could be considered. Developments of an oral appliance have been previously used for positive effect by the Kent collaborative team. This involved the construction of a palatal lift appliance designed to provide gentle support and stimulus to the soft palate, for example in a case with Motor Neurone Disease (Kelly *et al.,*1996).

Following discussion with the patient (who had full cognition, but was unable to sign a consent form) the option for conventional Speech and Language Therapy in conjunction with the provision of a palatal lift was considered to be the preferred treatment strategy. Careful discussion with the patient outlined the process of constructing this particular oral appliance with its possible limitations and oral consent was given for the procedure and for publication and presentation of the outcome if appropriate. The intention of the palatal lift appliance was to provide support to the soft palate, thereby diverting airflow via the nasal passage to the oral orifice. In past cases (Kelly *et al.,* 1999), it has been considered important to objectively evaluate the effect of such interventions in order to be able to adjust the appliance, provide feedback to the patient and assess the appliance effectiveness.

In addition to the use of the Kent SNORS system for evaluative purposes, a new speech evaluation/therapy system (the Nasality Microphone) was used which had been developed by one of the authors (www.Rose-Medical.com - Paul Sharp). This measured a different but equally valuable acoustic (rather than airflow) voice sound, which directly relates to perceived nasality (*Figure 2*).

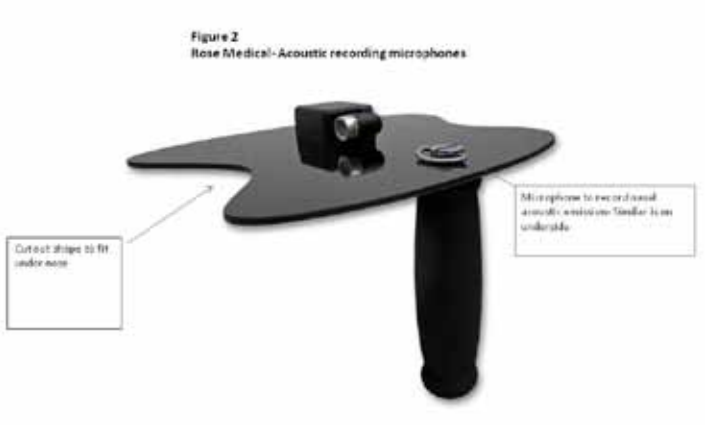


Figure 2: Rose Medical-Acoustic recording microphones

Method

An alginate impression was taken with a stock and special tray and a palatal lift appliance constructed (*Figure 3*) and fitted (*Figure 4*). A perforated impres-

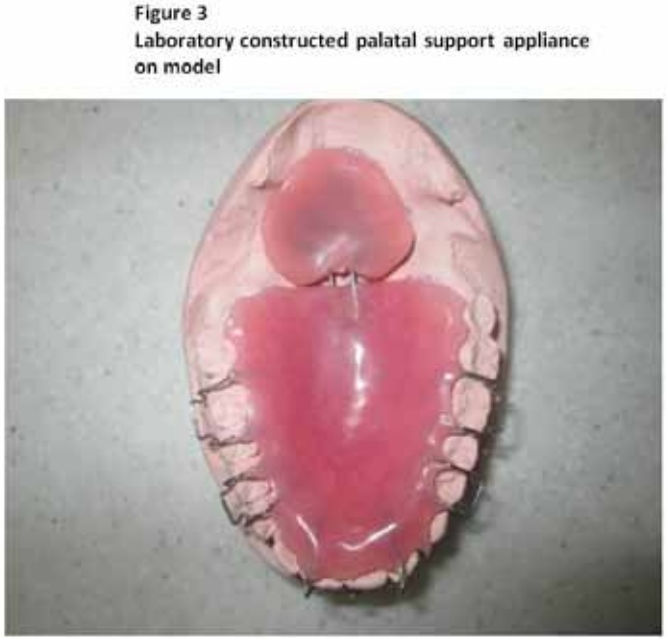


Figure 3: Laboratory constructed palatal support appliance on model

sion tray was used with adhesive. Alginate was preferred over a silicone based impression because of its firmer consistency with less likelihood to flow down the pharyngeal area. No undercuts were engaged in the soft palate area and with a good posterior support of the special tray there was no concern of alginate breaking away from the impression. Nominated ward staff were trained on insertion and removal of the appliance which was a simple procedure managed well by all ward staff involved. The appliance was tolerated very well by the patient and was worn throughout the day and removed at mealtimes and night time. Appointments were arranged for adjustment and to assess acceptability and effectiveness of the appliance. Airflow was measured using the Kent SNORS system before commencement of the use of the oral appliance and subsequently to assess its effect on airflow. Feedback from the Speech and Language Therapist and ward staff was also obtained. An acoustic assessment was also taken at the end of the four month assessment period using the Nasality Microphone to provide a numerical score of perceived nasality and an assessment of speech intelligibility using automated speech recognition. A series of standard words were used including a variation of predominantly oral words (e.g. cheese), which involve a low nasal airflow and others with a contrast of more plosive and nasal components (e.g. smoke) producing higher nasal airflow.

Results

Results of the recordings taken at two sessions are presented in *Table 1*, using the Kent SNORS system and were spaced over a period of four months. To reduce the possibility of inconsistency in recording only one clinician was used for recording. The initial recording (session 1) represented the presenting condition at start of treatment. Two recordings of nasality are presented one without and one with the oral appliance in place. In addition the reduction in nasal airflow is shown as a result of wearing the oral appliance. The second recording session (session 2) shows the results of change following a period of four months of wearing the appliance. *Table 1* also shows the overall reduction achieved over the period of four months when the patient wore the appliance. At each session, two separate recordings were taken to ensure quality and consistency of recording. The variation between recordings at each of the two sessions ranged from 0% to 10% with the mode being 0%. This demonstrated a good consistency of the recording method.

Figure 4
Palatal support appliance in mouth

Figure 4: Palatal support appliance in mouth

Results were also taken at the end of the four month assessment period at one session only using the Automated Speech Intelligibility Scoring Tool (Rose Medical). This showed that without wearing the palatal lift, 3 out of 10 words were recognised from the word list and the average intelligibility score was 27%. When the palatal lift was used, the word recognition increased to 8 out of 10 words and average intelligibility increased to 49%. The results from the Nasality Microphone also showed a 54% reduction in perceived nasality with the palatal lift fitted.

Discussion

The use of an oral appliance to reduce nasal airflow in this case had two functions. Firstly, to provide support to the muscles of the soft palate with the intention of reducing velopharyngeal incompetence, the mechanisms of this supporting function being fairly straight forward. Secondly, in providing stimulus to the soft palate with the intention of improving its activity and particularly its elevation; this function is more uncertain. Previous work has also used a palatal lift appliance in the management of velopharyngeal incompetence (Raj *et al*., 2012). Recovery from a stroke proceeds at variable rate, however the immediate six months post stroke are a significant period (Intercollegiate Stroke Working Party, 2012). This patient's speech demonstrated a consistent level of high hypernasality for some time post stroke (at least nine months). Results from the table show a significant numerical reduction in nasal airflow when using the palatal support oral appliance, with two interesting features. Firstly, at the initial fitting of the appliance there was a marked reduction in nasal airflow on all words with an average reduction over all the words of 57%. In session two again there was variation of

Table 1. Results of nasal airflow as a percentage of total airflow

Sample words	Begin	Type	Fight	Seat	Cheese	Shoot	Smoke	King	Missing
No appliance-session 1	83%	74%	66%	71%	74%	67%	54%	59%	63%
With appliance-session 1	19%	10%	6%	11%	13%	10%	10%	9%	10%
Reduction in nasal airflow session 1	64%	64%	60%	60%	61%	57%	44%	50%	53%
No appliance-session 2	32%	57%	37%	48%	51%	72%	57%	51%	36%
With appliance-session 2	3%	3%	4%	6%	4%	5%	6%	4%	8%
Reduction in nasal airflow session 2	29%	54%	33%	42%	47%	67%	51%	47%	28%
Reduction over four months with wearing appliance	80%	71%	62%	65%	70%	62%	48%	55%	55%

airflow reduction between words with the average reduction over all words of 44%. Results from this second session (after four months) showed that for all of the words with the exception of only two words (i.e. shoot and smoke) nasal airflow was reduced from baseline session one without wearing the oral appliance.

It is tempting to speculate that the use of the oral appliance may have been beneficial in stimulating soft palate function. However, this cannot be strongly supported as the reduction was not seen with all recordings and a continuation of physiological recovery may also have been a significant factor. Original work in the UK by Selley promoted this function of the palatal training appliance in improving swallowing in post stroke cases (Selley, 1995). Results of improvement shown by percentage reduction in nasal airflow were encouraging; however, what is more important than these numerical values were the qualitative effects. That is, was there a marked improvement in the sounds and intelligibility of speech that would have a substantial benefit to the patient? These were obtained from patient and relative's response, feedback from ward and other hospital staff and from Speech and Language Therapy assessment.

In addition the acoustic assessment provided by the Rose Medical system proved extremely useful in this aspect of practical assessment. An increase in word recognition of 3 out of 10 (27% average intelligibility) to 8 out of 10 words from a standard word list (49% average intelligibility) was a marked improvement. The overall opinion particularly from ward staff was that communication was considerably improved. They could now clearly understand the patient's speech when previously it was extremely difficult and often relied on typed communication. It was reported that the quality of the patient's life had immeasurably improved and that she was obviously delighted at this intervention. This was particularly important as the patient's occupation as a lawyer relied on verbal communication as an essential part of her professional life, which she hoped to resume. The question as to whether the appliance would need to be worn on a permanent basis is yet to be resolved and a decision on this may emerge following a longer period of review. However if this is the case, the patient was prepared to accept this decision in view of the considerable benefit it provided to her speech intelligibility.

Conclusions

This case report has demonstrated the importance of interdisciplinary involvement in the care of people with disability. The construction of a simple oral appliance helped to have a significant benefit on the quality of life of this patient. The use of medical electronics technology provided an extremely valuable tool for assessment and the potential for further innovation in this field is clearly shown.

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