GRADUATION PROJECT

Degree in Dentistry

ORAL HEALTH IMPLICATION OF HORMONE THERAPY IN GENDER AFFIRMING CARE

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ABSTRACT

Background: Gender-affirming hormone therapy (GAHT) is increasingly used among transgender population and induces systemic hormonal changes that may affect oral tissues. However, its implications in dentistry remain poorly understood due to limited and heterogeneous evidence.**Objective:** This systematized review aims to investigate the relationship between GAHT and oral health, focusing on periodontal status, implant outcomes, and salivary changes.**Methods**: A systematized review was conducted following PRISMA-based principles. A comprehensive search was performed in PubMed and Scopus, including studies from the last 10 years. Given the scarcity of direct evidence, an integrative approach was adopted, incorporating both clinical and indirect data.**Results:** The literature points out that sex hormones modulate periodontal inflammation: estrogens may enhance inflammatory response, while androgens may support periodontal stability. GAHT related hormonal shifts could also affect alveolar bone metabolism, raising concerns about implant osseointegration and long-term stability, although current data remain inconclusive. Changes in salivary composition and oral microbiota have been reported within the first year of therapy, potentially increasing caries risk, especially when associated with xerostomia. At the same time, GAHT is linked to improved psychological well-being, which may positively influence oral hygiene behaviors and compliance to treatment.**Conclusions:** The relationship between GAHT and oral health cannot be considered causal but is biologically plausible and clinically relevant. The limited and heterogeneous evidence highlights the need for well-designed longitudinal studies to clarify these associations and support evidence-based dental guidelines for transgender patients.

KEYWORDS

Dentistry, Gender-Affirming Hormone Therapy (GAHT), Transgender, Sex Hormones, Periodontal Disease, Implantology.

ABSTRACT

Antecedentes: La terapia hormonal de afirmación de género (GAHT) induce cambios sistémicos que pueden afectar los tejidos orales. Sin embargo, sus implicaciones odontológicas son poco conocidas debido a la evidencia limitada y heterogénea.
Objetivo: Esta revisión sistematizada investiga la relación entre la GAHT y la salud bucodental, centrándose en el estado periodontal, implantes y cambios salivales.
Métodos: Se realizó una revisión sistematizada bajo principios PRISMA en PubMed y Scopus (últimos 10 años). Ante la escasez de evidencia directa, se adoptó un enfoque integrador con datos clínicos e indirectos.
Resultados: La literatura indica que las hormonas sexuales modulan la inflamación periodontal: los estrógenos pueden potenciarla, mientras los andrógenos favorecerían la estabilidad. Los cambios hormonales podrían afectar el metabolismo del hueso alveolar, planteando interrogantes sobre la osteointegración y estabilidad de implantes, aunque los datos no son concluyentes. Se reportan cambios en la composición salival y microbiota en el primer año de terapia, aumentando potencialmente el riesgo de caries, especialmente ante la xerostomía. Paralelamente, la GAHT mejora el bienestar psicológico, influyendo positivamente en la higiene oral y el cumplimiento del tratamiento.
Conclusiones: La relación entre GAHT y salud bucodental es biológicamente plausible y clínicamente relevante, aunque no causal. La evidencia actual resalta la necesidad de estudios longitudinales para esclarecer estas asociaciones y desarrollar guías odontológicas basadas en la evidencia para pacientes transgénero.

PALABRAS CLAVE

Dentistry, Gender-Affirming Hormone Therapy (GAHT), Transgender, Sex Hormones, Periodontal Disease, Implantology.

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1. INTRODUCTION

1.1 Introduction to Gender Affirming Hormone Therapy (GAHT)

In the past years, a rapid increase in transgender individuals visibility has been observed in society compared to the past(1–3). These noticeable changes can be observed in media, institutional and healthcare fields, where now more than ever their presence is acknowledged and discussed.

In parallel, the number of transgender patients with access to Gender-Affirming Hormone Therapy (GAHT) is increasing, raising the demand for a more scientific-based research and an open dialogue between Health Care Professionals for a real multidisciplinary approach.

GAHT is a form of treatment based on exogenous sex hormones which serves the purpose of helping individuals feel more aligned with their gender identity, producing physical changes that matches their internal sense of self(2,4). Apart from the expected physical changes research shows that GAHT helps with gender dysphoria related-mental distress in both male-to-female and female-to-male transgender individuals(2), in addiction a correlation between GAHT and lower rate of depression and suicidal among youngest population (13-24 years old) was found improving considerably the quality of life of transgender individuals(5).

In Male-to-Female therapy estrogens and androgens blockers are used to achieve the desired effects. Estrogens, administered orally, transdermal or IM, promote secondary sexual characteristics, while androgens blockers (like spironolactone and progestogenic anti-androgen) are used to reduce or block testosterone production and its effects. Occasionally also Gonadotropin Releasing Hormone Antagonist (GnRH) are used to shut down endogenous testosterone production at pituitary level(6).
In Female-to-Male Therapy testosterone is administered (IM or transdermal) for expressing male secondary sex characteristics, being the foundation of masculinizing therapy. Dosage is similar as Testosterone Replacement Therapy. At the beginning of the hormonal treatment also Progesterone (oral, IM or with intrauterine device) is used to help the patient stop menstrual cycle and eliminate the possibility of pregnancies if the uterus is still present. Along the therapy Testosterone alone is enough for maintaining the required objective, progesterone is helpful when it comes to achieving the initial results(6).

GAHT is already being widely discussed and investigated in Endocrinology, Psychology, Reproductive Health and Oncology, but in Dentistry the process of recognizing its influence over the Oral Health of patients has just started. From the

few studies available GAHT may play a role in the susceptibility of patients to periodontal problems, implant therapy and bone related complications, hyposalivation and therefore caries susceptibility(7,8). Despite this, there is a visible gap in knowledge when it comes to the management of transgender patients undergoing GAHT, especially regarding clinical protocols and therapeutic planification.

1.1.1. Sex Hormones Influence on Oral Tissues

Sex Hormones influence directly many different aspects of the oral environment. They act on the keratinization of the mucosa, contributing to epithelial integrity; they can alter salivary function with repercussions on the caries susceptibility as well as oral tissue protection; They operate as inflammatory modulators, managing duration and intensity of tissues response; They act on collagen metabolism and on the homeostasis of the alveolar bone, influencing the balance between bone reabsorption and deposition(8,9).

Estrogens are responsible for collagen turnover, angiogenesis and are associated with pregnancy gingivitis and menopausal xerostomia. Androgens on the other hand are associated to bone metabolism and inflammatory response, influencing periodontal stability(8,9).

GAHT induces long terms hormonal changes with repercussions on oral tissues and their adaptation mechanism. In transfeminine treatment (male to female, MtF) GAHT mimics post-menopausal symptoms, while transmasculine one (female to male, FtM) influences bone turnover and physiology of post-implant oral tissue, playing a crucial role in the planification and management of rehabilitative therapies(6).

1.2.2 Lack of Research

There are only a few available studies over transgender population in general and over the influence of GAHT and oral health. The consequence is a very limited knowledge among the scientific community which ultimately makes it difficult to come to solid conclusions and guidelines and adapt them in the daily management of these patients in the dental office.

A big part of our current understanding regarding GAHT comes from indirect sources of information such as menopausal studies, contraceptive hormones

therapies and testosterone-related systemic conditions. These studies offer valid points but from a different context, not aiming specifically for the clinical management of transgender patients undergoing GAHT in dentistry.

Variability in GAHT makes it incredibly difficult to obtain generalized results between patients. Dose, regime and duration of the therapy produce heterogeneous results, these variability complicates data interpretation and limits the possibility of establishing clear and universal guidelines(10).

The limited and heterogeneous nature of the evidences may result in misinterpretation of clinical signals, absence of specific guidelines regarding management of transgender patients and uncertainty in programming periodontal and implant treatments(11,12). Consequently, clinicians often are required to make individualized decisions under conditions of great uncertainty

1.3 Knowlegde Gap and Importance of this Review

Despite the lack of scientific studies on the topic, based on the few research available the suggested plausible effect of GAHT over the oral cavity include periodontal imbalance, alveolar bone metabolism alteration and complications in implant osteointegration(7,8,11).

In order to have a correct approach regarding the management of transgender patients following GAHT we need a clear evaluation of the published data, the identification of the biological mechanisms involved as well as an assessment of the inconsistencies and research limitations.

This systematic review aims to analyze and synthesize the current literature, clarify what's known and unknown, and support the development of inclusive, informed and evidence-based dental care for all transgender patients

2. OBJETIVE

Primary objective:

To investigate the relationship between Gender Affirming Hormone Therapy (GAHT) and overall Oral Health status

Secondary objectives:

To assess the impact of GAHT on periodontal tissue
To explore the implications of GAHT for implantology including potential effects on osteointegration and long term implant stability
To evaluate changes in salivary composition in patients undergoing GAHT

3. MATERIAL AND METHODS

3.1 Study Design

This systematized review was conducted following the PRISMA 2020 guidelines (Preferred Reporting Items for Systematic Review and Meta-Analyses). The study is designed as a systematized review of observational studies with the aim of synthesizing evidence regarding the oral health implication of gender affirming hormone therapy (GAHT) (7,9). However given the emerging problem of a shortage of studies covering GAHT and oral health implication we have adopted an integrative approach to include both direct clinical outcomes and indirect determinants of oral health.

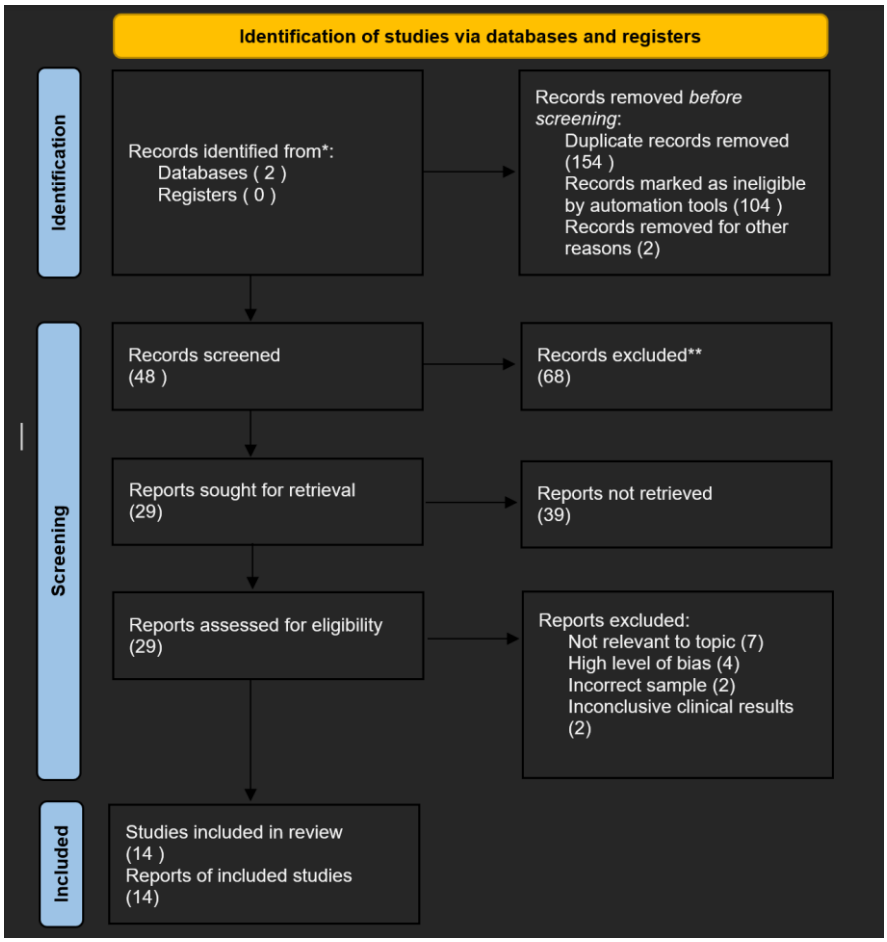


Figure 1. PRISMA 2020 flow diagram of study selection phase.

3.2 Research Questions (PICO)

The research question have been formulated using the PICO framework

- Population: Transgender Adults (above 18) receiving GAHT
- Intervention/Exposure: Hormone Therapy (both masculinizing and feminizing protocols)
- Comparison: Cisgender individuals or pre-transition baselines (where applicable)
- Outcome: Periodontal status, implant-related outcomes, salivary changes and oral health related quality of life
- Specific Questions: “In transgender adults receiving GAHT is there an association between the hormone therapy and periodontal or implant related outcomes?

3.3 Search Strategy

A comprehensive systematized review was conducted to identify relevant literature. The research has been conducted between October 15, 2025 and October 31, 2025. The primary search was performed using PubMed and Scopus. The timeframe used was restricted to studies published in the past 10 years to ensure the data reflect the current hormone therapy protocols and modern dental techniques.
To identify eligible studies a specific search string was conducted using Boolean operators (AND, OR) to combine keywords related to the population and the outcomes. The exact string used was:
(transgender OR gender-diverse) AND (Hormone therapy OR GAHT) AND (periodontitis OR dental implants OR oral health)

3.4 Eligibility Criteria

To ensure clarity and transparency the criteria for the study have been divided into standard eligibility criteria and an extended inclusion strategy justified by the lack of literature on the topic.

3.4.1 Inclusion Criteria

Initially only the studies that met the following criteria were selected:

- Observational studies and clinical trials
- Adults (age 18 or above) identifying as transgender
- Receiving GAHT, Studies reporting periodontal and or implant outcomes
- Quantitative or Qualitative reports on periodontal health, dental implants, oral microbe and saliva.

3.4.2 Exclusion Criteria

The following criteria have been excluded from the primary research

- Animal and in vitrio studies
- Pediatric population (unless relevant to long term mental health outcomes that might influence hygiene)
- Case Reports and Reviews that does not affect oral health implication as main objective.

3.4.3 Expanded Inclusion Strategy and Justification

Initially the aim was to select only studies with periodontal metrics, but the preliminary research revealed scarcity of primary data o this specific topic. To provide a comprehensive analysis and an empty review the conclusion criteria have been strategically expanded to include more articles based on the following justifications:

1. Indirect Determinants: articles focusing on mental health and behavioral health were included (such as Marshall-Paquin et al., Green et al., Nguyen et al). These factors are critical determinants of oral hygiene compliance impacting indirectly the health of the periodontium.
2. Biological Plausibility: studies that analyze the effect of sex hormones on general physiology and cisgender population were used to establish the biological plausibility of hormones effects on hard and soft tissues (such as Su et al., Chan Swe et al.).
3. Clinical Consequences and protocols: narrative reviews and consensus papers (such as Villar et al., Kumar et al.)

3.5 Data Extraction

Data were extracted using a standardized method to record author, country, study design, sample size, type and duration of GAHT exposure and main results regarding oral health.

3.6 Quality Assessment

The methodological quality of the studies has been assessed using NIH of JBJ (Joanna Briggs Institute) Critical Appraisal Checklist adapted for observational and cross-sectional studies. The risk of bias has been evaluated considering the type the study design, methodology and control of variables. According to this evaluation we have divided the studies into three categories: low, moderate and high risk of bias. However it is important to acknowledge that the quality assessment was simplified to fit the

scope of a Bachelor's thesis since the aim was to point out the main limitations rather than performing a complex analysis.

3.7 Data Synthesis

Due to the heterogeneity of the studies (ranging from clinical trials to narrative reviews and behavioral surveys) a narrative and descriptive synthesis was performed. Results were categorized into themes: direct periodontal effects, biological mechanisms and psychosocial barriers to care.

4. RESULTS

Table 1

The following table summarizes the main findings of the studies included in this systematized review, for each article the author, year and key results relevant to this case have been displayed. This overview provides a simple synthesis of the available evidence, analyzing clinical and systematic factors that may influence the oral health of transgender individuals following GAHT.

Author	Year	Results
Marshall-Paquin TL et al.	2017	Oral health professionals reported insufficient training regarding transgender healthcare, potentially affecting prevention and management of oral diseases in transgender patients.
Nguyen HB et al.	2018	GAHT improves psychological wellbeing and cognitive function, which may indirectly improve adherence to oral hygiene practices and healthcare utilization.
Tamrat J	2016	Structural barriers and insufficient training may lead to delayed diagnosis and treatment of oral diseases in transgender patients.
Chan Swe N et al.	2022	GAHT influences bone density and remodeling which may affect alveolar bone physiology and long-term implant stability.
Green AE et al.	2022	Access to GAHT associated with improved mental health outcomes, which may positively influence health behaviors including oral hygiene adherence.
Oh JW et al.	2022	Hormonal changes induced by GAHT may resemble menopausal endocrine conditions and may be associated with xerostomia and oral mucosal changes.

Villar CC et al.	2024	Sex hormone levels were associated with periodontal inflammatory responses and increased susceptibility to periodontitis.
Cornejo Ulloa PE et al.	2023	GAHT induced changes in salivary composition and oral microbiota within the first 6 months, with stabilization around 12 months.
Su X et al.	2023	Significant associations were found between circulating sex hormone levels and prevalence of periodontitis.
Van den Bosch MF et al.	2021	The protocol aims to map evidence on GAHT effects on craniofacial structures potentially relevant to oral health.
Kumar V et al.	2025	Evidence suggests higher prevalence of dental caries and periodontal disease in transgender populations, possibly related to healthcare barriers and hormonal influences.
Fakhrjahani I et al.	2024	The literature highlights disparities in access to oral healthcare and limited evidence on clinical oral outcomes in transgender populations.
Delgado-Ruiz R. et al.	2019	GAHT influences density and bone turnover, this changes might change implant osteointegration. Indirect evidence.
Dobrolińska M. et al	2019	After gonadectomy and long term GAHT, bone mineral density is generally maintained or slightly increased in MtF, but may decrease in MtF individuals, suggesting hormone dependent effects

Table 2

To better contextualize the evidences of this systematized review a more detailed table was developed, containing author, year of publication, methodology, and relevant oral findings in transgender adult population currently following GAHT. The table includes, when applicable, the specific type of GAHT, as well as the duration of the treatment and the risk of bias, which for some articles is higher the others due to the scarcity of the studies available nowadays.

Author / Year/ Country	**Study type**	**Population (n)**	**Type of GAHT**	**Duration of treatment**	**Oral variables assessed**	**Risk of bias /Limitations**
Marshall-Paquin TL et al., 2017 Canada / USA	Cross-sectional survey	Dental hygienists and oral health professionals (n≈268 adults)	Not applicable	Not applicable	Access to dental care, provider knowledge influencing oral health management	Moderate. Self-reported survey; no clinical oral parameters measured.

Author / Year/ Country	Study type	Population (n)	Type of GAHT	Duration of treatment	Oral variables assessed	Risk of bias /Limitations
Nguyen HB et al., 2018 USA	Narrative review	Transgender adults receiving GAHT in included studies (18–60 years)	Estrogen therapy + anti-androgens (MtF); testosterone therapy (FtM)	6 months–5 years across studies	Behavioral factors affecting oral health (hygiene compliance, healthcare utilization)	High. Indirect evidence; no clinical oral outcomes reported.
Tamrat J, 2016 Canada	Narrative review / conceptual analysis	Transgender adults accessing dental care	Not applicable	Not applicable	Access to preventive and therapeutic dental care	High. No systematic methodology, no clinical data.
Chan Swe N et al., 2022 International	Literature review	Transgender adults undergoing GAHT (18–65 years)	Estrogen therapy or testosterone therapy	6 months–10 years in analyzed studies	Bone metabolism relevant to alveolar bone and implant osseointegration	High. Evidence mainly systemic; limited direct oral studies.
Green AE et al., 2022 USA	Observational cohort study	Transgender and nonbinary youth (13–24 years; n≈9000)	Various GAHT regimens	≥6 months reported GAHT exposure	Health behaviors influencing oral health (self-care behaviors)	Moderate. Oral health not directly measured.
Oh JW et al., 2022 South Korea	Narrative review	Transgender adults receiving GAHT (18–60 years)	Estrogens, anti-androgens, testosterone	6 months–several years	Hormonal effects influencing salivary flow and oral mucosa	High. Heavy reliance on non-clinical evidence
Villar CC et al., 2024 International	Observational epidemiological study	Adults ≥18 years with periodontal data	Systemic hormone levels	Not applicable	Periodontal parameters: PPD, CAL, inflammation	High. Non-systematic selection, no critical appraisal

Author / Year/ Country	**Study type**	**Population (n)**	**Type of GAHT**	**Duration of treatment**	**Oral variables assessed**	**Risk of bias /Limitations**
Cornejo Ulloa PE et al., 2023 Netherlands	Prospective longitudinal study	Transgender adults initiating GAHT (n≈39; 21–60 years)	Testosterone therapy (FtM) or estrogen + anti-androgen therapy (MtF)	12-month follow-up	Salivary biomarkers, oral microbiome, xerostomia symptoms	Moderate. Prospective design, but small sample size; limited follow-up duration.
Su X et al., 2023 USA	Cross-sectional epidemiological study	US adults from NHANES dataset (30–80 years)	Endogenous sex hormone levels	Not applicable	Periodontitis indicators: PPD, CAL	Moderate. Cross-sectional design; causality cannot be established.
Van den Bosch MF et al., 2021 Netherlands	Scoping review protocol	Transgender individuals undergoing GAHT (adolescents and adults)	Various GAHT regimens	Not applicable	Craniofacial hard and soft tissues including alveolar bone	High. Protocol without results; no clinical data yet.
Kumar V et al., 2025 International	**Systematic review** and meta-analysis	Transgender populations (adolescent and adults; thousands of participants)	Various GAHT regimens	6 months–>10 years across studies	Caries (DMFT index), periodontal disease (PPD, CAL), oral hygiene indices	Low. Comprehensive search and quantitative synthesis
Fakhrjahani I et al., 2024 nternational	Scoping review	LGBTQ+ population including transgender Adults	Various GAHT regimens	Months to several years	dental service utilization	Moderate. Structured search but no quality assessment
Delgado-Ruiz R. et al., 2019 (USA/International)	Systematic review	Not applicable	Both estrogen and testostero	Variable among studies (long-	Bone mineral density, bone turnover markers,	Moderate. Lack of standardized protocol,

Author / Year/ Country	Study type	Population (n)	Type of GAHT	Duration of treatment	Oral variables assessed	Risk of bias /Limitations
			ne therapy	term focus)	implant osteointegration	indirect evidence
Dobrolińska M. et al., 2019 (Netherlands)	Observational cohort studies	200 transgender individuals aftergonadectomy	Estrogen and testosterone therapy	Years; variable. Long term focus	Bone mineral density	Moderate. No control group without GAHT, lack of oral specific outcomes

4.1 Periodontal Health and Inflammation

Sex hormones function as direct inflammatory modulators, controlling both the duration and the intensity of the response in oral tissues(7,9) as demonstrated by Su et al., 2023 in a cross-sectional analysis of U.S. adults examining circulating sex hormone levels and periodontal status, and discussed by Villar et al., 2024 in their review on sex disparities and hormonal influence on
periodontal inflammation. Specifically estrogens and androgens act on periodontal tissues influencing cytokine production and vascular response, through chemical receptors in gingival fibroblasts, periodontal ligament and osteoblasts.
High levels of estrogens are linked to collagen turnover and angiogenesis, which can lead to clinical conditions similar to pregnancy gingivitis (9), as reported by Su et al., 2023, who analyzed hormonal levels in relation to periodontal outcomes in US adults from NHANES dataset. This translates into an increase in gingival vascular permeability and inflammatory cell infiltration, which can mean an excessive inflammatory response even in presence of a modest amount of bacterial plaque.
Androgens are associated with periodontal stability by influencing bone metabolism and the modulation of the inflammatory response (7,9). As stated by Su et al., 2023, showing significant associations between circulating hormones and periodontal disease prevalence. They are responsible for maintaining alveolar bone density and evidence shows that they may have a protective effect by regulating pro-inflammatory mediators involved in periodontal breakdown, discussed by Villar et al., 2024.
In transfeminine (MtF) individuals, GAHT can induce physiological changes that mimic post-menopausal symptoms, potentially increasing the risk of periodontal issues (4,6) as described by Oh et al., 2022 in their review of gender-affirming hormone therapy in transgender adults and by Chan Swe et al., 2022 who reported that GAHT can influence skeletal physiology and bone Metabolism.

4.2 Alveolar Bone and Implantology

Sex hormones influence the homeostasis of the alveolar bone by managing the balance between bone resorption and deposition (4) as discussed in the literature review by Chan Swe et al., 2022
evaluating the effects of GAHT on skeletal health and bone remodeling, possibly Increasing the risk of compromising the success and longevity of implants.
In transmasculine (FtM) therapy, testosterone affects bone turnover and the physiology of oral tissues following implant procedures (4,10) according to Chan Swe et al., 2022, and Van den Bosch et al., 2021 proposing a scoping review protocol specifically aimed at mapping GAHT effects on craniofacial hard and soft tissues relevant for dental treatments.
Current evidence suggests that GAHT-induced changes in bone metabolism may lead to complications in implant osseointegration and long-term stability (8,10) as suggested by Van den Bosch et al., 2021 and supported by the longitudinal study by Cornejo Ulloa et al., 2023 investigating biological oral changes occurring during GAHT. However we need more studies with a longer follow-up in order to really assess the long-term stability and quantify how much does the GAHT effects implant therapy, the data that we have today are not enough.

4.3 Salivary Function and Caries Susceptibility

Hormonal fluctuations can alter both the composition and the function of saliva, reducing the natural protection of the oral cavity (8) as demonstrated by Cornejo Ulloa et al., 2023 in a longitudinal study evaluating salivary composition and oral microbiota changes in individuals undergoing GAHT.
The change in salivary proteins and microbiota starts in the first 6 months of GAHT and stabilizes itself around the 12^{th} month of therapy according to Cornejo Ulloa et al., 2023.
Depending on the type of transition we can have different responses regarding saliva.
GAHT is associated with hyposalivation, which is a direct factor in increasing a patient's susceptibility to dental caries (8) since the buffering capacity of saliva is reduced in this scenario.
Fluctuations in estrogen levels are specifically linked to xerostomia, matching symptoms typically observed in menopausal patients (6), a mechanism described by Oh et al., 2022 in their review of endocrine effects associated with GAHT.

4.4 Psychosocial and Behavioral Determinants

GAHT is strongly correlated with improved mental health outcomes, including lower rates of depression and suicidal ideation (2,5) as reported by Green et al., 2022 in a study

involving transgender and nonbinary youth showing reduced depression and suicidality among individuals receiving GAHT, and discussed by Nguyen et al., 2018 who reviewed the psychological and cognitive benefits associated with hormone therapy.
These improvements in behavioral health and cognition are critical determinants for better oral hygiene compliance (2) as suggested by Nguyen et al., 2018 who reported that improved psychological wellbeing may indirectly enhance healthcare utilization and adherence to health related behaviors. Oh et al., 2022 in their review of endocrine effects associated with GAHT.
Nowadays we acknowledge that there is a significant gap in the knowledge and willingness of oral health professionals to manage transgender patients, which affects service utilization (1,11,12). However It is often difficult to determine whether a dentist's decision not to provide treatment is related to the current limitations in scientific evidence or professional training, or to broader social and structural factors. This highlights the need for improved professional education and clearer clinical guidelines backed by scientific evidence and literature.

5. DISCUSION

5.1 Limitation in qualifying clinical impact of GAHT on Oral Health

The evidences analyzed suggests that the relationship between GAHT and oral health cannot be interpreted in a linear way, but rather as a result of the interaction between biological mechanisms, behavioral factors and a structural limitation of the health system. The main issue about this topic is not the absence of plausible associations, is the inability of the current literature to quantify their real clinical impact.

5.2 Hormonal modulation and periodontal response

Regarding periodontal health, there has been a certain consistency across studies supporting the importance that sex hormones play as modulators of the inflammatory response. The findings of Su X and the observations of Villar CC find common ground in suggesting that a variation of hormone levels may alter the balance between immune response and tissue destruction (7,9). However this agreement is more theoretical then clinical since these studies rely on observational models or population not directly exposed to GAHT. This leads to a contradiction: the biological mechanism is well supported, but there is no evidence that such alterations lead to clinically significant increase in periodontal pathologies and complications among these patients. This limits the transferability of these findings to dental practice

5.3 GAHT and Implant outcomes

A similar issue emerges in implant dentistry. The studies by Chan Swe N and Van den Bosch MF suggest that GAHT may influence bone turnover, inducing a potential risk for implants osteointegration (4,10). However this hypothesis is not supported by direct clinical data on implant failure or reduced long-term stability. Same for the contribution of Cornejo Ulloa PE, that shows early biological changes, but does not allow a correlation to implant outcomes(8). Practically this means that implant-related risk in patients undergoing GAHT is currently more hypothesized the demonstrated, proving once again that this topic needs to be backed up by more literature focused on clinical and direct data.

5.4 GAHT and salivary alterations

In contrast, salivary alterations represents an area where the literature shows a greater convergence between biological data and clinical implications. Cornejo Ulloa PE finds a consistent changes in salivary composition and microbiota, that can be observed already in the first month of therapy, while Oh JM links these modification to xerostomia (8). Unlike periodontal tissue or bone the transition from biological data to clinical risk is more immediate, especially regarding caries development. Although the limitations remain also in this care, such as small sample size and lack of large scale longitudinal studies. A deeper investigation is still required, such as comparative studies to analyze factors like caries prevalence and quality of life.

5.5 Psychosocial determinants and behavioral modulation of GAHT

The most relevant and underestimated aspect, however, concerns psychosocial factors. The studies by Green AE and Nguyen HB clearly shows that GAHT is associated with an improvement of mental health and wellbeing which translates into a better adherence to health behaviors (2,5). This induces a counterintuitive element, while biological mechanism suggest a possible increase in oral risk, behavioral factors may instead exert a protective effect. In addition to this, as stated by Marshall-Paquin TL, limited access to care may worsen oral conditions more independently of hormone therapy (1). The consequence is that the oral health status of the transgender population cannot be explained exclusively by GAHT, but must be addressed with a multifactorial model in which also social determinants play a role.

6. CONCLUSIONS

The complexity of this topic is amplified also by methodological limitations in the literature. The heterogeneity of GAHT protocols, variability in treatment duration and lack of standardized outcomes make direct comparison between studies difficult. In addition, the frequent use of indirect data and the scarcity longitudinal studies prevent causal relationship from being established. In this scenario the main risk is misinterpreting the role of sex hormones and give them effects that may be mediated by other factors.

From a clinical perspective, in absence of robust evidence, a specific protocol for GAHT patients is not justified, however ignoring potential biological effects would be equally incorrect. A more scientific and ethically correct approach would consist of an individualized risk assessment, with particular attention to signs of periodontal conditions, implant planning and signs of xerostomia, while waiting the emergence of new evidence from future studies.

In conclusion, the current literature does not allow a single, definitive characterization of the impact of GAHT on oral health, but it highlights a dynamic balance between potentially adverse biological factors and behavioral and social determinants that may modulate the risk. The future challenge will not only be to produce more data, but to generate evidence that is clinically meaningful, standardized and directly applicable to dental practice

7. SUSTAINABILITY

An improved diagnostic approach and more accurate clinical protocols for patient undergoing GAHT would generate a benefit beyond individual care. An early identification of periodontal disease, implant related risk and salivary alteration allows a preventive and minimally invasive dentistry, improving the clinical outcomes and reducing the progression of oral diseases.
From a broader perspective this approach contributes to a more efficient allocation of healthcare resources, possibly reducing the need of complex and expensive dental treatment.
Overall optimizing clinical management provides a dual advantage: an improved quality of life and healthcare for the patients and increased sustainability at the system level, both in clinical and economical terms

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9. ANNEXES

ANNEX 1 – Use of Artificial Intelligence

1. Purpose: the purpose of this annex is to address the use of artificial intelligence (AI) tool for the preparation of this TFG
2. Scope of use: AI tools have been adopted exclusively to support language refinement and to ensure the clarity and formal quality of this document. In particular they have been used for grammar correction, sentence structure and use of appropriate scientific terminology in English
3. Author Responsibility: All scientific content, data interpretation, clinical analysis and conclusions found in this work are entirely a responsibility of the author.
4. Limitations: AI outputs were critically reviewed and validated by the author to avoid inaccuracies or inappropriate use of terminology