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ORIGINAL ARTICLE

Restorative Dentistry Considerations in the Geriatric Dentistry: Systematic Review

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Background and aim

As the number of elderly people visiting dental clinics increases, it is essential to have sufficient information on the correct treatment as well as the appropriate treatment plan for these patients. Therefore, the present study aimed at reviewing the most important restorative considerations for the elderly.

Method

In this systematic review study, databases such as Pubmed, Embase, Web of Science, Scopus, ProQuest, Google scholar, as well as Iranian databases were searched with the keywords of elderly dentistry and restorative considerations. Inclusion criteria were original articles and reviews related to restorative dentistry considerations for the elderly without a time limit and being written in either English or Persian. In order to combine the results of the research, a thematic content analysis method was applied.

Results

The total number of documents recovered was 4208, the number of duplicate documents was 2042, and the number of documents reviewed was 17. The most important considerations related to the elderly included giving due attention to medical and social conditions, medication use, type of restorative teeth, level of restoration involved, use of dentures, age and gender, oral cancer screening, tooth decay education and prevention, and oral hygiene. The most important considerations related to restorative methods and materials were applying minimally invasive methods such as ART, more durable restorative materials, and giving due attention to the aesthetic and non-aesthetic needs of the elderly in choosing restorative materials. The most important considerations related to dentists were the differences in applying restorative methods and materials by experienced dentists in comparison younger dentists and the rate of referral of elderly people to dental centers.

Conclusion

The most important dental considerations of the elderly are using minimally invasive methods and restorative materials with easy maintenance which are washable according to their social, economic, medical, gender, and age conditions. It is also necessary to consider the prevention of tooth decay and provide the required training for families and their caregivers in nursing homes. The elderly people are also required to avoid change their dentists frequently to maintain their oral health.

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INTRODUCTION

The world population is ageing, transforming societies from youth-dominated age profiles to age profiles where over 20% of the population are aged above 65 years. The global ageing population has been related to the recent socioeconomic development through falling fertility rates and increased life expectancy at birth. The multimorbidity of these populations increases the difficulty of maintaining oral health for frail older adults.[1] Lack of oral health increase morbidity in this population.[2] Importance of oral health in elderly causes to educate geriatric dentistry in dental faculties in the world.[3,4]

The global burden of oral problems in elderly patients has shifted from complete tooth loss to periodontitis and untreated decays. One of the most common problems among the elderly is caries. Tooth decay has remained a major public health problem worldwide, with untreated permanent tooth decay being the most common chronic disease among the 291 diseases investigated from 1990-2010 with a global prevalence of 35% for all age groups.[5] The rate of tooth decay in the elderly is higher due to increased dental retention, and other risk factors such as gum erosion exposed to root surfaces, decreased salivation (dry mouth) and physical limitations to maintain oral hygiene.[6] Moreover, old age reduces the number of visits to the dentist for routine care.[7] This leads to untreated disease, pain and tooth loss, and reduced quality of life in the elderly.[8] In addition, access to conventional dental treatment is more difficult for poor individuals or the elderly living in nursing homes. Therefore, providing appropriate and cost-effective dental treatment for these people can be challenging. Hence, governments, policymakers, and society at large are looking for appropriate solutions to improve oral health and thus the quality of life of the elderly.[9]

Advances in periodontics and endodontics have also promoted the dentists' ability to preserve natural teeth, so that for most people today, especially the elderly, the loss of teeth isn't a complicated issue. The advent of implants in the late 1970s was another restorative solution to help dentists.[10] One study indicated that more than 60% of restorations are conducted to replace the existing fillings, especially in the elderly. Nearly 19.1% of restorations performed on the anterior and posterior teeth of people over 60 years of age are due to primary caries. Whereas, in 17-to-19-year-old individuals, this figure is 65.8%.[11] Hence, primary caries, secondary caries, concerns about tooth beauty, restorative fractures, cost, and insurance coverage are other reasons for restorations.[12]

Studies have indicated that the prevalence of oral diseases is more common among the residents of nursing homes owing to social and economic conditions and poor oral hygiene. The severity of oral disease can lead to respiratory diseases and eventually death among the elderly.[13] Given the increasing growth of old people in the world and their care and treatment needs, especially in the field of dental care, there is a growing need for cost-effective approaches and methods of treatment fitting their social, economic, and medical conditions. Therefore, recognizing restorative considerations for these people can be effective in making desirable clinical decisions and promoting oral health in the elderly. Accordingly, the researcher's search for dental literature indicated a lack of comprehensive study on restorative dentistry considerations for the elderly. Various review studies have focused more on one aspect of restoration and more frequently on the type of minimally invasive restoration.[10,14-16] Combining a set of restorative dentistry considerations and approaches proposed for the elderly in the existing texts can be effective in improving the clinical practice of dentists in order to provide desirable restorative services for the elderly community. Therefore, the present study aimed at answering this question "What restorative dental considerations are required to be taken into account for the elderly?"

METHODS

Data searches

This is an applied study conducted as a systematic review in 2021. For this purpose, the researchers have searched non-Iranian databases including Web of Science, Scopus, PubMed, Embase, Proquest, Google Scholar search engine as well as the Iranian databases such as Scientific Information Database (SID), Magiran, and Irandoc with keywords like elderly dentistry, restorative considerations, and synonymous words extracted from MESH and EMTREE.

Keyword searches

All searches were conducted in March 2021 without time and location limitations. An example of a search strategy in the Pabmed is as follows:

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(Aged[tiab] OR elderly[tiab] OR "old people"[tiab] OR geriatric[tiab]) AND (("Atraumatic Restorative Treatment"[tiab] AND Dental[tiab]) OR "Dental Atraumatic Restorative Treatment"[tiab] OR "restorative consideration"[ALL] OR "restorative considerations"[ALL] OR "dental restoration"[tiab] OR "dental restoration failure"[tiab] OR "dental restoration repair"[tiab] OR ("dental restoration"[tiab] AND permanent[tiab]) OR ("dental restoration"[tiab] AND temporary[tiab]) OR "dental restorative procedure"[tiab] OR "dental tissue conditioning"[tiab] OR "denture repair"[tiab] OR "permanent dental restoration"[tiab] OR "regenerative
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dental therapy"[tiab] OR "reparative dental service"[tiab] OR "restorative dental care"[tiab] OR "restorative dental procedure"[tiab] OR "restorative dental services"[tiab] OR "restorative dental treatment"[tiab] OR "temporary dental restoration"[tiab] OR "tissue conditioning"[tiab] OR ("tissue conditioning"[tiab] AND dental[tiab]) OR "tooth restoration"[tiab] OR "restorative care"[tiab] OR "extended care"[tiab] OR "post-acute care"[tiab] OR "skilled care"[tiab] OR "sub-acute care"[tiab] OR "subacute care"[tiab])

Sample searches in other databases and the number of search results are provided in the Appendix 1. Inclusion criteria were as follows: studies and review studies are related to restorative considerations for old people, the studies have been written in either English or Persian, there is an access to the full text of the article, and there was no time and locations restrictions. Exclusion criteria also include books, theses and dissertations, letters to the editor, editor articles, conference papers, and articles of poor quality in terms of reported findings (data are reported as incomplete) and articles in languages other than English or Persian. The quality of the articles was not evaluated due to scoping review.[17] In order to extract the restorative considerations of the elderly, a thematic content analysis method was applied.

RESULTS

The results of a systematic review of restorative considerations for the elderly are reported in Table 1. Figure 1 also shows the process of selecting studies to enter the study.

Most of these studies were conducted as clinical trials, literature reviews, and retrospective descriptive studies. Moreover, most of these studies were related to Ireland accounting for four studies, the United States with three studies, and Hong Kong. The Netherlands, Iran, Australia, Finland, Saudi Arabia, Colombia, and Singapore each accounted for one study. In general, restorative considerations in the elderly fall into three categories, which are be discussed below.

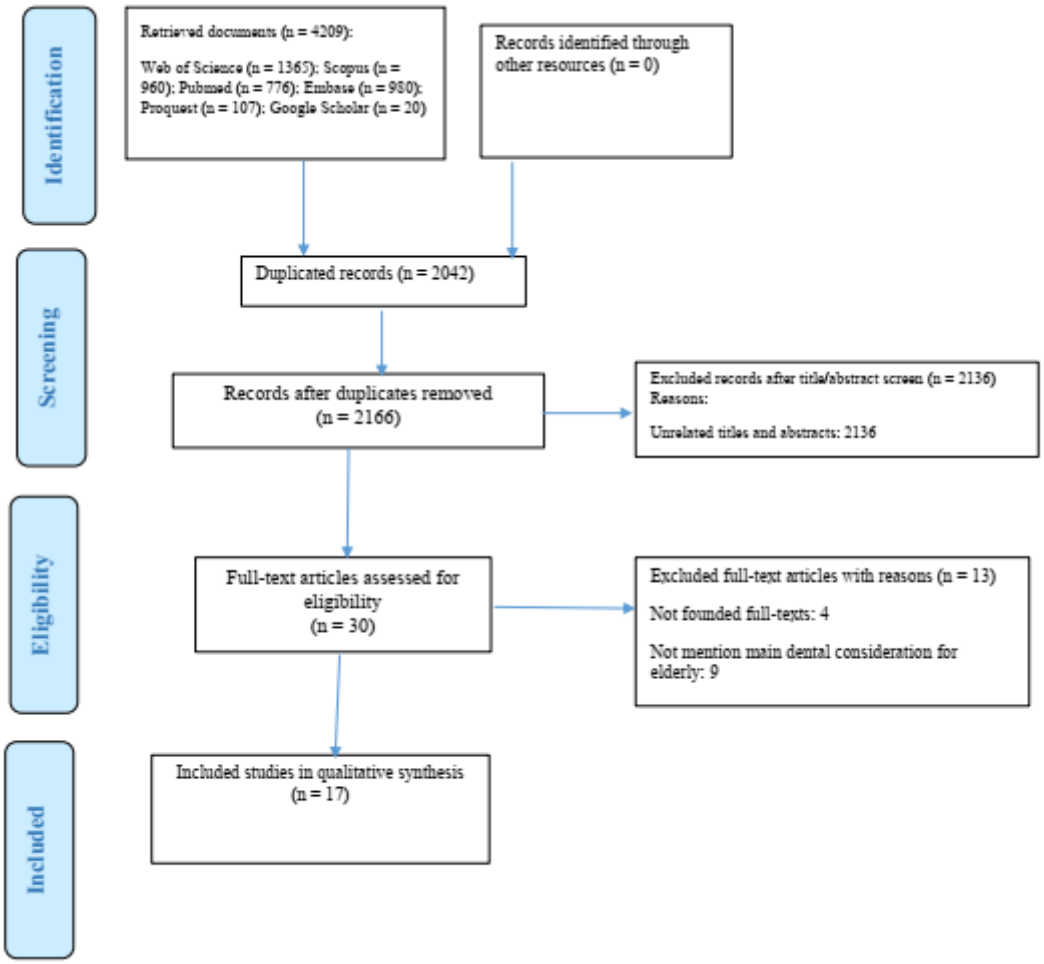

Figure 1 *PRISMA diagram of search and selection process*

Considerations related to the elderly themselves

The most important considerations that dentists are required to consider regarding the condition of the elderly include: the level of restoration involved and the type of tooth being restored[18]; presence of systemic diseases in the elderly and decreased salivation[9,19]; bone, tooth tissue, and periodontal deformities, oral cancer screening in the elderly, the elderly with lung and heart diseases, Parkinson's disease, diabetes, depression, osteoporosis, dementia, stroke, hypertension, Alzheimer's disease, dementia, medications, insomnia;[9,10,19,20] treating and eliminating dry mouth and improving salivary gland function with fluoride, treating dental diseases before radiotherapy, effect of bisphosphonate on jaw osteonecrosis, increased incidence of bruxism in the elderly, using chlorhexidine brush and sponge in patients suffering from ventilator-associated pneumonia, determining the appropriate time to remove teeth in middle age[10]; using dentures;[10,18,20] the elderly's social conditions, the elderly's unfavorable past experience in dental treatment[20]; applying a preventive approach instead of treatment, observing oral hygiene and not consuming carbohydrates, fluoride consumption, repair conditions,[10,13,20,21] age, gender, paying costs, dental arch[11,22]; the presence of a tooth opposite the restored tooth.[13]

Considerations related to restorative materials and methods

The most important considerations related to restoration methods and materials include durability of restoration, type of restoration material and size of restoration;[11,18,21] using implants for the elderly and the preference of non-invasive therapies (ART) over major surgeries;[10,19,20] applying composite and glass ionomer (longer durability of composite resin compared to amalgam), ozone therapy, lack of using implants in patients with bone necrosis[10]; conservative restoration (oral hygiene and prevention and topical fluoride)[10,23]; lack of using indirect composite resin, lack of using ceramic inlay and onlay in people with poor oral or bruxism, lack of using all-ceramihygiene c crowns in cases where beauty is not a priority for the elderly, using implant prostheses only at very old ages, lower jaw implants compared to the upper jaw implants[10]; restoration of crowns and tooth surfaces in people aged 65 to 74 years; the effect of posterior re-restoration on bone erosion, especially in men and the elderly; lack of using amalgam and composite resin in cases of advanced lesions and hard tissue loss, use of washable restorative materials, combination of restorative materials with composite resin for beauty purposes or sandwich technique, use of full veneer crowns as a preservative, not using welded joints, using high hardness castings, limited adhesive porcelain to non-pressure areas, combination of Maryland bridge and resin porcelain veneers[24]; using crown and ionomer in the elderly for restoration[22]; using ART and glass ionomer, glass ionomer modified with composite resin, using caries detection tools when using ART[13,20]; economical use of ART with amalgam[14]; using easy-to-maintain restorations, lack of using dental implants to support removable partial dentures, using SDA shortened dental arch restorative approach compared to RPD removable partial dentures[20]; more frequent use of amalgam, composite and GIC restoration materials, less frequent use of crowns or bridge holders, placement of intra-cavity restorations with initial restoration, higher crown and bridge sensor rate than other intra-cavity restorations, success of composite over amalgam and GIC in intra-cavity restorations, using bridges as the most common root canal restoration, the higher the number of restoration surfaces the shorter the shelf life, a longer shelf life of amalgam in anterior and premolars[15]; using ionomer glass in ART and ioner glass resin in conventional method, complete removal of rotten tissue before ART restoration, using ART restoration in the elderly, especially in nursing homes due to lack of local anesthesia, no pain, and using hand tools[25]; using cost-effective ART compared to CT in the restoration of elderly teeth[9,26]; the importance of controlling the moisture and the size of the cavity in the restoration and repairing rather than restoring.[9]

Considerations related to the dentist's performance

The most important considerations related to dentists include differences in dentists' restorative performance (lack of proper diagnosis, improper use of restorative materials, insufficient removal of decayed lesions, and failing to control moisture), dentist experience, and the constant change of one's dentist.[13,18,22]

DISCUSSION

The present study aimed to determine the most important geriatric restorative considerations in the geriatric dentistry through a systematic review. Most of the identified studies had been conducted by literature review and clinical trials in the United States and Ireland. The most important restorative dentistry considerations for the elderly were related to the elderly themselves, considerations related to restorative methods and materials, and considerations related to dentists.

Regarding the considerations related to the elderly themselves that dentists are required to give due attention, different authors have expressed relatively similar opinions about the health and social conditions of the elderly. Root and periodontal caries are common dental diseases in the elderly. People aged 65-74 need more crown and tooth restorations than people over 74. Re-restorations are also more likely to occur due to recurrence of caries, especially

Table 1:The features of the entered studies

Main author (Year)	Country	Population	Method	Dentistry considerations
M Laske (2016)	Netherlands	50-95 year individuals	Descriptive retrospective	- Durability of restoration - Differences in the restoration performance of dentists - The use of dentures - The amount of surface involved in restoration - Type of tooth to be restored - Type of restoration material
M Rabi'ei (2016)	Iran	-	Review	- The Existence of systemic diseases in the elderly and decreased salivation - Deformation of bones and dental and periodontal tissue - Use of implants for the elderly - Oral cancer screening in the elderly - Elderly with lung and heart diseases, Parkinson's Disease, diabetes, depression, osteoporosis, dementia, stroke, and hypertension - Preference of non-invasive therapies over major surgeries
CG Murray (2015)	Australia	-	Review	- Prevention or reduction of root canal caries in the elderly - Treating and eliminating dry mouth and improving the function of salivary glands with fluoride - Application of minimally invasive methods - Application of composite and ionomer glass - Ozone therapy - Giving due attention to systemic diseases, dementia, Alzheimer's Disease, and medications - Treatment of dental diseases before radiotherapy - The effect of bisphosphonate on osteonecrosis of one's jaw - Lack of applying implants in patients with bone necrosis - Increased incidence of bruxism in the elderly - Using chlorhexidine brush and sponge in patients with ventilator-associated pneumonia - Educating patients and their families - Using dentures - Determining the right time to remove teeth in middle age - Conservative restoration - Durability of composite resin compared to amalgam - Lack of using indirect composite resin - Lack of using ceramic inlay and onlay in people with poor oral hygiene or bruxism - Lack of using all-ceramic crowns in cases where beauty is not a priority for the elderly - Using implant prostheses only at very old ages - Lower jaw implants compared to the upper jaw implants
C.M Pine (2001)	England	16-65 individuals and older	Descriptive	- Paying attention to the conditions of tooth filling - Durability of restoration - Observing oral hygiene and nutrition in the elderly - Educating the required cares for restored teeth
GP Barnes (1986)	United States	>60 years old	Descriptive	- Restoring crowns and tooth surfaces in 65-74year-old individuals
K Hakkarainen (1980)	Finland	43 patients aged 27-45 and 42 patients aged 46-64	Observational	- The effect of posterior restoration on bone erosion, especially in men and the elderly

Main author (Year)	Country	Population	Method	Dentistry considerations
CA Wilson (2014)	Saudi Arabia	-	Review	- Conservative restoration (oral hygiene and prevention and topical fluoride) - Not using amalgam and composite resin in cases of advanced lesions and hard tissue loss - Using washable restorative materials - Combining washable restorative materials with composite resin for aesthetic purposes with a sandwich technique - Using fully veneered crowns as a holder - Not using welded joints - Using casting alloys with high hardness - Limited use of adhesive porcelain to areas lacking pressure - Combining the use of Maryland bridge and resin porcelain veneers
WS Hawthorne (1996)	Hong Kong	29 - 79 years	Retrospective study	- Use of crown and ionomer in the elderly for restoration - Dentist experience and its constant change - Patient's age and gender
AC Cruz Gonzalez (2016)	Colombia	75 elderly individuals	Semi-experimental	- Using ART and glass ionomer - Using glass ionomer modified with composite resin - Dentist performance (lack of proper diagnosis, lack of proper use of restorative materials, lack of adequate removal of decayed lesion, and lack of moisture control) - Use of caries detection tools when using ART - Lack of observing hygiene - Existence of teeth opposite the restorative tooth
C da Mata (2015)	Ireland	99 elderly, aged 65-90	Randomized Clinical Trial	- Minimal Invasive Dentistry (ART)
C da Mata(2014)	Ireland	82 elderly, aged 65-88	Randomized Clinical Trial	- Economical application of ART with amalgam
ECM Lo (2006)	Hong Kong	>60 years old	Clinical trial	- Restoring with ART and conventional methods both cause high durability of the restoration - Using ionomer glass in ART and ionomer glass resin in conventional method - Complete removal of decayed tissue before conducting ART restoration - Applying ART repair in the elderly, especially in nursing homes due to lack of local anesthesia, lack of pain, and using hand tools
P Finbarr Allen (2019)	Singapore	Non-Iranian studies	Review	- Social and medical conditions of the elderly - Adverse past experiences of the elderly in dental treatment - Dentistry with the minimal invasion - Using caries risk assessment tools - Using restorations with easy maintenance - Not performing surgical intervention - Applying a preventive approach instead of treatment (observing oral hygiene and not consuming carbohydrates, fluoride consumption, restorations conditions and the presence of dentures) - Not using dental implants to maintain a partial removable denture - Applying SDA shortened dental arch restorative approach to RPD partial removable dentures
DJ Caplan (2018)	United States	65 - 104 years	Descriptive retrospective	- More frequent use of amalgam, composite and GIC restorative materials.
C da Mata (2015)	Ireland	65 - 90 years	Clinical trial	- Applying cost-effective ART compared to CT in the restoring elderly individuals' teeth - Early diagnosis and prevention of root caries in the elderly - The importance of moisture control and cavity size in restoration - Repairing instead of restoring
C da Mata (2019)	Ireland	> 65 years old	Clinical trial	- Applying cost-effective ART compared to CT in the restoring elderly teeth
TS Ghazal (2018)	United States	> 85 years old	Descriptive retrospective	- Elderly-related factors (age, gender, paying costs, dental arch, underlying disease, medication use, salivation deficiency, insomnia, poor or lack of observing oral hygiene) - Factors related to restoration (type and size of restoration)

in the roots.[22] Among the factors affecting most tooth decay in the elderly, along with reduced salivary flow, changes in the oral flora, reduction of caries-inhibitory contents, including proline-rich proteins, exposure to more cement in the oral environment for several reasons, one's desire for salty and sweet foods, the presence of dentures, and poor oral hygiene, and the need for restoration in the elderly.[19] Murray has stated that there are many causes for dry mouth, most of which occur with aging and include dehydration, damage to the salivary glands owing to autoimmune diseases (Sjogren's syndrome) and radiation. Simultaneous use of several drugs as well as taking drugs related to dry mouth such as anticholinergic drugs have significant effects on dry mouth.[10]

Studies have indicated that older people suffer from a variety of systemic diseases and other complications of aging, such as diabetes, cancer, dementia, Parkinson's disease, depression, gnashing of teeth, bruxism and lung and heart diseases. Thus, they are required to take various medications to improve their health conditions. This leads to dry mouth and the occurrence of oral diseases, especially the fungal ones. This exacerbates tooth decay, especially in nursing home residents due to poor oral hygiene. Regarding restorations that require surgery or anesthesia, using anesthetic drugs has adverse effects on the elderly with neurological diseases such as Alzheimer's Disease.[10]Therefore, the condition of the disease and medication are required to be considered in choosing the appropriate restoration approach for the elderly.[10,19,20] Other side effects of aging include changes in hard tooth tissue, decreased facial height, and dental erosion, especially in the lower anterior teeth where the pulp of the tooth usually appears. Secondary dentin stiffness protects the tooth pulp. However, pulp changes make endodontic treatments difficult.[19]

Another important point is regular oral cancer screening for the elderly. This is especially necessary in toothless people, with or without dentures.[19] Oral malignancies increase with aging, along with tumors in other parts of the body. Treatment of malignant tumors of the head and neck with radiation and drug use leads to destruction of the salivary glands. Dry mouth causes rapid tooth decay and alveolar vascular changes, leading to osteoradionecrosis and osteonecrosis, resulting in a catastrophic lower jaw fracture. The incidence rate of osteoradionecrosis in patients with teeth is almost twice higher than the rate for patients without teeth. Thus, it is necessary to treat dental diseases before radiation to oral tissues.[10,23,27] One of the most important points in the restorative treatment of the elderly is providing the required training to observe oral hygiene and prevent tooth decay. Oral bacteria can lead to ventilator-associated pneumonia if hygiene is not properly observed, in such cases advising and educating elderly's family or caregivers to maintain oral hygiene and using chlorhexidine brushes and sponges is the best way to prevent the consequences of this disease. In addition to observing good oral hygiene, having a diet free of sugars and acids, as well as fluoride, can help prevent or reduce caries. This approach is called conservative restorative dentistry, aiming to maintain the health of natural teeth and selectively extract damaged teeth. Moreover, dentists need to provide the necessary training for the care of restored teeth to the elderly and their families or caregivers in nursing homes.[10,21,23] In addition, the study conducted by Laske et al indicated that there is no difference in terms of gender between the annual failure rate (AFR); however, it is higher in people over 65.[18] Women under the 75 years old usually have a longer restoration life through better oral hygiene and less functional damage. Thus, older age is associated with greater failure of restoration. Patients who use Medicaid insurance have poorer oral health and more restorative failures than those who go to private clinics. Residents of private nursing homes also have better oral hygiene and durability than others.[11] Also, the presence of dentures due to caries and periodontal problems causes less durability of the restoration. Moreover, restoration in molar teeth compared to anterior teeth (annual failure rate of 4.4%) and premolars (annual failure rate of 0.4%) indicates a lower survival rate (annual failure rate of 5.2%). The first molar needs more restoration than other teeth, however, it also accounts for the highest annual failure rate of restoration. In surface restorations, the maximum rate of restoration failure depends on the amount of surface involved.[18]

Evidence shows that the risk of root decay decreases every 3 to 6 months with a non-invasive method, a combination of oral hygiene guidelines and professional application solutions (SDF = 38%; NAF 22,500; CHX = 40%) every 3 to 6 months. The evidence also shows that using chlorhexidine, fluoride, calcium phosphate, amorphous calcium and fluoride (diamine silver) are quite effective in reducing the incidence of root decay in the elderly.[18] Also, the timing of tooth extraction in middle age and providing the necessary training to use dentures are other important considerations.[10]

Regarding the considerations related to the methods and restorative materials, studies have indicated that for the elderly, root surface filling is used more frequently. Moreover, one of the most important considerations in restoring its durability is especially in patients who take several medications at the same time or have a specific medication regimen. This is because taking several medications can cause salivary gland dysfunction and tooth decay. Despite the inability of people in their 70s and 80s, the durability of restoration along with oral hygiene leads to healthy teeth in such people.[21] Regarding the condition of hard tooth loss, using amalgam and composite resin is limited. In these cases, washable

restorative materials with composite resin called sandwich technique can be used, which has both a higher adhesion and a more acceptable beauty. Moreover, in the face of common dental caries, dentists are required to use the conservative cavity design method proposed by Elderton and Mclean, which is both biocompatible and less psychologically harmful to the elderly.[23] Moreover, bulging posterior restorations are associated with approximate destruction of the surrounding bone, which is more commonly observed in men at higher ages due to periodontal disease, more plaque, and more bone erosion.[27]

Another important consideration regarding restoration methods and materials is using caries assessment tools such as Cariogram and CAMBRA to reduce dental caries and periodontal disease in the early stages. Meanwhile, the Cariogram is more successful in assessing the risk of caries in the elderly. However, in general, there is little evidence of the ability of these methods to predict the future course of the disease. Also, using easily maintained restorations prevents damage to the teeth around removable dentures, conventional fixed bridges, and implant restorations in medium and long terms.[20] At present, applying fixed dentures is not contraindicated for the elderly. If the elderly patient has good periodontal support, a single restoration method can help the elderly person without teeth with Maryland bridge and resin porcelain veneers both mechanically and aesthetically. Using removable partial dentures according to the covered surface of the tooth and the degree of hygiene observed by the elderly may cause damage to the surrounding teeth due to the presence of implants for its maintenance. For patients who have lost some of their teeth, the best approach is using a shortened dental arch (SDA), which was proposed by Kayser in 1984. Shortened dental arch includes 12 anterior teeth and 8 premolars in people over 45 years of age.[23] In general, SDA is a more appropriate approach than RPD in terms of reducing costs and preventing oral diseases in the elderly.[20]

Also, the type of restoration material affects its durability. Hawthorne has stated that crown and ionomer are mostly used for restoration in the elderly and there is no difference between men and women in terms of using restorative materials.[22] While Murray introduced amalgam as a suitable material for use in the posterior teeth of the elderly, so that despite the fracture, the restoration is still useful after 100 months and its replacement is usually unnecessary for the elderly. [10]Composite resin restorations are about 2.5 times more durable than amalgam and are recommended in cases of patient beauty requests. Glass ionomer restorations for the elderly and RACF patients are a useful alternative restoration material to tooth color because they are cariostatic and use minimally invasive dentistry. Using indirect composite resins is contraindicated for elderly patients because its failure rate is similar to direct restoration and takes longer to be manufactured.[10]

Clinical and technical challenges of providing a fixed crown and bridge for the elderly, especially those living in nursing homes, prevent them from being selected in most cases. The metal and ceramic crowns have a success rate of 94%, the bridges are expected to survive more than 87% by 10 years, though. All-ceramic crowns are usually preferred over ceramic and metal crowns for their beauty; however, in posterior regions, they have higher fractures and, therefore, it is recommended not to use ceramic and metal crowns in patients for therapeutic purposes than for beauty ones.[10] Laske introduced composite as the most commonly used restorative material for the elderly. The failure rate of 10-year restoration was for composite restorations (4.4%), amalgam (5.1%), compomers (7.5%), and glass ionomer cement (11.1%).[18]

Caplan's study indicated that amalgam, composite, and GIC restorations are among the most widely used restorations in the elderly; crowns or bridge holder were less commonly used.[15] In general, in-cavity restorations are often primarily replaced by the same type of restoration. Among intercoronal restorations, amalgam and GIC restorations fail due to more tooth extraction than composite restorations, and bridges are the most common type of root canal restoration. For amalgam restoration, the average survival time is similar for anterior and premolars; however, it is shorter for mill teeth. For composite restorations, the average survival time for anterior teeth is worse than that of premolars and molars, and for GIC restorations, the average survival time is the same for all types of teeth. Regardless of the restorative material, the life of larger restorations (at larger levels) is shorter than that of smaller restorations (one level). In a given tooth, initial restorations are more durable than subsequent restorations.[15]

On the other hand, one of the appropriate treatment approaches for the elderly is minimally invasive intervention/dentistry, including the diagnosis and treatment of caries as soon as possible and with minimal invasiveness. This means prioritizing prevention, providing the necessary information and guidance to empower patients to maintain oral hygiene, and conducting conservative intervention to minimize tooth loss during surgery. Conservative restorative techniques such as ART and using the concept of shortened dental arch can improve the condition of the elderly teeth and improve the quality of life associated with their oral health. The results of the study conducted by Mata show that minimally invasive methods such as ART and conventional restorative technique (CT) are equally effective in improving the oral health of the elderly and improving their quality of life.[28] The time and cost of ART is less due to non-surgical intervention and anesthesia.[20] The best restoration material is using

glass ionomer.[13] If ART is used with amalgam, it increases its cost-effectiveness.[14]

The combination of glass ionomer and composite resin together causes more coverage and adhesion. This will make the restoration more successful with ART. The width of the root surface of a decaying lesion affects the success of the restoration. ART failure is more likely to be caused by secondary caries. This is more common in nursing home residents due to poor hygiene. Failure to completely remove the decayed lesion, especially with hand tools, increases the severity of the aforementioned failure. The presence of dental plaque is an important factor in the occurrence of secondary caries. Therefore, it is required to identify and completely remove decayed tissue before performing ART restoration with the help of identification tools. The presence of a tooth opposite the tooth receiving the restorative material affect the prolongation of the restorative process resulting from the concentration of tensile forces in that area, causing the failure to maintain and the formation of marginal cracks.[13] Moreover, the moisture content and adhesion of glass ionomer should be controlled in both ART and CT methods for having more successful restorations.[25]

Moreover, in the case of the elderly, if some parts of the restorations are damaged, it is best to repair it before the complete loss of the restoration.[9]Also, Enamelon as a calcium phosphate-based remineralization technology combined with fluoride therapy, and Carisolv as a minimally invasive method that removes only necrotic tissue can be other effective methods of removing root caries in the elderly. Glass ionomer and composite resin are used to restore the intended part. Laboratory evidence has also shown the effective use of ozone on the surface of decayed teeth, but clinical evidence is insufficient to ensure its effectiveness and cost-effectiveness.[10] Moreover, the larger the repair and the more levels it covers, the more likely it is to fail.[11]Owing to the complications of implants that are difficult to manage, its application is not recommended for the elderly, especially for individuals living in nursing homes. Implants must not be used in patients with bone necrosis.[10]

Other factors associated with dentistry that affect the success of restorations include inadequate diagnosis in order to adopt the appropriate clinical approach, inadequate removal of decayed lesion, inadequate use of restorative materials, and inadequate moisture management.[13] The constant change of one's dentist can also affect the amount of restoration work and leads to more restoration work to be conducted. Older people who visit the dentist more often or change their dentist regularly will face more expensive restorations and more crown and ionomer glasses. Experienced dentists use amalgam, especially ionomer, for further restoration, and as for the elderly, they use more crowns and glass ionomers. While younger dentists use more composite resin. This is mainly due to the importance of restorative aesthetics for women who use more composite resin in their anterior teeth.[22] The failure rate of restorations conducted in individual methods (one dentist) or small groups (2 or 3 dentists) is lower than that of the methods conducted by a larger group (several dentists); the size of the treatment has no effect on the durability of the restoration.[18] One of the limitations of this study was the lack of access to the full text of some of the studies. It was attempted to have access to the full texts of such studies by sending emails to the corresponding authors and searching on social networks such as Research Gate.

CONCLUSION

The most important restorative dentistry considerations for the elderly were identified at three levels of considerations related to the elderly themselves, restorative materials and methods, and the dentist's performance through reviewing the related literature. It is, thus, recommended that dentists consider the medical and social conditions of the elderly, age and gender, medications used, type of restorative tooth, level of restoration involved, appropriate timing of tooth extraction in middle age, oral cancer screening, giving due attention to caries prevention approach, and providing the necessary training to the elderly, their families, and their caregivers in nursing homes. Moreover, selecting a suitable durable restoration material and comfortable and washable storage conditions according to the patient's social and economic conditions, using conservative care methods and minimally invasive restoration by identifying and eliminating caries with the help of appropriate tools, controlling moisture and the size of the restoration, aesthetic and non-aesthetic considerations are other suggestions. The elderly people are also required to avoid frequent changes of dentist to observe their oral and teeth health and carefully follow the educational recommendations provided to them. Moreover, due to the special conditions of the elderly and their care and treatment needs, it is recommended that further studies be conducted to evaluate the desired effect of new materials and methods.

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