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Mechanical splinting of the nasal and velopharyngeal airway for patency of the upper airway in OSA

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Introduction:

Obstruction of the pharyngeal airway is the key symptom in obstructive sleep apnea (OSA). The root causes may reside in the pharynx, but also in the nasal passage. As an alternative to positive pressure ventilation by CPAP to open up the airway, natural nasal breathing can be restored by mechanical splinting of the nasal or velopharyngeal airway.

Material & Methods:

Fluid dynamic studies have elucidated the essential regions of risk leading to pharyngeal obstructions. Essential conclusions from a broad scientific literature analysis will be presented and compared to the clinical results from mechanical splinting of the nasal and velopharyngeal airway by nitinol stents.

The dynamic view on the fluid mechanical situation in the different compartments of the upper airway is an indispensable approach to achieve a reliable view on the root causes of OSA. This enables an optimized therapeutic approach for OSA patients, to achieve high therapeutic efficacy and concurrent patient compliance.

Results:

Numerous mechanical and computer fluid dynamics studies revealed the high importance of a good laminar nasal flow to prevent pharyngeal obstructions in patients anatomically predisposed for OSA. Decreased nasal breathing leads to high flow velocities in the nasal passage, resulting in an increased negative pressure in the naso/velopharynx where the highest amount of soft tissue (pharyngeal walls, soft palate) is located. Consequently, this region is the most prone-to-collapse one in the upper airway, which is reflected by the very high incidence of concentric or antero-posterior collapses.

Nasal airway splinting by stents leads to good nasal flow and may improve the OSA condition. Velopharyngeal mechanical splinting prevents obstructions in this region and, thereby, keeps the airway patent. Mandibular advancement devices may complement the mechanical splinting approach in case of mandible instability leading to a narrow oropharynx.

Discussion:

Mechanical splinting of the upper airway improves the fluid mechanical situation. It enables normal natural nasal breathing by preventing collapses and consequently OSA, as long as no oropharyngeal obstructions are involved. Furthermore, optimal nasal breathing is relevant to ensure flow of the nasal nitric oxide (NO), produced mainly in the sinuses, to the lung. NO is a key regulatory molecule for many physiological functions. Its blood concentration is known to be reduced in OSA, in parallel to O₂. NO deficiency is the trigger for cardiovascular complications, etc.