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ARTICLE

IMPLEMENTATION OF A TELEORTHODONTIC APPROACH AND ITS IMPACT ON WAITING TIMES AT SAN CAMILO HOSPITAL, CHILE

Estrategia de Teleortodoncia e impacto en los tiempos de espera del Hospital San Camilo, Chile

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ABSTRACT

Aim: Determine the impact of orthodontic referrals, using a teleorthodontic approach on waiting times for care among patients with progressive anomalies in the province of San Felipe, Chile.

Material and Methods: An observational, descriptive, and retrospective study was conducted on patients referred through the *Hospital Digital* platform between March 2022 and March 2023. The study analyzed variables such as waiting times, assigned clinical priority, and the appropriateness of referrals, among others. A nonparametric statistical analysis and adjusted regression models were used.

Results: Among the 173 patients, 94.8% of the referrals were deemed appropriate, and 32.9% were categorized as high priority. The mean waiting time was 218 days (CI: 187–251), which was significantly shorter than the 1,825 days of waiting time reported by the conventional management system.

Conclusion: Teleorthodontics optimizes the use of clinical resources by providing timely care for high-risk patients, particularly those with progressive anomalies classified as high priority. It also enables early diagnosis through the assessment of photographs and radiographs. The integration of this approach into the public healthcare system could help improve access to dental care and the efficiency of orthodontic care.

Keywords: *Orthodontics; Teledentistry; Waiting lists; Delivery of health care; Public facilities; Public hospitals*

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RESUMEN

Objetivo: Determinar el impacto de la derivación a ortodoncia, a través de la estrategia de teleortodoncia, en el tiempo de espera de atención en pacientes con anomalías progresivas en la provincia de San Felipe, Chile.

Materiales y Métodos: Se realizó un estudio observacional, descriptivo y retrospectivo en pacientes derivados a través de la plataforma Hospital Digital entre marzo de 2022 y marzo de 2023. Se analizaron los tiempos de espera, la prioridad clínica asignada, la pertinencia de las derivaciones, entre otras variables. Se realizó un análisis estadístico no paramétrico y modelos de regresión ajustados.

Resultados: De los 173 usuarios, el 94.8% de las interconsultas fue pertinente y el 32.9% fueron categorizados con prioridad alta donde el tiempo de espera promedio fue de 218 días (IC:187-251), significativamente menor a los 1.825 días informados por el sistema de gestión de tiempos de espera del sistema convencional.

Conclusión: La teleortodoncia optimiza recursos clínicos al atender oportunamente casos de riesgo mayor, como anomalías progresivas de alta prioridad, permitiendo el diagnóstico precoz con fotografías y radiografías. La incorporación de esta estrategia en el sistema público podría contribuir a mejorar el acceso y eficiencia en la atención ortodóncica.

Palabras clave: *Ortodoncia; Teleodontologia; Listas de espera; Atención a la salud; Instalaciones públicas; Hospitales públicos*

INTRODUCTION

Health inequities are reflected in gaps in service coverage, financial barriers to treatment, and long waiting times, disproportionally affecting vulnerable populations. In the field of oral health, these inequalities are further exacerbated by multiple social determinants, including sociocultural, economic, environmental, and behavioral factors. Poverty and rural residence, in particular, are major barriers to equitable access to dental care. In this context, the Chilean public healthcare system reflects this problem by evidencing a high burden of oral diseases across all stages of life. Access to public dental care in Chile begins at the primary care level (PC), which plays a fundamental role in promoting oral health and preventing disease.

However, dental specialties, such as orthodontics, are generally provided at the secondary and tertiary care levels, posing significant challenges in terms of accessibility and waiting times.[1]

Dento-maxillary anomalies (DMAs) refer to a group of abnormalities affecting the growth, development, and physiology of the anatomical structures of the stomatognathic system, thereby altering their form, function, and aesthetics.[2] According to the World Health Organization (WHO), malocclusion is the third most prevalent oral health condition, following dental caries and periodontal disease.[3] Some DMAs are progressive and, if not treated promptly, they may have serious consequences for dental aesthetics and function and may even compromise the integrity of the teeth. At San Camilo Hospital in San Felipe, Chile, the anomalies given priority include Class III malocclusions in patients with mixed dentition and impacted anterior teeth.

Class III is considered a progressive DMA characterized by excessive mandibular growth relative to maxillary growth in the sagittal plane. Its clinical manifestations vary in severity and may include anterior crossbite, a concave facial profile, and maxillary growth deficiency. Some patients may require surgical orthodontic treatment once active growth has ceased. Non-surgical management of Class III malocclusion remains a challenge in orthodontic practice. However, early diagnosis and timely intervention may help reduce the burden of severe malocclusion in late adolescence.[4-7]

Dental impaction is a common concern in orthodontic practice, and early detection and intervention can help prevent several complications.[8] Delayed treatment increases the risk of damage to adjacent teeth, sometimes leading to resorption and even tooth loss.[9]

In the Chilean Public Healthcare Service, these anomalies are managed by orthodontists at the secondary care level. There are referral protocols to help primary care providers (at lower-complexity hospitals) in determining which patients should be referred for specialist assessment.

Traditionally, referrals have been submitted in paper or electronic format by primary care dentists, with priority assigned according to established protocols and the length of time the patient has been on the waiting list.

In March 2022, teleorthodontics (TO) was implemented as a pilot project. Through a digital platform (Hospital Digital), primary care dentists submit referrals accompanied by clinical photographs, radiographs, and other predefined information. This allows orthodontists to directly assess each case and establish a presumptive diagnosis, propose a treatment plan, and recommend either management at the primary care level or referral to a higher level of care. Following the implementation of the teleorthodontic approach, the conventional referral pathway continued to operate in parallel.

Thus, the teleorthodontic platform served as a complementary mechanism rather than a replacement for the existing system. Its use was left to the discretion of the primary care dentist, depending on the need to confirm the appropriateness of treatment, assess the patient's condition and determine the clinical priority of each case. The aim of this study was to determine the impact of the teleorthodontic (TO) referral approach on waiting times for care among patients with progressive dento-maxillary anomalies in the province of San Felipe, Chile.

MATERIALS AND METHODS

Study Design

An observational, descriptive, retrospective study was conducted to analyze the waiting times among patients referred for orthodontic care. The study covered the period from March 2022 to March 2023.

Sample

A total of 602 patients were included in the study: 173 referred through the teleorthodontic (TO) approach and 429 through the conventional referral system. Data from patients with incomplete clinical records were excluded from the analysis.

The group referred through conventional pathways lacked the clinical information required to assess comparable clinical variables. Therefore, this group was used exclusively as a control group for the analysis of the "waiting time" variable. Consequently, no equivalent comparative analyses were conducted between the two groups.

Variables

The primary variable of the study was waiting time, defined as the number of days elapsed between the date of referral and the date of admission to orthodontic care. For patients who had not yet been admitted to care at the time of analysis, waiting time was calculated up to the study cutoff date.

Sociodemographic variables (gender, age, FONASA income bracket, and proximity to the treatment center), clinical variables (facial profile, symmetry, and degree of dental crowding), and process-related variables (assigned priority and relevance of the referral) were also collected. Sociodemographic information is recorded by the primary care provider at the time of referral, whereas clinical variables are assessed by the orthodontist responding to the digital referral request.

Relevance or appropriateness was determined based on the criteria established in the Aconcagua Health Service's Referral and Counter-Referral Protocol for Orthodontics and Dento-Maxillary Orthopedics.[10] The assessment was performed by a single orthodontist, who is also responsible for the teleorthodontic approach.

Statistical Analysis

Descriptive analyses were performed to characterize the study population using frequency distributions and summary statistics. Differences in waiting times across priority groups were assessed using nonparametric statistical tests, such as the Mann-Whitney U test (Wilcoxon rank-sum test), and regression models, including negative binomial regression and Poisson regression, adjusted for relevant covariates. The significance level was set at 0.05. All analyses were performed using the statistical software STATA MP 15.0.

Ethical Considerations

The study was based on secondary data previously collected within the healthcare system, ensuring the confidentiality and anonymization of patient information. As the study did not involve direct interventions nor the collection of sensitive data, it was classified as low risk. The research was approved by the Scientific Ethics Committee of the Aconcagua Health Service (Letter C.E.C. 50/2023).

RESULTS

Data from 173 patients with complete records from march 2022 to march 2023 were analyzed. Of these, 51.4% were female, 56.65% were 3 to 9 years of age, and 61.8% resided outside the municipality where the hospital is located. Additionally, 94.8% of the referrals were deemed appropriate or relevant, while 32.9% (57 patients) were classified as high priority (Table 1).

The vast majority of referrals classified as high priority involved patients under 13 years of age, with the 3-to-9-year-old age group being the most frequently represented. This age group was also the largest among referrals classified as low priority (Figure 1).

The mean waiting time was 218 days (CI: 187–251), compared with the benchmark of 1,825 days of waiting time reported by the Waiting Time Management System (SIGTE, for its acronym in Spanish). Among patients referred through the TO approach, the low-priority subgroup had a mean waiting time of 622 days, calculated as of June 24, 2024 (Figure 2). Separate waiting times figures for the conventional group were not available, as SIGTE reports only aggregate data by specialty. The Mann-Whitney test revealed a significant difference in waiting days between the high-priority and low-priority groups ($z=10.06$, $p<0.001$).

Figure 1

Frequency of referrals by priority and age group

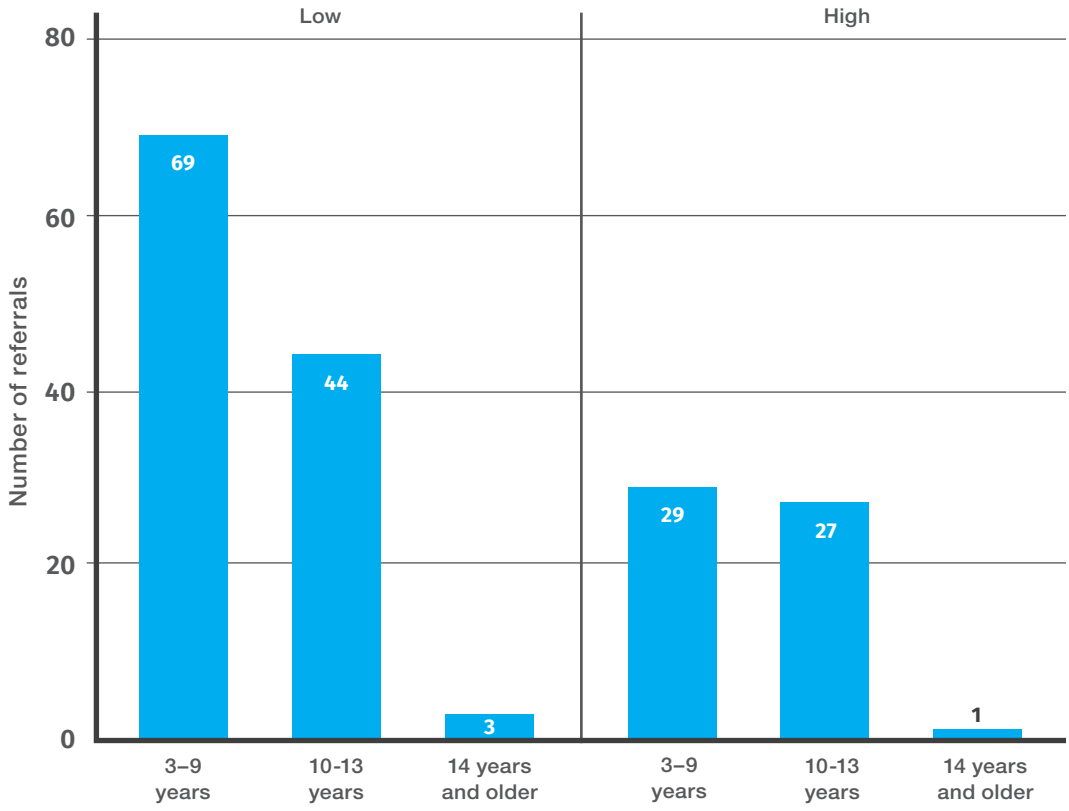


Figure 2

Comparison of waiting times in teleorthodontics by referral priority level

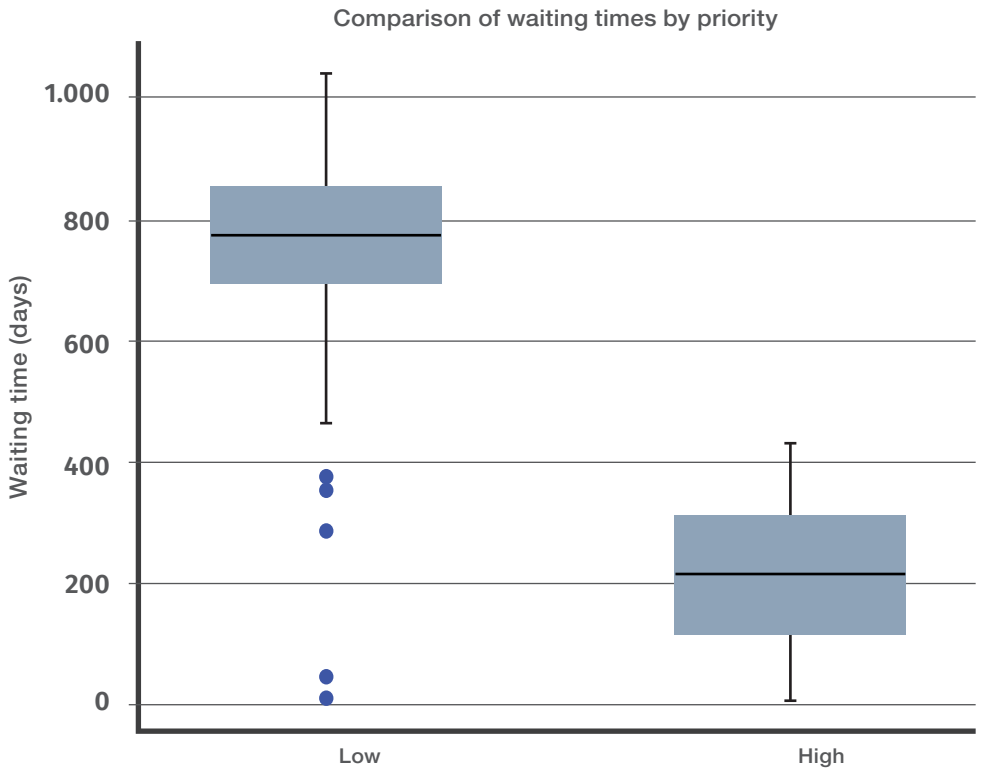


Table 1
Sociodemographic characteristics of the study population

		Frequency	Percent	Cumulative Percent
Gender	Female	89	51.45	51.45
	Male	84	48.55	100.00
Age	3 to 9 years	98	56.65	56.65
	10 to 13 years	71	41.04	97.69
	14 years and older	4	2.31	100.00
FONASA income bracket	A	83	47.98	47.98
	B	46	26.59	74.57
	C	22	12.72	87.28
	D	22	12.72	100.00
Percent of Appropiateness	No	9	5.20	5.20
	Yes	164	94.80	100.00
Priority	Low	116	67.05	67.05
	High	57	32.95	100.00
Proximity to HSC	Distant	107	61.85	61.85
	Nearby	66	38.15	100.00

The low-priority group had significantly higher waiting days compared with the high-priority group. The Shapiro-Wilk test indicated that the waiting days variable was not normally distributed ($p<0.05$). The median number of waiting days in the low-priority group was 782 days, with an interquartile range (IQR) of 162.5, ranging from a minimum of 8 days to a maximum of 1,045 days. In contrast, the high-priority group had a median of 216 days (IQR: 196), with a minimum of 7 days and a maximum of 432.

In the total sample (n = 173), the median was 696 days (IQR: 544), with a range of 7 to 1,045 days. A negative binomial regression model was used to assess the association between waiting days and referral priority. The results indicated that the high-priority group had significantly fewer waiting days than those in the low-priority group (coeff. = -1.2447, $p< 0.0001$).

A Poisson regression model was used to evaluate the factors associated with referral priority, including profile (convex or concave), symmetry, upper dental crowding (mild, moderate, or severe), and lower dental crowding (mild, moderate, or severe). A concave profile was the only factor significantly associated with priority (coeff. =0.957, $p=0.003$), suggesting that patients with a concave profile were more likely to be classified as "high" priority than those with a convex profile. In contrast, the variables of symmetry, upper dental crowding, and lower dental crowding were not significantly associated with the priority variable, as their coefficients were close to zero and their p-values exceeded 0.05.

Therefore, these findings suggest that a concave profile may be an important factor in determining priority classification in the context studied, whereas other characteristics, such as dental crowding and symmetry, do not appear to influence this classification.

DISCUSSION

Regarding waiting times, a substantial reduction was observed compared with historical data reported by the SIGTE, from a mean of 1,825 days to 218 days. However, considerable differences remained according to priority classification: patients classified as high priority had a median waiting time of 216 days, while those classified as low priority had a median of 782 days.

This difference was statistically significant ($p<0.001$), according to the Mann-Whitney test. The negative binomial regression model confirmed that high-priority classification was associated with significantly shorter waiting times. Meanwhile, the Poisson regression analysis revealed that a concave facial profile was the only factor with a statistically significant association with high-priority classification, suggesting its clinical relevance in decision-making regarding priority assignment. In contrast, other clinical variables, such as facial symmetry and degree of dental crowding, showed no significant associations.

Waiting lists for orthodontic care in the Chilean hospital system can be managed through strategies aimed at regulating both demand and supply. In this context, supply management should not be restricted to administrative aspects but should also incorporate clinical criteria, as diagnoses vary in complexity and some may require more complex treatments that entail higher costs for the healthcare system. Timely intervention can help reduce these costs while also improving patients' quality of life.[10]

The implementation of teleorthodontics through the *Hospital Digital* platform has made it possible to optimize the use of clinical resources by prioritizing high-risk cases, such as patients with progressive anomalies, including skeletal Class III malocclusions and impacted teeth. This approach relies on preliminary diagnoses based on photographs and radiographs, which is not feasible under the conventional referral system.

The findings of this study show that teleorthodontics not only significantly reduces waiting times for high-priority cases but also allows for earlier intervention in vulnerable pediatric populations. Patients referred through this pathway are mostly between the ages of 3 and 9 and belong primarily to the Category A of the Chilean National Health Fund (FONASA, for its acronym in Spanish), which provides free public healthcare services to low-income individuals. This indicates that the strategy primarily benefits populations with greater socioeconomic vulnerability. Furthermore, a high proportion of these patients reside outside the hospital's service area, highlighting the approach's potential to overcome geographical barriers to healthcare access.

Various studies have identified geographic and socioeconomic barriers, along with limited availability of dental services, as common factors contributing to poor oral health among children.[11] In this regard, teleorthodontics represents a valuable public health tool, as it facilitates access to care, reduces diagnostic time, eliminates unnecessary travel, optimizes the allocation of specialists, and lowers costs, without compromising the quality of care.[12] In the case of the San Camilo Hospital in San Felipe, the experience with teleorthodontics has demonstrated positive outcomes, including reduced waiting times, timely intervention in patients with progressive anomalies, and the prevention of more complex treatments, resulting in improved prognoses and better quality of life for patients.

Similar experiences have been reported in other settings. In Northern Ireland, for example, the introduction of teledentistry

in 2005 enabled the effective prioritization of oral medicine cases.[13]

Similarly, Berndt *et al.*,[14] noted that, when direct referral to an orthodontist is not feasible, interceptive treatments performed by general dentists under remote supervision offer a viable alternative for reducing the severity of malocclusions.

Furthermore, conditions such as dental impaction have a multifactorial etiology and require an interdisciplinary approach. Early detection of these anomalies, which are often referred by general dentists, makes it possible to prevent complications through timely interventions.[7]

A relevant example is anterior crossbite, which may indicate an underlying skeletal discrepancy, such as skeletal Class III malocclusion. In such cases, early referral to an orthodontist is recommended to assess the possible need for treatment with maxillary protraction appliances. The literature indicates that maxillary protraction is most effective when performed during early mixed dentition stage, with skeletal changes resulting in up to 3 mm of maxillary advancement. Such treatment may help avoid the need for orthognathic surgery in adulthood.[15]

Limitations

One limitation of this study was the inability to perform a survival analysis because of the lack of variability in waiting times among patients in the high-priority group. This limited variability meant that the study data did not meet the necessary assumptions for applying survival analysis methods, such as the Kaplan-Meier estimate or the Cox model, resulting in calculational errors when these methods were attempted.

Consequently, nonparametric and regression statistical analyses were used instead. These methods allowed for an appropriate assessment of differences between groups without requiring the data to follow a normal distribution. The group managed through conventional methods lacked the clinical information required to assess comparable clinical variables. For this reason, equivalent comparative analyses between the two groups could not be performed.

It is important to acknowledge that a limitation of the study is that its findings are restricted to the local context of the San Camilo Hospital and its referral network. Therefore, their absolute generalization to the national context should be approached with caution. Nevertheless, since the referral protocols and clinical guidelines applied at this medical center are closely aligned with the technical standards recommended by the Chilean Ministry of Health (MINSAL, for its acronym in Spanish) for facilities in the Chilean public healthcare system, this experience provides a valuable precedent. Although operational capacities may vary across regions, the standardized structure of the *Hospital Digital* platform suggests that the teleorthodontic model described in this paper includes design features that could be adapted and used as a reference by other Health Services facing similar challenges with their waiting lists.

CONCLUSIONS

Teleorthodontics optimizes the use of clinical resources by providing timely care for high-risk cases, such as patients with progressive anomalies, and enables preliminary diagnoses based on photographs and radiographs, an approach that is not feasible under the conventional referral system. Teleorthodontics reduces waiting times for cases classified as high priority. These findings demonstrate the sustainability of teleorthodontics and its potential

to strengthen the public healthcare system. Currently, it is necessary to regulate various aspects, such as privacy, data protection, informed consent, and measures to prevent data loss throughout the entire intervention process. Furthermore, all dental professionals using the *Hospital Digital* platform must receive proper training, and the platform must be fully accessible to the dentists.

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CONFLICT OF INTERESTS

The authors declare no conflict of interest.

ETHICS APPROVAL

Study was approved by the Scientific Research Ethics Committee of the Aconcagua Health Service (Servicio de Salud Aconcagua) C.E.C 50/2023.

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