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Review Article

The Hand and Manual Grips in Dentistry

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Abstract

Hands evolved from fish fins. Hand-held dental instruments have been used since ancient times. Advanced power-driven tools demand refined manual skill.

Aim: Reviewed here are classical manual grips used in executing dentistry. Skill combined with manual grips facilitates complex dental restoration and rehabilitation. Reviewed here are common hand-grips in ubiquitous use of dental hand-held instruments, Digital and wrist positions for activation are appraised and implications for use of a robotic hand in future. Skill combined with manual grips facilitates successful complex dental restoration and rehabilitation.

Keywords: Computer; Hand; Grips; Manual-Skills; Dexterity; Mechanical-hand; Robots

Abbreviations

CE: Common Era; BC: Before Christ; HHDI: Hand Held Dental Instrument; TIG: Thumb Index Grip; PG: Pen-Grip; MPG: Modified Pen-Grip; IMPG: Inverted Modified Pen-Grip; ITG: Index-Thumb Grip; MITG: Modified Index Thumb Grip; BMSG: Bimanual Support for Grips; MHCW: Medical Health Care Worker; DHCW: Dental Health Care Worker; RPM: Revolutions Per Minute.

Introduction

The human hand is a complex mechanical organ constituted by a palm, a wrist and five digits. These anatomical structures are made up of bone, sinews, fibres, muscle, lymphatics, blood vasculature, an intricate network of nerves from the ulnar and radial nerves, all enveloped by skin and nails. The evolutionary origin of two hands (left and right), each with four fingers and one thumb evolved through millennia from anlage traced back to the bilateral anterior dorso-lateral fins of fish [1,2]. The conventional names of the five digits of the outstretched-hand are (from lateral to mesial) the thumb, the index-, middle-, ring- and pinky-fingers These digits are attached to the palm, which is connected to the wrist, which articulates through carpal and wrist bones with the radius and ulnar bones of the arm. The composite multiparts of the hands allows for complex movements and digital actions [3-5]. Yet these manual digits and actions determine limits, control and constraints in the practice of modern 21st century dentistry.

Use of manual instruments to execute dental therapies and activities including cleaning, restoration, replacement or exodontia, have been in the armamentarium of practitioners since ancient times. Illustrations with surviving examples of these instruments survive and are on show in variousmuseums.[1] Most dental cutting tools were designed as hand-held dental instruments (HHDI) for manually powered use. Mechanical hand-and/or-foot driven hand

pieces were extensively used until 1914-1918 C.E, World-War-One, after which electric drills were introduced. Mechanical hand-and/or-foot driven hand pieces were replaced by electric motor belt driven machines reaching 5000->8000 revs-per minute (rpm) [6,7]. Subsequent introductions of the air-rotor turbine, with 80000->100 000 rpm's markedly improved cavity preparation under a stream of cooling water.

Dental scalers and curettes are basic scraping hand instruments for cleaning or treating teeth. Scalers have pointed, hook-like tines for removing mainly extrinsic supragingival dental deposits, (above-gum, calculus, stain and debris), whereas curettes have rounded, spoon-shaped tips, which are safer for removal of intrinsic subgingival (below-gum tooth material, infected or toxin affected cementum, dentin and rarely enamel). Scalers and curettes have different designs to reach all areas of the tooth, especially cervical areas and exposed roots. Accordingly, scalers remove extrinsic tooth material, and root-plaining is removal of intrinsic tooth material. Scaling, root plaining, and gingival curettage is achieved using hand held dental instruments (HHDI) [8-11].

Scalers and curettes were supplemented by ultra-sonic Magneto-strictive and Piezoelectric Ultrasonic Scalers [10,11]. These ultra-sonic instruments are also water cooled. All these devices and pragmatic ordinates are used ubiquitously, but descriptions of different basic manual grips to hold for use with description of kinetic movements used are exiguous.

Aim

Described here are six basic manual-grips used in dentistry: The thumb-index-grip (TIG); The pen-grip (PG); the modified pen-grip (MPG); the inverted modified pen -grip (IMPG); the Middle-index-thumb grip (MITG) and the modified middle-index-thumb grip (MMITG)**.** Outlined are digital, manual leverage loci with movements, to execute conceptual kinetic musculo-skeletal control. Also indicated is a mechanical, remotely controlled and robotic-device which mimics hand movements.

There are six basic hand-grips

A picture is worth a thousand words. Accordingly, see Figures 1-7 below.

The thumb-index grip (TIG); Figure 1.

Figure 1: The Thumb-Index Grip (TIG). This TIG is used for delicate actions; like adding some medication to a small area, or placing some material into a specific spot. The arrow indicates the applicator tip. Endodontists use the TIG frequently when manipulating endodontic instruments like reamers or endo-files.

The pen-grip (PG); Figure 2.

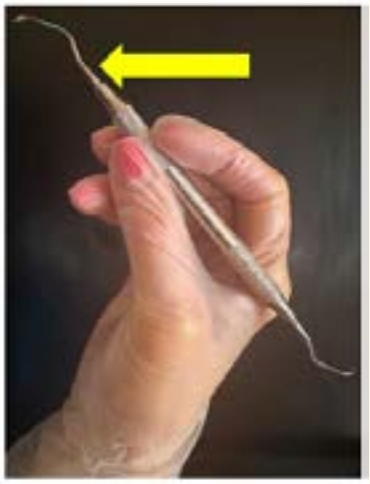

Figure 2: The typical Pen-Grip: Arrow working tip. The PG is the most common grip used for scaling, root-plaining, and holding drills or other HHDI's, as dental ordinates. It is a common grip used to direct cavity-prep cutting with a high-speed drill.

The Modified Pen-Grip (MPG); Figure 3.

Figure 3: The modified Pen-grip (MPG): Arrow working tip. The MPG is used for scaling and root-plaining. The arrow indicates working tine. Different sets of curettes for example Gracey curettes, are commonly used with this MPG.

The inverted modified pen-grip (IMPG); Figure 4.

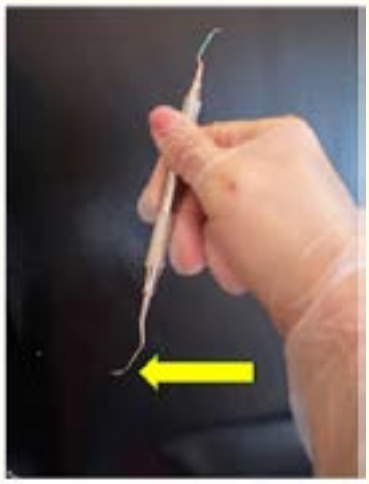

Figure 4: The inverted modified Pen-Grip (IMPG): Arrow working tip. The IMPG is used for scaling and root-plaining, especially on the posterior of the lower anterior incisors. This IMPG is similar to, but slightly different from MPG. The operator starts by pointing the working tip away from self, then rotating the working tip 180o, to point to self to perfect the grip.

The middle-index-thumb grip (MITG); Figure 5.

Figure 5: The middle-index-thumb grip (MITG): This HHDI is held mainly in position by the thumb and index, supported by the other digits. The Arrow indicates the working tip. The MITG is a powerful grip and used when strong force is needed. This grip is used commonly to hold extraction forceps for the lower dentition.

The modified middle index thumb grip (MMITG); Figure 6.

Figure 6: The modified middle index thumb grip: The HHDI is supported by the middle digit and held by the index and thumb. The arrow indicates the working tip. The MMITG is also very powerful grip used when strong force is needed. This grip is used commonly to hold extraction forceps for the upper dentition.

Bimanual support for grips. (BMSG); Figure 7.

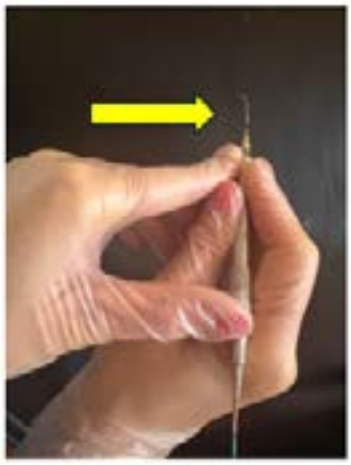

Figure 7: Bimanual support for grips (BMSG): Both hands are placed for support, stability and strength. The arrow indicates the working tip. The digits are placed together to anchor the grip and secure a firm grip on the working instrument.

Movements and leverage

Most DHCW's are right-handed and remain seated while working.

Many prefer standing especially for extractions and dentoalveolar and maxilla-facial surgeries. About 10% of people are left-handers, and many train their right hand, ab initio. to be ambidextrous. Most M/DHCW's move and position their hands reflexly to hold instruments. Reorienting body-position, arm and hand placing will be determined by establishing a clear line-of-sight for eye-brain-hand coordination. With dentistry the operator will place their dominating operating hand onto the chin or facial area in conjunction with a hand-held mirror in the opposite hand, which facilitates lip-mouth retraction for visual and instrument access. Often anchorage is secured by placing the middle finger of the operating hand onto the occlusal/incisal surface of the teeth being treated. This anchorage is important and facilitates the action.

There are at least three basic movements:

- Digital extension and flexion.
- The wrist drop movement,
- Bimanual coupling.

Digital extension and flexion

The working movements include digital movements to-and-fro, with the cutting edge of the instrument working in the selected desired direction. It is frequently used for scaling and root-plaining.

The wrist drop movement

The whole wrist acts as a pivot and the whole hand with a fixed grip is moved to obtain the movement needed with the cutting instrument. It is also frequently used for scaling and root-plaining.

The bimanual coupling movement involves moving the two hands in unison, in a locked movement. This reduces manual fatigue and is a strong movement.

Discussion

The produced outcomes of dentistry demand knowledge, discipline, learned skill and manual dexterity; but the human hand anatomy dictates the limits of manual movements, and what the empty digits can achieve.

The dental manual instruments are specially designed and engineered with specific shaped tips, and can be regarded as specialized extensions of digits. The intention, purpose, knowing the practical pragmatic effects and limitations are achieved with eye-hand co-ordination by holding and gripping the HHDI's as hand- held specialized instruments. The actions demand musculo-skeletal skills, control, co-ordination and understanding of all the basic grips which are learnt and acquired with practice [11].

All movements are accurate results originating from conceptual thinking of the mind, with the hand deemed as an extension of the brain. Accordingly, Human hand-held instruments are extensions of the brain [18]. The way the instrument will execute function with movement is determined in the brain. The hand does with the instrument working-tip what the executive motor cortex of the brain dictates [4,5,18].

Grip strength and hand-shakes

The manual grip-strength decreases with age [15,16]. Dentists probably have strong grips because they exercise their hands and grips regularly throughout their working careers.

Handshakes are recorded in ancient history from as early as 9th Century BC in Assyria. Handshakes between people are a

ubiquitous globally accepted habit. The hand-shake originates from extending the right hand out in friendship as a confident greeting gesture to show it will not be used to grab a weapon. A firm grip with a handshake is alleged to reflect a strong character [16,17].

Usually, the contralateral cerebral hemisphere activates motor control of an upper limb. About 90% of the general population are right-handers. Hand grip strength is linked to various influencing factors such as cortical activation asymmetry, lateralization of cortical manual preference, the reflex use of the dominant or non-dominant hand, and the type of task performed. Manual laterality determines that the dominant hand has a stronger grip [18,19].

Grip strength decreases in old age, and may contribute to early retirement of M/DHCW [20-22].

Concluding Remarks

All medical Dental Health Care Workers (M/DHCW's) hands demand care and maintenance, to function optimally. This is achieved by implementing hand-hygiene practices. Human hands are not sterile, but harbor an ongoing dynamic dermal microflora ecosystem. When practicing dentistry hand-hygiene is important, and besides washing, scrubbing, nail-cleaning and drying pre-operatively, the essential use of sterile barrier gloves ensures no cross-infection of microorganisms. Donning protective gloves have now become routine in practice. So much so, that if a M/DHCW's inserts an ungloved hand into any human orifice, it may be regarded as an assault on the individual [12,13].

Because manual skills are initiated and controlled by the brain, mechanical and electric engineers have created a five-digit mechanical robotic hand, which can be programmed to execute complex manual actions. This remote-controlled robotic hand with five equally articulated fingers exists. This not only may have a possible future role in replacement hand-prosthetics and for industry, but also in the practise of dentistry [14]. More research is needed to investigate how manual grip strength in M/DHCW's, especially dentists, develops.

Conclusion

The hand is a complicated multifunctional organ and HHDI's are controlled by the brain. Specialized grips maximize, optimize and facilitate instrument use in Dentistry.

Conflict of Interest

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Data Availability Statement

Not applicable.

Ethical Statement

The project did not meet the definition of human subject research under the purview of the IRB according to federal regulations and consequently is exempt.

Informed Consent Statement

Informed consent was taken for this study.

Authors' Contributions

The author is the sole writer and accepts full responsibility for the content.

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