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1. Effects of Motor and Sensory Stimulation in Stroke Patients with Long-Lasting Dysphagia

Hagg, M. & Larsson, B. (2004). *Dysphagia* 19:219–230

Summary of study

Relevance to conditions

This study is most important to the following condition groups:

Conditions	Dysphagia,	Hiatus hernia	Snoring and sleep apnoea
Key words	Stroke, rehab.		VCT. Velum closure is linked to snoring and OSA.

Study type

Peer reviewed, Cohort pre- and post- study.

Aim

The present investigation aimed to assess the effect of motor and sensory stimulation using manual muscle therapy and palatal plate according to Morales in stroke patients with dysphagia persisting for more than 6 months.

Patients

7 patients, F=1, M=6. Adult, median age 72 (range 48 – 84 years. All with oropharyngeal dysphagia of duration median 1½ years (range 6 months – 4 years)

Methods

Body regulation, manual orofacial regulation, palatal plate application, and velopharyngeal closure training. Duration: once per week for 5 weeks in a clinical setting, and home exercises three times per day.

Outcome measurements

- Swallowing ability (using Timed Water Swallow Test - TWST) – lower normal value for swallowing rate ≥ 10 ml / sec
- Meal Observation Test (MOT),
- Clinical examination of orofacial sensory and motor function
- Velum Closure Test (VCT) – lower normal value ≥ 10 sec
- Videofluoroscopy (VF).

Results

Descriptive statement of improvement in swallowing, orofacial sensory function, orofacial motor function and velum closure ability in all patients. The Orofacial Motor Tests (OFMT) were validated and Kappa coefficients were calculated for both intra- and inter-rater reliability with a result of = 0.90.

Conclusion

Orofacial regulation therapy according Castillo Morales can improve long-lasting oropharyngeal dysphagia in stroke patients. The Orofacial Motor Tests (OFMT) were shown to have a high Kappa coefficient of reliability.

2. Reliable Lip force measurement in healthy controls and in patients with stroke. A methodological study.

Hägg M, Olgarsson M, Anniko M. (2008). *Dysphagia*, 22: 291-296, 2008

Summary of study

Relevance to conditions

This study is most important to the following condition groups:

Conditions	Dysphagia,	Hiatus hernia	Snoring and sleep apnoea
Key words	Proof of effective measurement of pharyngeal sling competence. And the existence of a lower normal limit.		

Study type

Peer reviewed. Methodological study

Aim

To (i) test the intra- and inter-reliability of pharyngeal sling force measurements by means of a newly devised Lip Force Meter, LF100, (ii) determine a normal lower limit for this, and (iii) determine the instrument's sensitivity and specificity.

Patients

- 64 patients: 22 with stroke, F=13, M=9, mean age 77 years (range 38 – 90)
- 42 healthy controls, F=27, M=15, mean age 57 years (range 25 – 87).

Methods

Test for intra- and inter-reliability of pharyngeal sling force by means of so-called lip force measurements (LF100). Determine a normal lower limit for pharyngeal sling force measured in Newtons. Determine LF100 instrument's sensitivity and specificity.

Outcome measurements

Pharyngeal sling competence (using Lip Force meter – LF100), Inter Class Coefficient (ICC).

Results

Intra-investigator reliability with the LF100 ICC was 0.83 - 0.90. Inter-investigator reliability ICC was 0.71 - 0.91. Significant difference in pharyngeal sling competence between controls and stroke patients (mean = 24.7 ± 6.3 N and 9.5 ± 5.5 N, $p < 0.001$). The sensitivity of LF100 was 91% and the specificity 95%. The lower cut-off level for pharyngeal sling force was 15 N.

Statistical significance of result

($p < 0.001$) difference in pharyngeal sling competence between controls and stroke patients.

Conclusion

The LF100 showed itself to be a suitable and reliable instrument for measuring pharyngeal sling competence. The Kappa coefficient of Intra-investigator reliability is rated as 'almost perfect agreement' and the inter-investigator reliability as 'substantial agreement'.

3. Lip muscle training in stroke patients with dysphagia

Hägg, M. & Anniko, M. (2008). Lip muscle training in stroke patients with dysphagia, Acta Oto-Laryngologica, 128:9, 1027 — 1033

Summary of study

Relevance to conditions

This study is most important to the following condition groups:

Conditions	Dysphagia,	Hiatus hernia	Snoring and sleep apnoea
Key words	Proof of effect of IQoro on swallowing, facial paresis in stroke patients.		

Study type

Peer reviewed, Prospective, Cohort pre- and post- study

Aim

To ascertain whether (i) neuromuscular training with IQoro can improve the pharyngeal sling competence and swallowing ability of stroke patients with oropharyngeal dysphagia, (ii) whether these improvements are connected with improvement of central facial palsy, (iii) whether these improvements are affected by the interval between stroke onset and initiation of treatment, (iv) or age, (v) or gender.

Patients

30 patients with stroke, F=12, M=18. Adult, 49 – 88 years.

Methods

IQoro Neuromuscular Training. Duration: 10 seconds x 3, three times per day for a period of 5 – 8 weeks.

Outcome measurements

- Pharyngeal sling competence (using Lip Force meter) – lower normal value ≥ 15 N
- Swallowing ability (using Timed Water Swallow Test - TWST) – lower normal value for swallowing rate ≥ 10 ml / sec

Results

- The median pharyngeal sling competence was 7N (range 0 - 27) before treatment, and 18.5 N (range 7 - 44) after treatment ($p < 0.001$).
- The median swallowing ability was 0 ml/s (range 0 - 9.1) before treatment, and 12.1 ml/s (range 0 - 36.7) at follow-up ($p < 0.001$).

There was no significant difference in swallowing improvement between patients with, versus those without, facial paresis. The interval between stroke attack and start of treatment, ranging from a few days up to 10 years, had no significant influence on the treatment results, nor did age or gender. Facial paresis was improved or at least ameliorated in all patients after oral neuromuscular training.

Statistical significance of result

($p < 0.001$) pharyngeal sling competence.

($p < 0.001$) swallowing ability.

Conclusion

IQoro training improves oropharyngeal dysphagia and facial paresis in patients with stroke irrespective of time to intervention, age or gender. The presence or absence of facial paresis had no effect on treatment outcomes.

4. Influence of lip force on swallowing capacity in stroke patients and in healthy subjects.

(Included in thesis, Paper III)

Hägg M, Anniko M. ActaOto-Laryngologica 130: pp1204-8, 2010

Summary of study

Relevance to conditions

This study is most important to the following condition groups:

Conditions	Dysphagia,	Hiatus hernia	Snoring and sleep apnoea
Key words	Proof of importance of pharyngeal sling competence on swallowing.		

Study type

Peer reviewed, Prospective, Cross-sectional

Aim

The aim was to study the influence of pharyngeal sling force on swallowing ability.

Patients

- 22 patients with stroke, F=13, M=9. Adult, Median age 78 (range 38 – 90 years).
- 45 healthy controls, F=30, M=9=15. Adult, Median age 57 (range 25 – 87 years).

Methods

Results for pharyngeal sling force and swallowing ability were compared for patients with stroke and for healthy controls.

Outcome measurements

- Pharyngeal sling force was measured with a LF100 lip force meter– lower normal value ≥ 15 N.
- Swallowing ability was measured using the Timed Water Swallowing Test (TWST) – lower normal value for swallowing rate ≥ 10 ml / sec.

Results

A significant correlation was found between pharyngeal sling competence and swallowing ability ($p = 0.012$) in stroke patients, but not in healthy subjects. Pharyngeal sling competence and swallowing ability was not age-related in stroke patients. Pharyngeal sling competence was not age-dependent in healthy subjects, but swallowing ability decreased with increasing age ($p < 0.0001$). Swallowing ability did not reach a pathological value and a regression analysis showed that 73% of the variation in swallowing ability is attributable to pharyngeal sling competence and age.

Statistical significance of result

($p = 0.012$) correlation between pharyngeal sling force and swallowing ability in stroke patients

($p < 0.0001$) swallowing ability decreased with increasing age.

Conclusion

Pathological pharyngeal sling force will strongly influence swallowing ability in patients with oropharyngeal dysphagia despite the absence of clinical signs of facial paresis. Patients with impaired swallowing ability suffered a subclinical facial paresis. In healthy subjects, the swallowing ability is diminished by age - probably due to a certain loss of the sensory function involved in normal swallowing. The results support earlier findings that physical lip muscle training can be used to treat dysphagia.

5. Longstanding effect and outcome differences of palatal plate and oral screen training on stroke-related dysphagia.

Hägg M, Tibbling L. The Open Rehabilitation Journal, 2013, 6, pp 26-33.

Summary of study

Relevance to conditions

This study is most important to the following condition groups:

Conditions	Dysphagia,	Hiatus hernia	Snoring and sleep apnoea
Key words	Proof of effect of IQoro and Palatal plate training on swallowing in stroke patients.		.

Study type

Peer reviewed, Prospective, Cohort pre- and post- study

Aim

To determine (i) whether oral training effect on stroke related dysphagia differs between two different oral devices: a palatal plate (PP) and IQoro neuromuscular training (IQNT) device, and (ii) whether any improvement is still present at late follow-up.

Patients

- 12 adult patients with stroke-related dysphagia treated with PP, F=2, M=10, median age 69 (range 46 – 82).
- 14 adult patients with stroke-related dysphagia treated with IQNT, F=7, M=7, median age 69 (range 55 – 81).

Methods

Prospective chart analysis of outcomes of the two different treatment groups: PP and IQNT. PP training session duration was 90 minutes per day. IQoro training session duration was 90 seconds per day.

Outcome measurements

- Swallowing ability (using Timed Water Swallow Test - TWST) – lower normal value for swallowing rate ≥ 10 ml / sec,
- Self-assessed scoring test (using Visual Analogue Scale – VAS).

Testing was performed at three timepoints: at baseline, end-of-treatment (13 weeks) and at late follow up.

Results

- At end of treatment swallowing ability had normalized in 33% of patients in the PP group and in 71% of the IQoro group.

- There was also a significant swallowing ability improvement difference between the PP and IQoro groups in the period from baseline to late follow-up ($p < 0.002$) in favour of the IQoro group.
- VAS, as tested at baseline and at end-of-treatment, did not differ significantly between the two groups.
- Training with PP and with IQoro produced lasting improvement of swallowing ability as assessed by TWST and VAS at late follow-up.

Statistical significance of result

($p < 0.001$) improvement in swallowing ability at end of treatment (PP group = 33% normalised).

($p < 0.001$) improvement in swallowing ability at end of treatment (IQoro group = 71% normalised).

($p < 0.002$) better improvement in IQNT over PP at late follow-up.

Conclusion

Both Palatal Plate and IQoro Neuromuscular Training lead to improvements in swallowing ability as measured by TWST and VAS. Improvements with IQoro Neuromuscular Training are significantly superior, and were achieved at far lower cost and in far shorter training sessions.

6. Four-quadrant Facial Function in Dysphagic Patients after Stroke and Healthy Controls.

Hägg M., Tibbling L. Neurology Research International Volume 2014, Article ID 672685, 5 pages.

Summary of study

Relevance to conditions

This study is most important to the following condition groups:

Conditions	Dysphagia,	Hiatus hernia	Snoring and sleep apnoea
Key words	Proof of existence of multi-quadrant facial paresis in all stroke patients, and the effectiveness of IQoro in treating.		

Study type

Peer reviewed, Prospective, Cross-sectional.

Aim

To examine any motility disturbance after stroke in a quadrant of the face other than the quadrant innervated by the lower facial nerve contralateral to the cortical lesion.

Patients

46 adult patients: 31 after first stroke and 15 healthy controls.

The stroke group consisted of F=11, M=20, median age 67 (range 46 - 82 years).

11 patients had a cortical lesion on the right-hand side (RHS), 18 on the left-hand side (LHS) and 2 had a bilateral lesion.

Facial palsy (FP) at rest, was diagnosed by the referring physicians in 7 on RHS, 8 LHS and in 1 of the bilateral cases. FP at rest was not diagnosed in 15 patients.

The 15 healthy controls comprised F=6, M=9. Median age 66 (range 52 – 77 years)

Methods

Measurement and comparison of patients' facial activity and swallowing ability. The IQoro training period was 3 months.

Outcome measurements

- Facial Activity Test (FAT)
- Swallowing ability (using Timed Water Swallow Test - TWST) – lower normal value for swallowing rate ≥ 10 ml / sec.

Results

The majority of poststroke patients with dysphagia have subclinical orofacial motor dysfunction in three or four facial quadrants as assessed with a FAT. However, whether

subclinical orofacial motor dysfunction can be present in stroke-afflicted patients without dysphagia is unknown.

Statistical significance of result

($p < 0.001$) Pharyngeal sling force improvement

($p < 0.001$) Swallowing ability improvement

Conclusion

IQoro training improves oropharyngeal dysphagia and facial paresis in patients with stroke irrespective of time to intervention, age or gender. The presence or absence of facial paresis had no effect on treatment outcomes.

7. Effects on facial dysfunction and swallowing capacity of intraoral stimulation early and late after stroke.

Hägg MK., Tibbling LI. NeuroRehabilitation. 2015;36 (1):101-6.

Summary of study

Relevance to conditions

This study is most important to the following condition groups:

Conditions	Dysphagia,	Hiatus hernia	Snoring and sleep apnoea
Key words	Proof of effect of IQoro on swallowing, facial paresis in stroke patients.		

Study type

Peer reviewed, Prospective, Cohort pre- and post- study

Aim

This study aimed to investigate whether intraoral stimulation after stroke has simultaneous effects on facial dysfunction in the contralateral lower facial quadrant and in the other three facial quadrants, on lip force, and on dysphagia.

Patients

42 patients with stroke, divided between:

- Group 1 (n=31), median age 79 years, with a recent stroke (0 - 5 weeks),
- Group 2 (n=20) median age 62 years, who had suffered stroke longer ago – median 57 weeks (range 6 weeks to 8.8 years).

Methods

Patients were treated with intraoral stimulation with either IQoro (90 seconds per day) or a Palatal Plate (90 minutes per day) and assessed for facial activity, pharyngeal sling force, and swallowing ability at three time-points: before treatment, at the end of treatment, and at late follow-up (>1 year after the end of treatment). The treatment period was 3 months.

Outcome measurements

- Facial Activity Test (FAT),
- Pharyngeal sling force (using Lip Force meter) – lower normal value ≥ 15 N,
- Swallowing ability (using Timed Water Swallow Test - TWST) – lower normal value for swallowing rate ≥ 10 ml / sec.

Results

FAT, LF, and TWST scores were all improved from baseline to end-of-treatment ($p < 0.001$ for each), with these improvements remaining at late follow-up. Baseline and treatment data did not significantly differ between patients treated shortly and late after stroke.

Statistical significance of result

($p < 0.001$) pharyngeal sling force (LF)
($p < 0.001$) swallowing ability (TWST)

($p < 0.001$) orofacial sensory and motor test (FAT)

Conclusion

IQoro is effective in improving swallowing ability and facial activity in all four facial quadrants in patients after stroke irrespective of time from stroke debut to start of treatment. Improvements were still present at long-term follow-up. It is very unlikely that the improvements seen were due to spontaneous remission.

8. Effect of oral IQoro® and palatal plate training in post-stroke, four-quadrant facial dysfunction and dysphagia: A comparison study.

Hägg M., Tibbling L. Acta Otolaryngol. 2015 Sep;135(9):962-8.

Summary of study

Relevance to conditions

This study is most important to the following condition groups:

Conditions	Dysphagia,	Hiatus hernia	Snoring and sleep apnoea
Key words	Proof of effect of IQoro and PP on swallowing, facial paresis in stroke patients.		.

Study type

Peer reviewed, Prospective, Randomized, Cohort pre- and post-study

Aim

To compare Palatal Plate (PP) and IQoro Neuromuscular Training (IQNT) in terms of (i) effect on four-quadrant facial dysfunction and dysphagia after a first-ever stroke, and (ii) whether the training effect persisted at late follow-up.

Patients

- 13 adult patients with PP, F=2, M=11, median age 68 (range 46 – 82). Median 59 weeks post stroke.
- 18 adult patients with IQNT, F=9, M=9, median age 66 (range 53 – 81). Median 5 weeks post stroke.

Methods

13 patients in 2005–2008 trained with a PP for 90 minutes per day, while 18 patients in 2009–2012 trained with an IQoro for 90 seconds per day. Patients were evaluated at baseline, after 3 months of treatment and at late follow-up (>1 year)

Outcome measurements

- Facial Activity Test (FAT),
- Swallowing ability (using Timed Water Swallow Test - TWST) – lower normal value for swallowing rate ≥ 10 ml / sec.

Results

Facial activity and swallowing ability significantly improved ($p < 0.001$) in both groups. FAT scores at end-of-training and at late follow-up did not differ significantly between the groups, irrespective of whether the interval between stroke incidence and the start of training was long or short.

Statistical significance of result

($p < 0.001$) swallowing ability (TWST) for both PP and IQNT treatments.

($p < 0.001$) orofacial sensory and motor test (FAT) for both PP and IQNT treatments.

Conclusion

There is little difference between the effectiveness of palatal plate and IQoro neuromuscular treatments, but large practical and economic advantages in using IQoro. The results support the evidence that improvement is not a result of spontaneous remission.

9. Effect of IQoro® training in hiatal hernia patients with misdirected swallowing and esophageal retention symptoms.

Hägg M, Tibbling L, Franzén T. Acta Otolaryngol. 2015 Jul;135(7):635-9

Summary of study

Relevance to conditions

This study is most important to the following condition groups:

Conditions	Dysphagia,	Hiatus hernia	Snoring and sleep apnoea
Key words	Proof of effect of IQoro on mis-directed swallowing,	Proof of effect of IQoro training on hiatal incompetence and several HH symptoms.	Velum Closure competence is linked to snoring and OSA.

Study type

Peer reviewed, Prospective, Cohort pre- and post-study.

Aim

To investigate whether muscle training with IQoro influences symptoms of misdirected swallowing and esophageal retention in patients with hiatal hernia.

Patients

28 patients, F=14, M=14. Adult, Median age 59 years (range 22 – 85). All patients had hiatal hernia with misdirected swallowing and esophageal retention symptoms for median 4 years (range 1 – 28).

Methods

IQoro training of duration 3 x 10 seconds three times per day for a duration of 6 – 8 months. Outcome measurements were made at two time points: before training and at end of training.

Outcome measurements

12 patients in the study

- High Resolution Manometry (HRM).

All patients in the study,

- self-assessed scoring test (using Visual Analogue Scale – VAS),
- oral sensory test,
- pharyngeal sling force (using Lip Force meter) – lower normal value ≥ 15 N,
- swallowing ability (using Timed Water Swallow Test - TWST) – lower normal value for swallowing rate ≥ 10 ml / sec,
- Velum Closure Test (VCT) – lower normal value ≥ 10 sec,
- Orofacial Motor Test,
- Orofacial Sensory Test

- Hiatal hernia symptom questionnaire.

Results

All Orofacial motor tests and Orofacial sensory test scores were normal before treatment, indicating that there was no neurological cause to the patient's symptoms.

- Reflux symptoms were reported before training in 100% of patients, 100% of these showed improvement at end of training, ($p < 0.001$) and 61% were entirely symptom free and ceased PPI medication.
- All hiatal hernia patients were improved after training ($p < 0.001$) with IQoro and showed significant improvements in
 - misdirected swallowing,
 - cough,
 - hoarseness,
 - esophageal retention,
 - globus sensation,
 - scores for VAS, pharyngeal sling force, VCT and TWST.
- Traction during the training action with IQoro resulted in a 65 mm Hg increase in the mean pressure of the Diaphragmatic Hiatus as measured by high resolution manometry.

Statistical significance of result

($p < 0.001$) improvements in misdirected swallowing, cough, hoarseness, esophageal retention, globus sensation, VAS scores, pharyngeal sling force, velum closure and swallowing ability.

Conclusion

IQoro training significantly improves all the symptoms of hiatus hernia, potentially through improved hiatal competence. All symptoms were significantly improved at end of training suggesting that lasting improved hiatal competence had been achieved.

10. Esophageal dysphagia and reflux symptoms before and after oral IQoro® training.

Hägg M, Tibbling L, Franzén T. World J Gastroenterol 2015; 21(24): 7558-7562

Summary of study

Relevance to conditions

This study is most important to the following condition groups:

Conditions	Dysphagia,	Hiatus hernia	Snoring and sleep apnoea
Key words	Proof of effect of IQoro on mis-directed swallowing,	Proof of effect of IQoro training on hiatal incompetence and several HH symptoms.	Velum Closure competence is linked to snoring and OSA.

Study type

Peer reviewed, Prospective, Cohort pre- and post- study

Aim

To examine whether training with an IQoro Neuromuscular Training (IQNT) improves esophageal dysphagia and reflux symptoms.

Patients

43 patients (F=22, M=21) median age 57 years (range 22 – 85) with esophageal dysphagia of a non-stenotic nature, of which:

- 21 patients with median age 52 years (range 19 – 85) with a confirmed Hiatal hernia,
- 22 patients with median age 57 years (range 22 – 85) exhibited Hiatal hernia symptoms but had no confirmed diagnosis.

All patients had been using PPI medication for more than one year.

Methods

IQoro training 3 x 10 seconds three times per day for a duration of 6 months. Outcome measurements were made at two time points: before training and at end of training.

Outcome measurements

12 patients, median age 53 years (range 22 - 68 years) with hiatal hernia were measured using:

- High Resolution Manometry during IQoro traction to record pressure in the upper esophageal sphincter and hiatus canal.

All patients were measured using:

- Symptom questionnaire (esophageal dysphagia and acid chest symptoms)
- Swallowing questionnaire (ability to swallow food), measured using Visual Analogue Scale (VAS)
- Swallowing ability (measured using Timed Water Swallow Test - TWST) – lower normal value for swallowing rate ≥ 10 ml / sec
- Pharyngeal sling force (measured using Lip Force meter) – lower normal value ≥ 15 N

- Velopharyngeal Closure Test (VCT) – lower normal value ≥ 10 sec
- Orofacial motor tests
- Orofacial sensory test

Results

All Orofacial motor tests and Orofacial sensory test scores were normal before treatment, indicating that there was no neurological cause to the patient's symptoms.

No significant difference in symptom frequency was found between the group with confirmed hiatus hernia, and those without a confirmed diagnosis, this was true both before and after training.

- Esophageal dysphagia was present in all 43 patients at start of treatment, and 98% of patients showed improvement after IQoro neuromuscular training ($p < 0.001$).
- Reflux symptoms were reported before training in 86% of the patients, 100% of these showed improvement at end of training, ($p < 0.001$) and 58% were entirely symptom free and ceased PPI medication.
- VAS scores were classified as pathologic in all 43 patients, and 100% showed improvement after IQoro neuromuscular training ($p < 0.001$).
- Pharyngeal sling force ($p < 0.001$) and velum closure test values ($p < 0.001$). were significantly higher after IQoro neuromuscular training.
- High Resolution Manometry during IQoro traction showed an increase in mean pressure in the diaphragmatic hiatus region from 0 mm Hg at rest (range: 0-0 mm Hg) to 65 mm Hg (range: 20-100 mm Hg).

Statistical significance of result

($p < 0.001$) esophageal dysphagia

($p < 0.001$) reflux symptoms

($p < 0.001$) VAS values

($p < 0.001$) pharyngeal sling force scores significantly higher

($p < 0.001$) VCT scores significantly higher

($p = NS$) No statistical difference between symptoms or outcomes between those with or without confirmed Hiatal hernia diagnosis - both before and after treatment.

Conclusion

IQoro neuromuscular training can relieve/improve esophageal dysphagia and reflux symptoms in adults, likely due to improved hiatal competence. The similarity of the results in the two groups suggest that many people suffer from Hiatus hernia despite this not having been confirmed by diagnosis.

11. Effect of IQoro® training on impaired postural control and oropharyngeal motor function in patients with dysphagia after stroke.

Hägg M., Tibbling L. Acta Otolaryngol 2016; 136 (7):742-748.

Summary of study

Relevance to conditions

This study is most important to the following condition groups:

Conditions	Dysphagia,	Hiatus hernia	Snoring and sleep apnoea
Key words	Proof of effect of IQoro on OPMD and IPC in stroke patients.	.	Velum Closure competence is linked to snoring and OSA.

Study type

Peer reviewed, Prospective, Cohort pre- and post-study.

Aim

To study the frequency of Impaired Postural Control (IPC) in patients with stroke-related dysphagia or Oropharyngeal Motility Disorder (OPMD) and whether IQoro Neuromuscular Training (IQNT) has any effect on IPC in parallel with its effect on OPMD.

Patients

26 adult patients with stroke with pathological levels for both OPMD and IPC (F=11, M=15), median age 68 years (range 49 - 82).

The patients were divided between

- Group 1(n=15)
 - had suffered stroke more than 1 year before
 - median age 67 years.
 - 100% had pathological lip and tongue motor function.
 - 10 had a pathological jaw function.
 - 12 had a pathological velum function.
 - 6 had a pathological velopharyngeal closure ability.
 - 14 exhibited misdirected swallowing.
 - 4 patients in this group were fed via PEG.

- Group 2 (n=11)
 - had suffered stroke within 1 month before starting IQoro treatment.
 - median age 69 years.
 - 100% had pathological lip and tongue motor function.
 - 10 had a pathological jaw function.
 - 12 had a pathological velum closure ability.
 - 8 had a pathological velopharyngeal closure ability.
 - 100% exhibited misdirected swallowing.
 - 1 patient in this group was fed via PEG.

108 patients were originally screened for inclusion in Group 2, but many were excluded before recruitment due to the following criteria: deceased (67), second stroke (26), unable to cooperate (15).

Methods

IQoro training 3 x 10 seconds, three times per day for a duration of 13 weeks.

Outcome measurements were made at three time points: before training, at end of training, and at a late follow-up (median 59 weeks after end of training).

Outcome measurements

The following measurements were used at all three timepoints:

- Postural Control according to Castillo Morales (PCCM),
- Postural Assessment Scale for Stroke patients (PASS),
- Oropharyngeal motor function (OPM) - function of the lips, jaw, tongue and velum,
- Swallowing ability (measured using Timed Water Swallow Test - TWST) – lower normal value for swallowing rate ≥ 10 ml / sec
- Pharyngeal sling force (measured using Lip Force meter) – lower normal value ≥ 15 N
- Velopharyngeal Closure Test (VCT) – lower normal value ≥ 10 sec

Results

- 2 patients in Group 1 showed no improvement in either swallowing ability or postural control.
- 24 patients (92%) showed significant improvement in all outcome measures in both Group 1 and Group 2 after 3 months' IQoro neuromuscular training including:
 - Postural Control according to Castillo Morales (PCCM),
 - Postural Assessment Scale for Stroke patients (PASS),
 - Oropharyngeal motor function (OPM) - function of the lips, jaw, tongue and velum,
 - Swallowing ability (measured using Timed Water Swallow Test - TWST) – lower normal value for swallowing rate ≥ 10 ml / sec
 - Pharyngeal sling force (measured using Lip Force meter)
 - Velopharyngeal Closure Test
- The PEG was removed from the 1 patient in the short-term intervention group.
- The PEGs were removed from all 4 patients in the long-term intervention group.
- The improvements were still present at late follow-up (median 59 weeks after end-of-training).

Statistical significance of result

- **Postural control**
 - ($p < 0.004$) improvement in PCCM, Group 1
 - ($p < 0.002$) improvement in PCCM, Group 2
 - ($p < 0.016$) improvement in PASS, Group 1
 - ($p < 0.031$) improvement in PASS, Group 2
- **Orofacial motor function**
 - ($p < 0.005$) improvement in lip function, Group 1
 - ($p < 0.008$) improvement in lip function, Group 2
 - ($p < 0.008$) improvement in jaw function, Group 1
 - ($p < 0.016$) improvement in jaw function, Group 2
 - ($p < 0.001$) improvement in tongue function, Group 1

($p < 0.008$) improvement in tongue function, Group 2

- **Velum function**

($p < 0.001$) improvement in soft palate function, Group 1

($p < 0.004$) improvement in soft palate function Group 2

($p < 0.001$) improvement in velopharyngeal closure ability, Group 1

($p < 0.039$) improvement in velopharyngeal closure ability, Group 2

- **Pharyngeal sling force**

($p < 0.002$) improvement in pharyngeal sling force, Group 1

($p < 0.008$) improvement in pharyngeal sling force, Group 2

- **Swallowing ability**

($p < 0.001$) improvement in swallowing ability, Group 1

($p < 0.002$) improvement in swallowing ability, Group 2

- **Long standing effect**

($p < NS$) no significant difference in any of the measured values between end of treatment and late follow up.

Conclusion

- IQoro successfully treats impaired postural control and oropharyngeal motor function in patients with dysphagia after stroke.
- PEGs can be removed after several years use, after 13 weeks' IQoro treatment.
- Velum function is significantly improved by IQoro training.
- Improvements made are still present at long-term follow up.
- The similarity of results in the two intervention groups further supports the contention that improvement is not due to spontaneous remission.
- Effectiveness of IQoro treatment is not affected by time from stroke to start of treatment, nor age or gender of patient.
- The positive effect on muscle groups not directly accessed by IQoro neuromuscular training supports the contention that the improvements are triggered by neurological rehabilitation.

12. Study protocol for the SOFIA project: Swallowing function, Oral health, and Food Intake in old Age: a descriptive study with a cluster randomized trial.

(a part of the SOFIA project)

Hägglund P., Olai L., Ståhltnacke K., Persenius M., Hägg M., Andersson M., Koistinen S., Carlsson E. BMC Geriatrics 2017, 17:78. DOI 10.1186/s12877-017-0466-8

Summary of study

Relevance to conditions

This study is most important to the following condition groups:

Conditions	Dysphagia,	Hiatus hernia	Snoring and sleep apnoea
Key words	Design of a study to show effectiveness of IQoro in improving swallowing in an elderly cohort.	.	

Study type

Peer reviewed, Prospective, Cohort pre- and post- study, Multi-Centre, Randomized Control Trial (RCT).

Aim

Description of study design of a study taking place in 5 Swedish counties.

This project aims to:

- (i) describe and analyse relationships between oral health and Health Related Quality of Life (HRQoL), swallowing ability, eating ability, and nutritional risk among older individuals admitted to short-term care;
- (ii) compare the perceptions that older individuals and staff report on care quality related to oral hygiene and eating; and
- (iii) study the feasibility and effects of a training program for people with impaired swallowing (i.e., dysphagia).

Patients

Approx 400 older individuals in short term residential care. All are to be ≥ 65 years old and have been in the facility for >3 days.

Approx 200 healthcare professionals will be engaged.

Methods

This project consists of two parts and is to be conducted in 36 residential facilities across 5 counties.

Part 1 is a cross-sectional, descriptive study of older people admitted to short-term care. Subjects will be assessed by trained healthcare professionals,

Part 2 is a cluster randomized intervention trial with controls. Elderly participants with dysphagia will be recruited consecutively to either the intervention or control group, depending on where they were admitted for short-term care. The intervention group will receive IQoro neuromuscular training 3 x 10 seconds, three times per day for a duration of 5 weeks'. Those in the control groups will receive traditional and compensatory care. At end of training, and at late follow up (6 months) post-training, all assessments will be repeated in both study groups.

Outcome measurements

- Part 1

Swallowing ability (using Timed Water Swallow Test - TWST) – lower normal value for swallowing rate ≥ 10 ml / sec

Health Related Quality of Life (HRQoL)

Oral health status

Oral Health Related Quality of Life (Oral HRQoL)

Eating and nutritional risk.

Subjects and staff will complete a questionnaire regarding their perceptions of care quality.

- Part 2

Swallowing ability (using Timed Water Swallow Test - TWST) – lower normal value for swallowing rate ≥ 10 ml / sec,

Oral health status

Oral HRQoL

Eating and nutritional risk

Swallowing related QoL

Discussion

The results will make important contributions to rehabilitation knowledge, including approaches for improving swallowing function, oral health, and food intake and for improving the quality of oral care for older people.

13. Swallowing dysfunction as risk factor for undernutrition in older people admitted to Swedish short-term care: a cross-sectional study

Hägglund P., Fält A., Hägg M., Wester P., Levring Jäghagen E. Aging Clin Exp Res. 2018 Apr 16. DOI.org/10.1007/s40520-018-0944-7.

Summary of study

Relevance to conditions

This study is most important to the following condition groups:

Conditions	Dysphagia,	Hiatus hernia	Snoring and sleep apnoea
Key words	A study to show the prevalence of swallowing difficulties in an elderly cohort.	.	

Study type

Peer reviewed, Prospective, Cohort pre- and post- study, Multi-Centre.

Aim

To describe and analyse the relationship between swallowing dysfunction and risk of undernutrition among older people in short-term care, including potential gender-related differences.

Patients

391 people (209 women) aged ≥ 65 years (median age 84 years) and admitted to one of 36 short-term residential facilities at least 3 days before. No other selection criteria were applied, including all conditions and comorbidities.

Outcome measurements

Swallowing ability (using Timed Water Swallow Test - TWST) – lower normal value for swallowing rate ≥ 10 ml / sec.

Undernutrition risk was assessed using the Minimal Eating Observation and Nutrition Form-version II.

Results

- Swallowing dysfunction was observed in 248 of 385 (63%) participants.
- Dysfunctional swallowing rate was observed in 213 of 385 (55%)
- Signs of aspiration were observed in 127 of 377 (34%).
- Women exhibited dysfunctional swallowing rate more frequently than men ($p = 0.030$).
- Men with normal swallowing rate exhibited signs of aspiration more frequently than women: cough ($p = 0.038$), and voice quality change ($p = 0.004$).
- Risk of undernutrition was found in 91 of 390 (23%) participants, more frequently among women ($p = 0.007$).

- A logistic regression model revealed an increased risk of undernutrition among older people with dysfunctional swallowing capacity (OR 1.74, 95% CI 1.04-2.92, $p = 0.034$).

Statistical significance of result

($p = 0.030$) Women exhibited dysfunctional swallowing rate more frequently than men.

($p = 0.038$) Men with a functional swallow exhibited signs of aspiration more frequently than women (Cough)

($p = 0.004$) Men with a functional swallow exhibited signs of aspiration more frequently than women (voice quality change).

($p = 0.007$) Risk of undernutrition was found more frequently among women

Conclusion

The high prevalence of swallowing dysfunction and risk of undernutrition in this group highlight the need for a systematic screening program and effective treatment to improve swallowing function for adequate and safe food intake among older people in short-term care.

14. Oral neuromuscular training relieves hernia-related dysphagia and GERD symptoms as effectively in obese as in non-obese patients.

Franzén T., Tibbling L., Hägg M. January 2019 Acta Oto-Laryngologica 138(11):1-5
DOI: 10.1080/00016489.2018.1503715

Summary of study

Relevance to conditions

This study is most important to the following condition groups:

Conditions	Dysphagia,	Hiatus hernia	Snoring and sleep apnoea
Key words		Proof of the effectiveness of IQoro in treating Hiatal hernia, and independent of patient's BMI.	

Study type

Peer reviewed, Prospective, Clinical Study, Cohort pre- and post- study.

Aim

To investigate whether Body Mass Index (BMI) has significance on IQoro neuromuscular training's effectiveness in treating Hiatal hernia (HH) related symptoms.

Patients

86 adult patients (F = 46, M = 40) with verified hiatal hernias and long- standing Intermittent Esophageal Disease (IED) and other Gastro Esophageal Reflux Disease (GERD) symptoms.

Before entry into the study the patients were partitioned into three groups according to BMI:

- Group A:
 - normal weight, BMI < 25
 - (n = 37: 19 women of median age 68 yrs., 18 men of median age 72 yrs.)
 - GERD symptoms - median duration 5 yrs (1 – 75).
 - PPI medication history median 5 yrs.
- Group B:
 - moderately obese, BMI 25 – 29
 - (n = 28: 16 women of median age 59 yrs., 12 men of median age 56 yrs.)
 - GERD symptoms - median duration 6 yrs (1 – 15).
 - PPI medication history median 6 yrs
- Group C:
 - severely obese, BMI 30 – 37
 - (n = 21: 11 women of median age 52 yrs., 10 men of median age 70 yrs.)
 - GERD symptoms - median duration 3 yrs (1 – 29).

- PPI medication history median 3 yrs

Methods

All patients received IQoro neuromuscular training 3 x 10 seconds, three times per day for a duration of 6 months.

All patients were measured before and after treatment.

Outcome measurements

Radiology or gastroscopy was used to confirm HH and to rule out esophageal stenosis before inclusion.

An Orofacial Muscle Function Test (OFMT) and an Orofacial Sensory Test (OST) were performed in order to exclude symptoms of any central nervous lesion. Patients with neurological diseases were excluded.

All patients were measured before and after treatment using:

- Symptom questionnaire (IED, GERD, reflux, heartburn, chest pain, globus sensation, non-productive cough, hoarseness, and misdirected swallowing.)
- Swallowing questionnaire (ability to swallow food), measured using Visual Analogue Scale (VAS)
- Swallowing ability (measured using Timed Water Swallow Test - TWST) – lower normal value for swallowing rate ≥ 10 ml / sec
- Pharyngeal sling force (measured using Lip Force meter) – lower normal value ≥ 15 N

Results

- At entry into the study there were no significant differences between the three BMI groups in:
 - TWST, LFT or VAS values
 - IED and GERD symptom severity, except that:
 - heartburn and cough were significantly more common in Groups B and C, and that
 - misdirected swallowing was significantly more common in Group C.
- After IQoro neuromuscular training, the following was observed in all three BMI groups:
 - all IED and GERD symptom scores were significantly improved or reduced ($p < 0.001$)
 - median BMI was not significantly changed
 - self-assessed GERD symptom improvement showed no significant difference across the groups, except for heartburn, cough and misdirected swallowing which were significantly ($p < 0.01$) more reduced in obese patients than in normal bodyweight patients.
 - VAS score, TWST, and pharyngeal sling force (LFT), showed significant improvement ($p < 0.001$) in median values, with no significant difference between the BMI groups except for:
 - TWST values, which were significantly ($p < 0.01$) more improved in Group C than in Group A
 - pharyngeal sling force (LFT), which was significantly ($p < 0.05$) more improved in Group B than in Group A.

Statistical significance of result

($p < 0.001$) all IED and GERD symptom scores were significantly improved or reduced
($p < 0.01$) heartburn, cough and misdirected swallowing were significantly more reduced in obese patients than in normal bodyweight patients

($p < 0.001$) VAS score, TWST, and pharyngeal sling force (LFT) improved

($p < NS$) no significant difference between other results across the three groups

Conclusion

IQoro neuromuscular training (IQNT), a non-surgical treatment for IED and other GERD symptoms in hiatal hernia patients, is equally successful in treating moderately- or severely obese patients as in treating sufferers of normal weight. Obesity in itself does not therefore seem to be a handicap in treating IED and other GERD symptoms by IQNT.

15. Effects of oral neuromuscular training on swallowing dysfunction among older people in intermediate care — a cluster randomised, controlled trial

(A part of the SOFIA study)

Patricia Hägglund, Mary Hägg, Per Wester, Eva Levring Jäghagen

Age and Ageing, Volume 48, Issue 4, July 2019, Pages 533–

540, <https://doi.org/10.1093/ageing/afz042>. Published: 07 May 2019

Summary of study

Relevance to conditions

This study is most important to the following condition groups:

Conditions	Dysphagia,	Hiatus hernia	Snoring and sleep apnoea
Key words	A study to show the effectiveness of IQoro in treating swallowing difficulties in an elderly cohort.	.	

Study type

Peer reviewed, Prospective, Cohort pre- and post- study, Randomised Controlled Trial (RCT)

Aim

This prospective, cluster randomised, controlled trial investigated the effect of oral neuromuscular training among older people in intermediate care with impaired swallowing.

Patients

385 participants who had been in one of 36 intermediate care units for at least 3 days were screened, and 116 participants were randomly assigned to IQoro neuromuscular training or usual care. No other selection criteria were applied. The cohort included residents with neurological disabilities, Parkinsons, stroke, Acquired Brain Injury (ABI), Traumatic Brain Injury (TBI), dementia, Chronic Obstructive Pulmonary Disease (COPD), cardiovascular diseases, musculoskeletal disorders, more. All recruited residents had diagnosed conditions affecting at least three different organs / organ systems.

- intervention group
 - ($n = 49$, $F = 22$, $M = 27$)
 - median age 83 (range 72 – 87)
- control group
 - ($n = 67$, $F = 38$, $M = 29$)
 - median age 85 (range 80 – 89)

The two groups were matched for gender, age, functional ability, BMI, comorbidities, dysphagia related illness, cognitive ability, and educational level.

Methods

Older people with swallowing dysfunction were cluster randomised according to care units for either:

- intervention group: IQoro neuromuscular training 3 x 10 seconds, three times per day for 5 weeks,
- control group: traditional and compensatory care.

Residents were measured at three time points: before training, at end of training and at late follow up (6 months post-treatment).

Outcome measurements

Residents were tested at each time point for:

- Primary endpoint: swallowing rate assessed by Timed Water Swallow Test (TWST) – lower normal value for swallowing rate ≥ 10 ml / sec
- The secondary endpoints were changes in signs of aspiration during the TWST and swallowing-related quality of life (QOL).

Results

- At end of treatment, the geometric mean of the swallowing rate in the intervention group had significantly improved 60% more than that of controls ($P = 0.007$).
- Signs of aspiration significantly reduced in the intervention group compared with controls ($p = 0.01$).
- At 6 months post-treatment, the swallowing rate of the intervention group remained significantly better ($p = 0.031$).
- No significant between-group differences were found for swallowing-related QOL.

Statistical significance of result

($p < 0.007$) improved swallowing rate in intervention compared with control group.

($p < 0.01$) reduced signs of aspiration in intervention compared with control group.

($p < 0.031$) swallowing rate in intervention compared with control group at 6 months after end of treatment.

($p < 0.46$) signs of aspiration were similar in the both groups at 6 months after end of training.

Conclusion

Oral neuromuscular training is a new promising swallowing rehabilitation method for older people in intermediate care with impaired swallowing. 5 weeks' training showed good improvements, but a longer treatment period would have been preferable.

16. Older people with swallowing dysfunction and poor oral health are at greater risk of early death

Hägglund P., Koistinen S., Olai L., Ståhlacke K., Wester P., Levring Jäghagen E. Acta Oto-Laryngologica. 2019

Summary of study

Relevance to conditions

This study is most important to the following condition groups:

Conditions	Dysphagia,	Hiatus hernia	Snoring and sleep apnoea
Key words	A study to show the relation between swallowing difficulties and early death in an elderly cohort.	.	

Study type

Peer reviewed, Prospective, Cohort pre- and post- study

Aim

We investigated the associations between swallowing dysfunction, poor oral health and mortality among older people in intermediate care in Sweden.

Methods

Older people in 36 intermediate care units (clusters) were assessed for swallowing ability and oral health.

Data were collected on age, sex, education level, multimorbidity, cognitive impairment, care dependency and body mass index (BMI).

Time to mortality was recorded during the following year.

Patients

391 patients with stroke, F=12, M=18, median age 84 years (range 49 – 84)

Outcome measurements

- Timed Water Swallow Test (TWST) – lower normal value for swallowing rate ≥ 10 ml / sec
- Oral health with the Revised Oral Assessment Guide (ROAG).
- Data were collected on age, sex, education level, multimorbidity, cognitive impairment, care dependency and Body Mass Index (BMI)

Results

- Mortality within one year was 25.1%.
- In the adjusted model, swallowing dysfunction and poor oral health were both independently associated with mortality
 - Swallowing dysfunction adjusted HR (aHR): 1.67, 95% CI, 1.02-2.75; ($p = 0.041$)

- Oral health aHR: 1.98, 95% CI 1.07-3.65; ($p = 0.029$).
- Participants with normal swallowing function and good oral health had a mortality rate of 13.0%.
- Participants with both swallowing dysfunction and poor oral health showed a mortality rate of 35.0%. This is 2.6 times (95% CI 1.15-5.89; ($p = 0.022$)) the mortality risk of those without these two dysfunctions.

Statistical significance of result

($p = 0.041$) mortality associated with swallowing function

($p = 0.029$) mortality associated with oral health

Conclusion

Swallowing dysfunction and poor oral health were identified as independent risk factors for mortality in older people in intermediate care. Although further studies are required to verify these findings, they suggest that systematic assessment of swallowing function and oral health status should be performed for care considerations.

17. A Scientific Comparison of Three Tests for Swallowing Dysfunction That Are Not Reliant on Access to VF or FEES Facilities

Hägg M., Tibbling L. BIO MEDICAL Journal of Scientific & Technical Research. 2019

Summary of study

Relevance to conditions

This study is most important to the following condition groups:

Conditions	Dysphagia,	Hiatus hernia	Snoring and sleep apnoea
Key words	A study to show the validity of three simple tests for swallowing difficulties, and the effectiveness of IQoro in treating this condition.	.	

Study type

Peer reviewed, Prospective, Cohort pre- and post- study.

Aim

Oral Pharyngeal Dysphagia (OPD) is a debilitating swallowing dysfunction that can lead to mortality through pneumonia, and severely impacts quality of life. Identifying the disease and tracking its rehabilitation is difficult when only expensive and scarce diagnostic tools are available.

To compare the Timed Water Swallow Test (TWST) with a Meal Observation Test (MOT) and Visual Analogue Scale (VAS) as tools for detecting Oral Pharyngeal Dysphagia (OPD) and its treatment.

Patients

22 patients, F = 7, M = 15, median age 69 years (range 47 - 82) with OPD (median 15.5 months after stroke)

Inclusion criteria:

- long-standing OPD as assessed by the referring physicians
- first-ever stroke
- no other central neurological diseases
- the ability to cooperate

Initially a total of 48 patients had been referred, 26 of whom could not complete the study: 18 mortalities, 5 new stroke, and 3 unable to cooperate or tube-fed, leaving 22.

Methods

Patients were assessed using three different outcome measures for swallowing difficulties at three time points: before treatment, at end of treatment and at late follow up (averagely 14 months post-treatment).

Treatment consisted of one of two alternative methods:

- IQoro neuromuscular training 30 seconds, three times per day for 3 months, or
- palatal plate therapy 30 minutes, three times per day for 3 months

Outcome measurements

- Timed Water Swallow Test (TWST), ml/sec.
- a 5-item Meal Observation Test (MOT). score 0 – 4.
- Visual Analogue Scale (VAS) for swallowing difficulties, 0 - 100 mm.

Results

All tests correctly identified almost all patients as having pathological levels for OPD at baseline. There was very good correlation of the three tests' results at baseline, end-of-treatment and at long term follow-up.

Table 1. Agreement in classification of patients as normal/pathological

Agreement	Baseline	End	Follow-up
TWST v. VAS	91% (n = 22)	82% (n = 22)	73% (n = 22)
MOT v. VAS	96% (n = 22)	40% (n = 20)	73% (n = 22)
MOT v. TWST	91% (n = 22)	60% (n = 20)	64% (n = 22)

Note TWST to VAS agreement of 82% at end of treatment in classification of patients as normal or pathological, and 73% at late follow-up.

Statistical significance of result

($p = 0.001$) TWST to VAS Spearman correlation agreement at end of treatment.

($p = 0.005$) TWST to VAS Spearman correlation agreement at late follow-up.

Conclusion

It seems that TWST has the widest degree of scientific evidence, and that both MOT and VAS give similar levels of certainty in diagnosing OPD.

The lack of correlation of VAS with the other test methodologies suggests that caution is needed when deploying this method alone in patient evaluation; this may be because of the hypothesised phenomenon of the patient's observation baseline changing over time.

This study demonstrates powerful alternatives to the clinician when preferred, or when more specialist VF or FEES resources are not readily available.

18. Sleep Apnoea, Snoring and IQoro® Training. Discussion and World's First Assessment Results

Summary of study

Relevance to conditions

This study is most important to the following condition groups:

Conditions	Dysphagia,	Hiatus hernia	Snoring and sleep apnoea
Key words		.	A pilot study showing the effect of IQoro training on OSA.

Study type

Pilot study, Prospective, Cohort pre- and post- study

Background

Snoring and Obstructive Sleep Apnoea (OSA) have debilitating primary effects on sufferers, and secondary complications include cardiovascular disease, stroke, heart attack and diabetes. The conditions are caused by muscular weakness in parts of the oropharyngeal regions and there are no current treatments targeted at improving this. IQoro Neuromuscular Training (IQNT) has been shown in earlier studies to improve this muscle function, and individuals report success with self-treatment, there is a need to study the effect in a more controlled environment.

Aim

The aim was to investigate whether IQNT can improve OSA symptoms in a cohort of long-term sufferers.

Patients

10 patients F = 5, M =5 mean age = 64 years (range 55 – 73) with diagnosed OSA who have used Continuous Positive Airway Pressure (CPAP) devices for more than 12 months. Body Mass Index (BMI) had a mean value of 28.1 (range = 22 – 30), only one patient being in the ideal BMI range.

Methods

Patients at 8 different geographically diverse sleep speciality clinics were assessed for sleep apnoea before treatment and at end of treatment.

Treatment consisted of IQoro neuromuscular training 30 seconds, three times per day for 3 months.

Outcome measurements

Sleep registration equipment to determine AHI values.

- an apnoea is defined as a drop in the peak thermal sensor excursion of $\geq 90\%$ of the baseline lasting at least 10 seconds,
- a hypopnea is defined as a 30% reduction in airflow compared with baseline, in combination with an oxygen desaturation of $\geq 3\%$.

- OSA is defined as a mean of five or more obstructive apnoeas and hypopneas per hour of sleep.

AHI defines different degrees of OSA as follows:

- Normal AHI 0 to ≤ 5
- mild sleep apnoea AHI >5 to ≤ 15
- moderate sleep apnoea AHI >15 to ≤ 30
- severe sleep apnoea AHI >30

Duration of sleep is usually an estimate from the recordings.

Results

- The mean score for the whole group improved from 'Severe' (36.6), to 'Moderate' (17.7) after three months' IQNT.
- All except one patient improved and moved to lower severity bands: either 'Mild' category (5 patients), or 'Moderate' category (4 patients). This most severely-affected patient improved dramatically (from 59.3 to 35.4), but without changing his severity category.
- It is interesting that the mean BMI value (28.1 reduced to 27.8) for the group, was not significantly changed from baseline to end of IQNT, hence reduced bodyweight was not a factor in the improvements.

Conclusion

This is a pilot study of the effects of day time IQoro neuromuscular training on OSA sufferers and showed promising results for a condition which is widely prevalent, costly to the individual and the healthcare services. Most patients are prescribed CPAP as a night-time breathing aid and there are no recommended treatments apart from surgery in extreme cases.