RELATIONSHIP BETWEEN HAND GRIP MUSCLE STRENGTH ON TOOTH BRUSHING RELATED TO DENTAL ABRASION

(HUBUNGAN ANTARA KEKUATAN OTOT GENGGAM PADA SAAT MENYIKAT GIGI DENGAN ABRASI GIGI)

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JHDS.unjani.ac.id/jite
Doi: 10.54052/jhds.

Article History
Received:31/07/2023
Accepted: 20/08/2023

ABSTRACT

Grip muscle strength in toothbrushing influences the brushing results. The strength has side effects, too, such as tooth abrasion. This study aims to systematically evaluate the results of tooth surface disappearance appraisal from toothbrushing in vitro and in vivo. Research methods performed by literature review with database articles search from *Clinical Trials*, *Google Scholar*, *Cochrane Library*, Pubmed, *The International Clinical Trials Registry Platform* (ICTRP), CINAHL with keywords. Articles were based on year, title, abstract, and full text and processed to final review. This research parameter utilized Optical profilometry from study designs: crossover and cross-sectional. Two full-text articles have been chosen, including inclusion criteria, and processed for final review. The study from Bizhang *et al.,* abrasive toothpaste and toothbrush strength 2N, proves that manual toothbrushes have significantly less lead abrasion—manual toothbrush with wavy brush head 2.50(±0.43). Hara *et al.,* reveal regimen B

(erosion+toothbrushing with fluoride) day 28 (0.77±0.79) showed less loss of enamel surface than regimen C (erosion+toothbrushing without fluoride) day 28 (2.20±1.96). Prospecting the articles about the abrasion effect from toothbrush strength that are appropriate with the aim of study is still limited relating to abstract, full text, and keywords. The evaluation value of particular toothbrushing power will increase oral dental health without leading to severe abrasion risk on the dental surface.

Keywords: grip muscle strength; tooth abrasion

ABSTRAK

Kekuatan otot genggam dalam menyikat berpengaruh dalam hasil menyikat. Kekuatan tersebut berefek samping abrasifitas pada permukaan gigi. Penelitian ini bertujuan untuk mengevaluasi secara sistematis hasil studi in vitro dan in vivo menggunakan penilaian kehilangan permukaan gigi dari pengaruh penyikatan gigi. Metode penelitian ini dilakukan secara literatur review dengan mencari artikel dari database Clinical Trials, Google Scholar, Cochrane Library, Pubmed, The International Clinical Trials Registry Platform (ICTRP), CINAHL dengan menggunakan kata kunci. Semua artikel dipilih berdasarkan tahun, judul, abstrak, teks lengkap, dan terakhir, semua artikel yang dipilih diproses untuk review final. Parameter penelitian menggunakan Optical profilometry dari desain penelitian crossover dan cross sectional. Artikel dengan teks lengkap terpilih sebanyak 2 artikel yang sesuai dengan kriteria inklusi dan diproses menjadi review final. Penelitian Bizhang, et al., penggunaan kekuatan sikat gigi (2N) dan pasta gigi abrasif, membuktikan sikat gigi manual signifikan lebih sedikit menyebabkan abrasi. Sikat gigi manual dengan kepala sikat bergelombang 2.50(±0.43). Hara, et al., mengungkapkan rejimen B (erosi + menyikat gigi dengan pasta gigi berfluoridasi) hari ke-28 (0.77±0.79) menunjukkan kehilangan permukaan enamel signifikan lebih rendah dibandingkan dengan rejimen C (erosi+menyikat gigi

dengan pasta gigi non-fluoridasi) hari ke-28 (2.20±1.96). Pencarian artikel mengenai dampak kekuatan menyikat terhadap abrasifitas dengan abstrak, teks lengkap dan kata kunci yang sesuai dengan tujuan penelitian ini masih sangat terbatas. Evaluasi nilai kekuatan sikatan tertentu akan menigkatkan kesehatan gigi dan mulut tanpa menimbulkan resiko abrasivitas permukaan gigi yang parah.

***Kata kunci**: abrasi gigi; kekuatan otot genggam*

INTRODUCTION

Toothbrushing is one way to increase oral dental health for individuals or populations.[1] Toothbrushing in dentistry is effective prevention to eliminate dental plaque to decrease the matters of oral dental health.[2] The result from Riset Kesehatan Dasar (Riskesdas) 2018 is that the proportion of daily toothbrushing behaviour in the population is 94.7%; however, 2.8% of the population toothbrushing with the right time and behaviour.[3]

The Elements related to the toothbrushing process are bristle design, toothbrush technique, and frequency or duration of toothbrushing.[4] Many factors that its use correspond to individual uses. Among others is a grip muscle strength, essential in describing individual hand motoric ability so it affects the results of toothbrushing in manual or electric.

Hand grip strength can be influenced by several factors that impact grip muscle strength in humans. A number of studies reported in the literature identified gender, age, body mass index (BMI), and occupation as factors that can affect grip muscle strength. Grip muscle strength in toothbrushing can affect the abrasiveness of the dental surface or gingival recession. Several pieces of literature about abrasiveness from toothbrush from database has been published. However, a rapid review has not yet evaluated between grip muscle strength and the impact on abrasiveness. Based on the explanation presented, this article aims to assess the result of the study in vitro and in vivo by appraisal of the loss of dental surface that is impacted by toothbrushing with the literature review method.

METHOD

A literature review was the design of this study. This design constitutes a research method that collects data on an

issue from any literature sources. It could be a scientific research journal, previous research manuscripts, or textbooks related and could answer several samples of scientific research journals used in this study. The overview is explained in PRISMA statements (The Preferred Reporting Items for Systematic Reviews and Meta-Analysis).

Selected articles language in English from 2013 – 2023 also specialized topics about hand strength and how toothbrushing could result in tooth abrasion. The article must be full text and not only abstract displays. Search the literature with the keywords "handgrip strength in toothbrush", "abrasive dental" or "abrasion dental". They were online using the database Clinical Trials, Google Scholar, Cochrane Library, Pubmed, The International Clinical Trials Registry Platform (ICTRP), CINAHL, an assessment from selected article data related to dental surface disappearance.

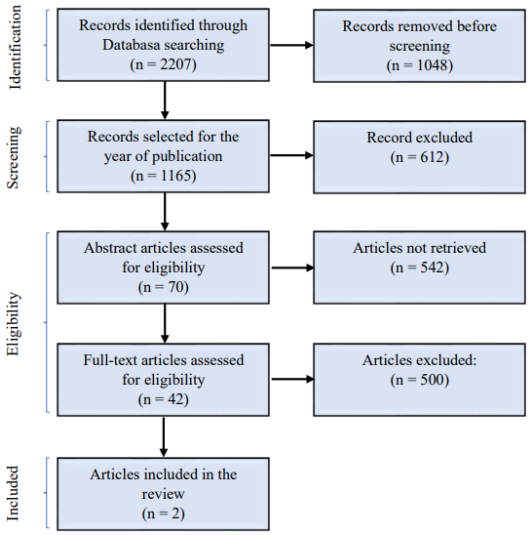

Figure 1. Flowchart of the study selection process

RESULT

The number of articles searched for 2207 was selected based on identifications, year which has been specified, keywords and abstract. Article with full text has been chosen as two articles, which were adjusted with inclusion criteria and have passed to the final review. Two articles selected had research methods with crossover and cross-sectional designs. The first article from Bizhang et al., which investigated the use of toothbrushing strength 2N and abrasive toothpaste, proved significantly that manual toothbrushing had less produce abrasion than electric toothbrushes throughout 8.5 years. The highest dentin abrasion occurs in sonic toothbrushes, 21.03(±1.26) and the lowest in manual toothbrushes with rippled-shaped brushes, 2.50(±0.43).[7]

No.	Author (year)	Study design	Number of samples	Parameters	Results	Rank
1.	Bizhang, *et al.*[5] (2017)	Crossover	50 round-shaped human enamel slabs (of 3 mm diameter and 2 mm thickness) were cut from permanent molars Subject: 16 adult volunteers (10 women and 6 men), 46–81 y.o	Optical profilometer (Proscan 2000; Scantron, Taunton, UK) with an accuracy of 0.1%, a <0.3 lm (14)	Enamel loss (µm) 1. Regimen A (Phase 1) • 7d: 0.14±0.24 • 14d: 0.07±0.30 • 21d: 0.21±0.21 • 28d: 0.05±2.42 2. Regimen B (Phase 1) • 7d: 0.36±0.23 • 14d: 0.44±0.37 • 21d: 0.80 ±026 • 28d: 1.26±0.46 3. Regimen C (Phase 1) • 7d: 0.87±1.02 • 14d: 1.44±2.31 • 21d: 2.36±2.52 • 28d: 2.36±2.70 4. Regimen B (Phase 1+2) • 7d: 0.22±0.28 • 14d: 0.17±0.47 • 21d: 0.41±0.57 • 28d: 0.77±0.79 5. Regimen C (Phase 1+2) • 7d: 0.96±1.01 • 14d: 1.36±1.62 • 21d: 1.98±1.93 • 28d: 2.20±1.96	Q_2
2.	Hara, *et al.*[6] (2014)	Cross-sectional	72 extracted human molars were used to generate cylindrical dentin specimens (6 mm in diameter and 2 mm high) were prepared using a tre- phine bur	Optical profilometry (InfiniteFokus G3, Alicona, Graz, Austria) with the corresponding software (IFM 2.2)	Dentin loss (µm) • Sonic toothbrush 21.03(±1.26) • Oscillating-rotating toothbrush 15.71(±0.85) • Manual flat-trim toothbrush 6.13(±1.24) • Manual rippled-shaped toothbrush 2.50(±0.43)	Q_1

The second article from Hara *et al.* reveals that fluoride toothpaste could decrease lesion development. It caused regimen B (erosion + toothbrushing with fluoride toothpaste) day 21 0.41±0.57); day 28 (0.77±0.79) showed less enamel surface disappearance significant than regimen C (erosion + toothbrushing with non-fluoride toothpaste) day 21 (1.98±1.93); and day 28 (2.20±1.96). Different time, day 7 and 14 has minor alteration from the beginning when compared to day 21 and 28. There are more surface disappearances on day 28 than on day 21 (P=0.03).[6]

Besides, toothbrushing with fluoride toothpaste has a profitable result reported in 2 of 2 articles (100%). Another essential variable, such as the influence of toothbrush strength not evaluated, different characteristics and saliva composition between subjects that can explain the observed variety in enamel wear.

DISCUSSION

Toothbrushing is an important thing that people should do to maintain dental oral hygiene. Manual or electric is the way and can be chosen for brushing teeth. The manual method has more techniques, such as a vertical (Leonard's method), horizontal, roll technique (Modified Stillman/*rolling stroke*), vibratory technique (Charter's, Stillman, and Bass), circular technique (Fones method), physiological technique (Smiths method) and scrub brush method.[4] Much research explains the different toothbrushing movements in manual and electric.

Brushing power will be

comparable to hand grip muscle strength when toothbrushing. In several studies, brushing strength ranges between 0.9 N, 1.7 N, 2.5 N, 3 N, or 4 N used on electric toothbrushes. While manual toothbrushing strength ranges between 1.6-3.23 N.[8,9] However, hand grip muscle strength could be influenced by gender, associated with a bigger musculoskeletal structure in males, causing testosterone hormone.[10,11] Whereas age relates to mass development and muscle fibre quantity. Muscles will continue to develop in teenagers to adults, while the mass and fibre muscle quantity in older people will decrease.[12]

Physical activity creates a load that stimulates muscle structure alteration, specifically increasing muscle mass to support the body's accepted workload.[13,14] Body Mass Index (BMI) or complication risk factors correspond to nutrition, especially protein. Protein is the substance required in muscle cell mass formation in the human body. Consequently, the mass increases correspondingly to muscle strength, which can also increase hand grip muscle strength.[15,16] Handgrip dynamometer is a device used to measure hand grip muscle strength. It is intended to measure hand maximum strength and muscle weakness in kilograms or Newton.[17–19]

Hand grip strengthened, and the way brushing teeth related to each other. Toothbrushing is a cleaning activity to eliminate dental plaque and increase oral health. Nonetheless, its action involving toothbrush and toothpaste could lead to dental wear if done rashly to abrasion.[20,21] A Study from Bizhang *et al.* revealed that brushing strength with value 3 N, which determines factor in non-caries lesion development[21], induces higher dentin disappearance. A radiotracer method is a device to measure abrasiveness level known as Radioactive Dentin Abrasivity (RDA).[7,22] Dentin abrasion significantly increases on value 1 N, 2 N, to 3 N ($p = 0.04$ for RDA 71, $p = 0.002$ for RDA 85 and $p = 0.01$ for RDA 133).[9] Furthermore, dental surface disappearance measurement can be scanned using optical profilometry, which has accuracy, precision and detection limits to standardize manufacturing products.[5,6]

Hara *et al.* experiment uses optical profilometry to evaluate dental surface disappearance. The method was 4x4 mm of surface that consisted of metal reference and enamel surface scanned by specific software (Proscan 2000; Scantron), enamel depth area calculated that related to the reference surface. The average value obtained from average duplicates per subject uses statistical analysis.[6] Study f Bizhang *et al.,* the average of surface

disappearance 21.03 (±1.26) μm for sonic toothbrush, 15.71 (±0.85) μm for oscillating-rotating toothbrush, 6.13 (±1.24) μm for flat trim brush head toothbrush, and 2.50 (±0.43) μm for rippled-shaped brush head toothbrush.[5] Wiegand *et al.* explained that the average toothbrushing strength in the manual was about 1.6 ± 0.3 N, while in the sonic toothbrush, 0.9 ± 0.2 N. Manual toothbrush reported the highest dentin abrasion but lowest on enamel surface.[8]

Sonic or manual toothbrush effected higher dentin abrasion than enamel surface. However, toothbrushing could impact enamel if toothbrushing strength reaches 3.5 N.[8] Dentin abrasion caused by toothbrush can be influenced by filament stiffness, bristle design, and toothbrushing movement, besides the strength itself.[8,9] According to FV Teche *et al.* and Dyer D *et al.*, fine bristles are more flexible, causing bristle areas that contact the dental surface to increase surface disappearance. More delicate, flexible bristle and toothpaste application can create more significant surface disappearance as, known as abrasion.[20,21,23]

Fine bristle and massive toothbrushing strength compared to medium bristle can sweep the particle, creating less abrasion.[9] Crossed rows of bristle caused less dentin wear compared to parallel bristle.[21] Another argument explains that the toothbrushing experience is not always the same. A stronger toothbrushing desire in a short time is expected to create more clean dental oral hygiene. The power applied in toothbrushing has a more significant effect on producing abrasion than its speed.[24] Research from Van der Weijden *et al.* explained the efficacy of dental oral cleaning related to lower toothbrushing strength with a value ±1.5 N than ±3.5 N.[9] So, toothbrushing with "lower" power is more effective. Without the application of abrasive toothpaste, the great strength of toothbrushing decreases four times to be gingival recession than caused by fine bristle.[24]

CONCLUSION

Based on the results of the literature review that has been carried out, it can be concluded that there is a relationship between grip muscle strength when brushing teeth and tooth abrasion which causes loss of tooth surface structure. Using an optical profilometer and software, certain toothbrushing strength influenced by grip muscle can be proved significantly produce dental abrasion.

Hand grip muscle strength with involved supporting factors is expected to support toothbrushing to maximize dental plaque elimination. Using manual or

electric toothbrushes with measured strength within safe limits could increase dental oral health without producing severe abrasion on the dental surface.

CONFLICT OF INTEREST

We at this moment declare that there is no conflict of interest in the review articles that we write.

ACKNOWLEDGEMENT

Our thanks go to the professionals who have assisted in preparing papers.

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