Episode #21 – Hand scaling vs. Ultrasonic Scaling November 6, 2020

Historical Overview
Periodontal treatment to remove supra- and subgingival deposits was primarily accomplished with handheld instruments (e.g. sickles, curettes, chisels, files, and hoes) until sonic and ultrasonic scalers were developed for 'gross scaling' and the removal of supragingival calculus and stains. [1]

The earliest reference to hand scalers was in Epitomoe medicoe libri septem (Medical Compendium in Seven Books) by Paul of Aegina (625-690) where he described that tartar deposits must be removed with either scrapers or a small file and that the teeth should be carefully cleaned after the last meal of the day.

Abu al-Qasim, also known as Albucasis (936-1013), a Spanish-Arabian physician, had a clear understanding of the major etiologic role of calculus deposits. He invented and proposed the use of scalers and described the techniques of scaling teeth.

Ambroise Paré (1510-1590), a French military head surgeon, understood the etiologic significance of calculus and used a set of scalers to remove the hard deposits on the teeth.

Bartolomeo Eustachi (1520-1574) wrote the 30-chapter book *Libellus de Dentibus* (A Little Treatise on the Teeth). He had very modern ideas and recommended both the scaling of teeth to remove calculus and the curettage of granulation tissue to promote reattachment of the gingival and periodontal tissue.

Pierre Fauchard (1678-1761) was a French surgeon who became known as the "Father of modern dentistry". His book, *Le Chirurgien Dentiste* (The Surgeon Dentist) covered all aspects of dental practice, including restorative dentistry, prosthodontics, oral surgery, periodontics, and orthodontics. Fauchard described in detail periodontal instruments that he invented (e.g. the "donkey snout", the "three-faced burin", the "convex-bladed knife", the "Z-shaped hook"). He also described the scaling technique using instruments he invented, in order to "detach hard matter or tartar from the teeth".

William J. Younger (1838-1920) designed scaling instruments which have been the basis for the modern instruments used today. [2]

In the 1940s, Dr. Clayton Gracey, a periodontist, approached Hu-Friedy's founder, Hugo Friedman, to develop a line of instruments that would allow clinicians to treat deep and

inaccessible periodontal pockets. In 1945, Gracey curettes were introduced. Together, Hugo Friedman and Dr. Gracey developed a series of 14 single-ended area-specific instruments for the removal of deposits from root surfaces. [3]

Ultrasonic scalers were introduced in the 1950s and were used for removal of heavy calculus and extrinsic stains. Their popularity grew during the 1960s and 1970s, although limited insert tip designs restricted ultrasonic scaling to mainly the removal of heavy supragingival deposits i.e. 'gross scaling'. [4]

During the 1980s, manufacturers introduced thinner, probe-like ultrasonic tips which lent themselves to removal of deposits below the gingival margin. Curved tips were also developed, allowing clinicians access to deeper periodontal pockets and furcation areas. Increased research in the effectiveness of ultrasonic scaling and its improved technology led to a paradigm shift to ultrasonic scaling becoming a predominant treatment modality for nonsurgical periodontal therapy. [4] [5]

The concept of 'root planing' was established when Hatfield and Aleo discovered in the 1970s that endotoxin could penetrate to the cementum and influence the attachment of fibroblasts. Thus, the purpose of root planing was to smooth root surfaces with hand instruments to effectively remove the infected cementum, so as to remove endotoxin and form a smooth, hard, and clean biocompatible root surface conducive to the attachment and healing of periodontal tissue. By the 1980s, more studies clarified that endotoxin was only loosely attached to the surface of the cementum, and most of the endotoxin was related to the bacterial biofilm. Therefore, it was suggested that excessive root planing for endotoxin removal was unreasonable. In 1994, the first European Working Conference on periodontology reached a consensus on the term "subgingival debridement," that is, to use a gentle method to remove subgingival plaque and calculus, and to preserve the cementum as much as possible. [6]

Many studies have demonstrated the effectiveness of hand and power scaling in reducing probing depths, increasing clinical attachment levels, and reducing inflammation by the removal of plaque bacteria, calculus, and endotoxin.

Advantages & disadvantages of ultrasonic scaling[1]

Advantages include:

- Less operator hand and wrist fatigue
- Efficient removal of dental plaque biofilm, calculus, and stain
- Decreased treatment time
- Less tissue trauma due to no sharp cutting edges
- Continuous lavage reduces the need for rinsing
- Antiseptic solution can be substituted for the water to provide simultaneous irrigation and disinfection of the area being treated
- Tips do not need sharpening
- Less chance of operator injury because there are no cutting edges [1] [5]

[1] Note these lists are not exhaustive

Disadvantages include:

- May increase root surface roughness
- Incorrect application of the tip to the tooth surface or unintentional overinstrumentation of calculus-free subgingival root areas may cause surface alterations including scratches, gouges, and nicks
- May chip or scratch restorations, e.g. ultrasonic scalers will alter the topography of amalgam restorations and can significantly damage porcelain and composite restorations
- Conventional ultrasonic scalers with metal tips cause considerable changes to implant surfaces
- May cause cavitations when applied to demineralized surfaces, such as initial carious lesions or hypoplasic enamel
- May contribute to clinician hearing loss
- Transmission of pathogenic microorganisms via aerosols is of concern. Studies show that bacteria and blood are routinely present in aerosols produced by ultrasonic scalers, increasing potential for spread of infection between clients and between client and clinician [1] [7]

Research on hand and ultrasonic scaling

Suvan et al. (2019)

Suvan et al. published research in December 2019 entitled 'Subgingival instrumentation for treatment of periodontitis. A systematic review'. The aim of this study was to appraise and summarize currently available literature on (a) the efficacy of subgingival instrumentation as part of nonsurgical periodontal therapy to treat periodontitis, (b) the efficacy of sonic, ultrasonic, and hand instruments used for the removal of subgingival soft and hard deposits, and (c) the influence of different modes of delivery of subgingival instrumentation in terms of timing.

The authors concluded that nonsurgical periodontal therapy by mechanical subgingival instrumentation is an efficacious means to achieve infection control in clients with periodontitis irrespective of whether performed by sonic, ultrasonic, or hand instruments or delivered full mouth within 24 hours or in segments over multiple visits. Clinicians should consider subgingival instrumentation as a key part of periodontal therapy and may choose instrument type and mode of delivery on an individual client basis. [8]

Zhang et al. (2020)

Zhang et al. published a study in June 2020 entitled 'Treating periodontitis–A systematic review and meta-analysis comparing ultrasonic and manual subgingival scaling at different probing pocket depths.' This study compared the effectiveness between ultrasonic scaling and manual subgingival scaling based on different initial probing pocket depths. A total of 10 randomized clinical trials comparing manual and ultrasonic subgingival scaling were included in this meta-analysis.

The authors concluded ultrasonic subgingival scaling is an efficient non-surgical treatment of periodontitis. However, when initial probing pocket depth (PPD) was 4 to

6 mm, PPD reduction proved manual subgingival scaling was superior, but clinical attachment loss (CAL)[2] results demonstrated no statistical differences between the two methods. When initial PPD was ≥6 mm, PPD and CAL reductions suggested that manual subgingival scaling was superior. Therefore, manual subgingival scaling is important and cannot be completely replaced by ultrasonic subgingival scaling. The authors suggested using a combination of ultrasonic and manual subgingival instruments when initial PPD is medium (4-6 mm) or deep (≥6 mm).

The research highlights the importance of hand scaling for clients with advanced periodontal tissue destruction and deep pockets to ensure adequate disease management. [9]

Johnston et al. (2020)

Johnston et al. published research in the *Journal of Clinical Periodontology* in July 2020 entitled 'The systemic inflammatory response following hand instrumentation versus ultrasonic instrumentation–A randomized controlled trial.' For this study, 39 patients with periodontitis were randomized to treatment with full-mouth debridement using either hand or ultrasonic instrumentation completed within 24 hours. At baseline and day 90, clinical parameters (e.g. full-mouth plaque, bleeding scores, and detailed 6-point periodontal pocket charting) were recorded. Serum, whole blood, saliva, subgingival plaque, and gingival crevicular fluid samples were collected at baseline, and at day 1, day 7, and day 90 post-treatment. Differences in systemic inflammatory markers were assessed using general linear models at each timepoint, corrected for age, gender, smoking status, body mass index, and baseline levels of each marker.

Intensive full-mouth non-surgical periodontal treatment has been consistently shown to trigger a larger systemic inflammatory response, demonstrated by significant increases in serum levels of C-reactive protein (CRP), interleukin-6 (IL-6), or tumour necrosis factor alpha (TNFα) 24 hours following treatment. This increase in systemic inflammation is short lived and typically resolves within 7 days.

Studies investigating the systemic inflammatory response generally report use of both hand and ultrasonic instruments in combination. When used individually, both types of instruments have been shown to significantly improve the clinical status of patients with equal efficacy. Although the clinical outcomes are similar, several studies report lower treatment times using ultrasonic instruments in comparison with hand instruments. A positive correlation between treatment time and CRP levels 24 hours after treatment has been reported.

For all patients of the Johnston et al. (2020) study, serum CRP increased at day 1, with no differences between hand and ultrasonic groups. There was no difference between groups in IL-6 or TNFα at day 1. Inflammatory markers returned to baseline levels by day 7. Treatment resulted in equal and marked improvements in clinical parameters in both groups. However, total treatment time was on average shorter for ultrasonic instrumentation. The authors concluded ultrasonic instrumentation resulted in shorter

[2] Refer to Episode 20 and corresponding Keynotes and Resources for information on clinical attachment loss (CAL) and its calculation

treatment time with comparable clinical outcomes. Levels of serum CRP at day 1 were similar following debridement with hand or ultrasonic instruments. [10]

Petsos et al. (2020)

Research was published in July 2020 by Petsos et al. in the *Journal of Periodontal Research* to evaluate tooth loss during 10 years of supportive periodontal therapy in patients who are periodontally compromised and to identify patient-related factors influencing tooth loss and periodontal tooth loss.

The retrospective cohort study identified 100 patients with periodontitis who received comprehensive periodontal therapy including nonsurgical and surgical management as well as supportive periodontal therapy (SPT). Patients were re-examined approximately 10 years after active therapy, and the influence of various known risk factors on tooth loss was reported. Mean tooth loss was 0.12 teeth/patient/year; fewer than half of the teeth were lost due to periodontal disease (0.04 teeth/patient/year), with significantly more teeth lost due to non-periodontal reasons. Smoking, baseline severity of periodontitis, nonadherence to SPT, positive interleukin-1 (IL-1) polymorphism, among others, were identified as patient-related risk factors for tooth loss, with smoking having the strongest impact (28.6-fold increased relative risk).

The study reinforces that with appropriate comprehensive periodontal therapy, which includes nonsurgical, surgical, and supportive periodontal therapies, a high level of maintenance of the natural dentition can be achieved in patients with periodontitis. When adequately maintained, patients lose teeth more often because of non-periodontal reasons rather than from periodontal disease. An interesting finding in this study was that a low number of SPT visits (2 visits per year versus 4 visits per year) was shown to be a risk factor for tooth loss due to periodontal disease. [11]

Sanz et al. (2020)

The 2017 World Workshop on the classification of periodontitis incorporates stages and grades of disease to link disease classification with approaches to prevention and treatment and describes not only disease severity and extent but also the degree of complexity and an individual's risk. There was a need for evidence-based clinical guidelines providing recommendations to treat periodontitis. Thus, Sanz et al. (2020) under the auspices of the European Federation of Periodontology developed a clinical practice guideline for the treatment of Stage I–III periodontitis.

The targeted patient population for the guideline was individuals with periodontitis stages I to III. The guideline did not address treatment of gingivitis, stage IV periodontitis, necrotizing periodontitis, periodontitis as manifestation of systemic diseases, or mucogingival conditions.

The guideline made recommendations on topics such as oral hygiene practices, supragingival professional mechanical plaque removal, and risk factor control. They

also addressed the question ‘Are treatment outcomes of subgingival instrumentation better after use of hand instruments, power scalers, or a combination of both?’

Sanz et al. recommended that subgingival periodontal instrumentation be performed with hand or powered (sonic/ultrasonic) instruments, either alone or in combination. Their recommendation was based on the evidence that outcomes of treatment were not dependent on the type of instrument employed. They also noted that client preference may conflict with the clinician's preference in terms of type of instrument and client autonomy should be respected. Therefore, the choice of instrument should be based upon the experience, skills, and preference of the clinician together with client preference. [12]

Yan et al. (2020)

A randomized controlled trial is currently underway by Yan et al. (2020). The study is to evaluate in vivo the effectiveness of ultrasonic subgingival scaling combined with manual root planing compared to ultrasonic subgingival scaling alone for the nonsurgical treatment of periodontitis using a split-mouth design. In addition, the researchers will follow-up with the participants after 1, 3, and 6 months, to reassess plaque index, probing depth, clinical attachment loss, bleeding index, furcation involvement, mobility, and patient-reported outcomes (e.g. for pain and sensitivity). The researchers are hoping that the results will add to the body of knowledge on the treatment of periodontitis. [6]

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Additional Resources

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