

## Treating the Cause or the Effect? A Biological Versus Mechanical Approach to Therapies: Similarities and Insights Derived from Modern Management of Poliomyelitis and Dentistry

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### Abstract

**Introduction:** Therapy for pain and restoration of function, aims for optimal survival to allow reaching old age with all organs and senses intact.

**Aim:** This appraisal reviews mechanical and biological approaches to therapy of poliomyelitis, with prosthetic or biomedical approaches of treatment of dental decay and gum diseases. These two diseases were selected to highlight contrasts and similarities of thinking related to therapy. For poliomyelitis survivors with therapy that employs mechanical aids, to biological manipulation of immunity. In dentistry treatment is with tooth repair with inert metals and plastics, removable or fixed prosthesis or extraction. An alternative therapeutic approach to both polio and tooth loss is with biomedical constructs. Prophylactic management for polio is with a vaccine. Changes in oral hygiene, using fluoride to impart caries resistance, and oral biofilm-control, embraces biomedical strategies that allows for survival of natural teeth into seniority. Human suffering, costs and successful prophylaxis, facilitates optimal function with these biomedical approaches.

**Conclusion:** Although both principles dictating policies are progressive and have served mankind well, the biomedical approach is closer to ideal nature by focusing on biomedical prevention, as opposed to the stress of mechanical cures. A biological approach to human illness yield optimal reduction of morbidity and mortality.

**Keywords:** *Biomedical; Biofilm; Biomechanical; Caries; Gum-Diseases; Osseo-Integration; Exodontics; Prostheses; Poliomyelitis; Vaccines*

### Provenance and Background

Therapy of people, for the relief of pain or restoration of full function emulating nature, aims for the ideal of optimal survival, which is to reach old age with all organs and senses intact until a natural demise. The two diseases selected to highlight contrasts of thinking are poliomyelitis and caries and gum-disease. Infantile paralysis, is a disease affecting neural innervations, causes crippling growth atrophy of limbs. For poliomyelitis survivors, mechanical therapy of affected limbs employs physical mechanical aids, ranging from splints to highly mechanized computer controlled apparatus allowing for vastly improved function. Nearly all dentistry is elective to control the ravages of dental decay and gum diseases, and the final option of therapy is extraction. Subsequent physical treatment is with removable- or fixed-

replacement, ranging from prostheses to osseointegrated implants. An alternative approach to both poliomyelitis and tooth loss resides in biomedical thinking and therapy. Biological prophylactic management brought forth a polio-vaccine which prevents the atrophic disuse of limbs with loss of function. Changes in oral hygiene, strengthening teeth with fluoride, and biological management of oral biofilm, allows for pristine survival of natural teeth into seniority.

### **Aim of the Study**

This appraisal compares and highlights mechanical and biomedical thinking that influences choices of therapy and subsequent medical management of poliomyelitis, dental decay and gum diseases.

### **Poliomyelitis**

**Pathogenesis:** Poliomyelitis is caused by a single stranded, RNA, picorna, neurotropic virus that effectively destroys the motor nerves in the spinal column that supplies muscles. There is a high rate of mutation in RNA-Picorna viruses, which makes the procurement of a vaccine very challenging. During the early 20<sup>th</sup> century paralyzing poliomyelitis was among the most feared diseases in the industrialized world. Contaminations were through infected foods or water and although it was assumed only young people were infected; later research revealed that everybody regardless of age could be affected. Viral-infection was located in the anterior horn cells of the spinal-cord dorsal-root-ganglion, motor-neurons innervating skeletal muscle cells and lymphoid cells. The virus is ingested with contaminated food or drink, settles in the lymph nodes of the tonsils, the neck and then the epithelium of the gastrointestinal tract. Most infections will be asymptomatic should the infection spread no further. Over 90% of polio virus infections cases resolve without further complications, but should the virus enter the bloodstream, it can be transported to the central nervous system where it selectively attacks neural cells. Innervated muscles from affected neurons undergo atrophy and consequent paralysis. Although this outcome is rare, it will infect 0.2 to 2% of unprotected people, and the neural damage is all too frequently permanent with tragic results [1].

**Therapy:** Modern sanitation practices helped in reducing the prevalence of infection, but infections were still present in under developed communities. Paralysis of the phrenic nerve interfered with automatic respiration, and people were kept alive with artificial means, namely in compression chambers called, the “iron-lung”, which assisted in respiration. Mechanical aids- were devised to help supplement remaining residual limb movement. Infected survivors of the poliovirus had individualized metal exo-skeletons and support- splints, constructed and fitted to assist atrophied and paralyzed muscles of victims with mobility, and acquisition of improved function. Metal and leather strapped support were devised to assist in mobility with affected limbs [2]. Applying biomedical, rather than biomechanical principles and thinking changed policies of approach and management of poliomyelitis infections and consequent disease. Initially, alive, attenuated polio-viruses were used as an antigen. Three polio-viral strains covered most of the neurovirulence of the naturally occurring variant and could be easily administered orally in a small drop on a sugar cube. However, an inactivated polio-virus was subsequently used as an antigen; this had to be injected intramuscularly [3].

### **Tooth-decay and gum diseases**

#### **Pathogenesis**

The most common diseases affecting Mankind is dental caries and gum disease. Consequent tooth loss affects health survival and longevity. The ideal hope is for people to reach their demise with a full complement of healthy functioning teeth. Tooth decay starts as a locus under stagnating biofilm on teeth that decalcifies tooth material. With bacterial action cavitation follows with progressive carious destruction of the tooth crown. Continuing caries will invade the pulp and root canals which opens pathways for peri-apical and intra-

osseous infectious complications like granulomas, abscesses, cyst formation, sinusitis or osteomyelitis. All biofilms are not the same. Oral bacteria exist in sessile and planktonic forms, and stagnation allows for a slow but progressive change of characteristic early biofilms to develop acids toxins, enzymes, antigens and mitogens which react with soft tissue elements around the teeth to develop gum disease. Most people suffer from gingivitis, but only about 30% of people, vulnerable to perio-pathogens, will develop periodontitis. Periodontitis allows an inexorable loss of attachment from the tooth to the supporting jaw-bones, such that the tooth will eventually be lost. Edentulism is a global problem and although many teeth are lost from caries destruction, more teeth are lost to gum disease [4,5].

## **Therapy**

Removal of a tooth by exodontia is still regarded as the final panacea for curing a tooth ache. Arresting pain deriving from a tooth may be effective, but the loss of function of a tooth is not reversible by natural healing. Dental-decay as an acquired infection that creates tooth-cavities; treatment involves removal of decay, and replacement with conformative and restorative materials and techniques. Preparing teeth to accept repair is painful. "Fillings" of amalgam, metal and plastics, and creation of inlays, onlays and crowns, is challenging, expensive and costly. Caries invading the pulp infects root canals which subsequently demands endodontic sterilization and root-canal therapies and peri-apical infections are treated with apicoectomies. Other peri-apical intra-osseous pathologies may develop and consequently demand specialist treatment for cures. After exodontias, partial or total edentulism relies on constructing and fitting prostheses. Removable partial and full dentures, improves appearance, and replaces and improves some lost functions (smiles, speech and mastication). Fixed partial-prostheses [as fixed tooth-supported crown-and-bridge work] are more successful, but usually demand more skill, time and cost than removables. The ultimate fixed biomechanical replacement of lost teeth is by osseointegrated implants. Receptor holes are drilled through the gums into the jaw-bones and metal (usually titanium) screws are engineered to fit snugly into the open passages, that are placed accurately into pre-determined positions. Dental super-structures are fitted onto the implants immediately to ensure a perfect fit. Initial modalities demanded a healing- period, but now (2020), full-arch upper-, and lower-dentitions, with complete form and function, may be restored and completed in one major operative session. And besides providing vastly improved appearance, will also establish a functioning occlusion, facilitate speech, mastication, and deglutition. Bone augmentation by bone-graft is a frequent prerequisite for placing the implants but all this is measured, assessed and planned for execution with a computer imaging techniques. An examination, treatment-planning, execution and cost all need to be optimal to realize full success with this approach. Despite this enormous leap in biomechanical therapeutic prosthodontics, those who have full fixed rehabilitations, most still lament the loss of their natural teeth and would choose their own natural teeth over the constructed dentition. Disclosing solutions allows everybody to visualize biofilm on their teeth. Oral Hygiene techniques are easy to learn and integrate into healthy living. Fluoridated water has proved most effective at inhibiting the start of caries and the developing of tooth decay. Oral biofilm containment, control and elimination have proved to be the most effective preventive biomedical measures against caries and gum diseases. Between home-care and regular visits to the dentists, stagnation of biofilm is eliminated. Regular biofilm removals by brushing, flossing and oral rinsing are almost totally effective at arresting the development of both decay, gingivitis and periodontitis. Consequently, an ever increasing number of people are retaining their own natural teeth all their lives. Searching for prophylactic vaccine to inhibit colonization and growth of the major bacteria in initiating decay and biofilm has been a biomedical quest for decades; some success has been achieved experimentally in animals, but the poly-microbial nature of biofilm, has blocked the procurement of an effective caries vaccine in humans [6-14].

## **Discussion**

Lifelong immunity against poliomyelitis is induced by first giving the inactivated virus residues of the polio-virus, followed by the ingestion of the live attenuated strains. Neuro-degeneration does not occur, spread of polio-virus is avoided, no consequent morbidity is manifest, and inoculated people live healthy lives with lifelong immunity into old age. Those who have survived the paralysis from the

polio-virus at a young age, face the reality of having multiple support-splints made during their growth spurts, until adulthood. Adult polio survivors need to have their prostheses and mechanical support serviced regularly to avoid breakages from metal fatigue and wear.

No mechanical therapy may be regarded as permanent, or as successful as a healthy natural developed organ. Cosmetic replacements are neither natural, nor durable for a lifetime. Biological manipulation of growth, as is done with orthodontic growth, procures excellent results. Orthognathic maxillofacial surgery may successfully correct unfortunate malformations, but most will agree a natural harmonious developed oro-facial complex, with a full set of healthy natural functioning teeth is more desirable. Most procedures in dentistry are invasive and elective. For many people, drilling, cutting and manipulating of both hard and soft tissue involves pain control. Local analgesia is in ubiquitous use, and also the use of conscious sedation and general anesthesia; all these biomechanical techniques have associated risk factors, demand specialized equipment and training and often add substantially to the cost of dental treatment. Tooth-rot is best managed over time as an individual strategy for every patient. Relative to the whole population, few people can be deemed to be absolutely 'caries free' if initial lesions and more advanced decayed cavities are considered. Currently it is self evident that on its' own, restorative treatment of tooth decay does not 'cure' caries. The decay process needs to be managed, with education about tooth maintenance and cleaning using home- and professional-cleaning, and also the collaboration of patients, to overcome the challenges arising during their lifetime. Periodontal disease as a localized destructive response induced from microbial infection in a sub-gingival periodontal pocket, demands an invasive mechanical approach (root-planing for removal of extrinsic and infected intrinsic tooth material) for arrest, healing and elimination of disease. Frank advanced periodontal disease is a strong aggravating factor, and a probable risk factor for systemic diseases which include diabetes mellitus, cardiovascular diseases and pre-term low birth weight infants. Although many advances in comprehending the epidemiology, etiology, pathogenesis and microbiology of periodontal disease with revolutionary treatment protocols and strategies preventing the onset of any gum disease is deemed preferable to having to undergo periodontal treatment. There are recent successful developments in the field of intra-pocket mechanical root-planing and local drug delivery systems to promote reattachment and avoid periodontal surgical therapies, but nothing among these mechanical invasive procedures is better than retaining the intact attachment apparatus of a healthy pristine periodontium. Due to the poly-microbial etiology, and the vast array of pathogenic microbes in invasive climax bacterial communities of periodontal pocket biofilms, no vaccine against periodontitis has ever been produced.

### **Concluding remarks**

Plagues, pandemics, diseases and mysterious ailments have affected mankind for millennia. When the cure of a disease is worse than the cause re-assessment of such cures is essential. Mechanical thinking revolves around superficial management of effects. Deeper, more demanding, comprehension, interpretation and application of complex and abstruse biomedical theories are necessary to realize innovative approaches to biological scourges that affect mankind. Necessity does find solutions, but things take time, perseverance, and creativity, understanding and pragmatic interpretation. A biomedical cure as a solution to pathological disease problems will always be better than compensatory fixes with mechanical amelioration.

### **Conclusion**

Although both principles, biomechanical and biomedical dictating policies are progressive and have served mankind well, the biomedical approach seems more preferable and much closer to optimizing nature. A biological approach to human illness yields optimal reduction of morbidity and mortality. Prevention remains better than cure.

### **Author's Statement**

The author has no conflict of interest to declare.

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