ASO Foundation for Research & Education

The ASOFRE is committed to maintaining a high standard of orthodontic education in Australia and supporting scientific and clinical research that explore methods for improved evidence-based orthodontic care.

Increased industry disruptors, including the rise of direct-to-consumer companies, encourage consumers to adopt more convenient and cheaper treatment options.

The ASO Foundation for Research and Education continues to focus on investing in orthodontic research and education to advance the field and keep members at the forefront of advancements in treatment and care.

ASOFRE 60th anniversary

In 2021, the ASOFRE celebrated 60 years in operation. Established following a bequest from the ASO's first President, Dr Stanley Wilkinson in 1961, the Foundation grew over the years and today it is in a strong financial position largely thanks to the generosity of ASO members and our corporate sponsors – in particular Henry Schein.

This is an exceptional milestone for ASOFRE and the ASO and it wouldn't have been possible without the ongoing support of ASO members over 6 decades.

2021 Foundation meeting

For the first time in ASOFRE history, due to the COVID-19 pandemic, the Foundation meeting was delivered in a virtual format on 13 March 2021. The change in delivery mode didn't deter attendance with over 280 delegates and speakers viewing the event remotely.

The invited speakers delivered a varied, relevant and engaging program. Emeritus Professor Laurie Walsh from The University of Queensland discussed the current COVID-19 protocols for orthodontic clinics, and the progress and efficacy of the COVID-19 vaccines and rollout programs. Associate Professor Maurice Meade presented some of the research currently being undertaken at the University of Adelaide. This included orthodontic social need indices and recommendations on avoiding root damage using TADs.

Drs Tony Weir and Vicki Vlaskalic discussed the management of overbite correction and arch expansion with the Invisalign system and made clinical recommendations based on scientific evidence. Finally, Professor Mauro Farella from the University of Otago, New Zealand, discussed the current evidence of aetiology and management of Bruxism and how it relates to the profession.

2023 Foundation Meeting planning is underway. The Committee is planning a joint meeting with the Australian and New Zealand Association of Oral & Maxillofacial Surgeons (ANZAOMS) and details are being finalised.

Congratulations to our 2021 ASOFRE Award winners

The 2021 Elsdon Storey Award for the most meritorious research paper was awarded to Haylea Blundell. Originally from Victoria, Haylea relocated to Brisbane in 2018 to undertake her orthodontic training at the University of Queensland. Haylea won the Award for her project "Predictability of overbite control with the Invisalign appliance" which is now available in the American Journal of Orthodontics and Dentofacial Orthopaedics.

Congratulations are also in order to Bethany Cunning from the University of Melbourne who was recognised with a Special Merit Award for her paper *"Comparative assessment of survival, stability and occlusal settling between two types of thermoplastic retainers: a prospective clinical trial."*

BETHANY CUNNING
Special Merit Award

HAYLEA BLUNDELL
Elsdon Storey Award

New ASOFRE members

We would like to introduce the new ASOFRE committee members Drs Simon Toms and Derek Allen. The Foundation welcomes them and appreciates their contribution and dedication to the Committee.

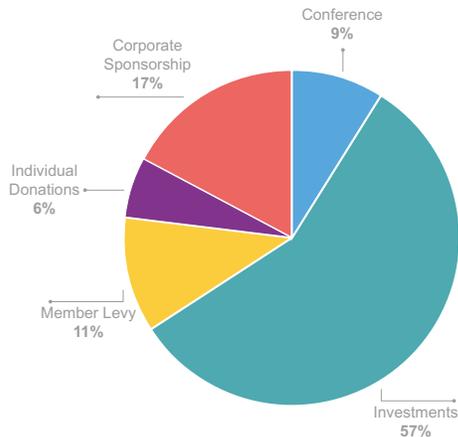## ASOFRE's income and expenses in 2021

Every year, income earned from the ASOFRE's substantial investment funds continue to be the main source of revenue, with levies and individual donations from members and/or patients on their behalf being another important income stream.

In 2021, members contributed close to 60K to the Foundation and the ASO extends its sincere gratitude to members for their continued support. The ASO would also like to thank our sponsors, in particular Henry Schein, for their support. This year our corporate supporter Henry Schein contributed close to $90K.
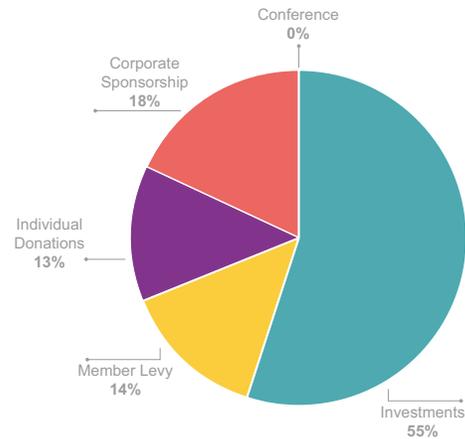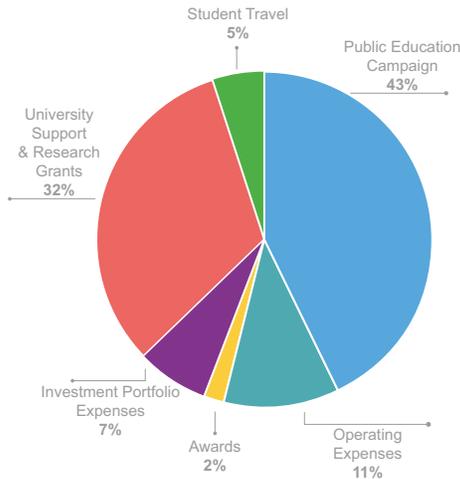
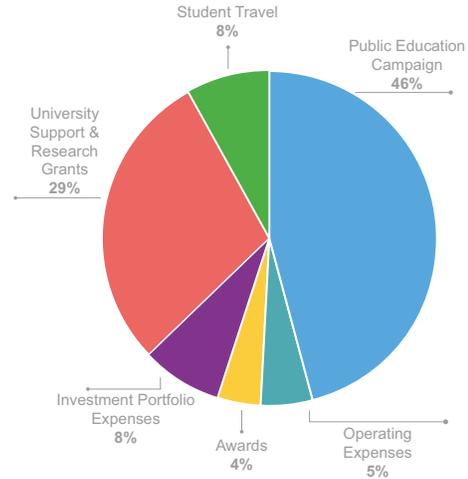**Chris Theodosi**
Chair, ASOFRE

FRE Income in 2021

Conference 9%
Corporate Sponsorship 17%
Individual Donations 6%
Member Levy 11%
Investments 57%

FRE Income in 2020

Conference 0%
Corporate Sponsorship 18%
Individual Donations 13%
Member Levy 14%
Investments 55%

FRE Spending in 2021

Student Travel 5%
Public Education Campaign 43%
University Support & Research Grants 32%
Investment Portfolio Expenses 7%
Awards 2%
Operating Expenses 11%

FRE Spending in 2020

Student Travel 8%
Public Education Campaign 46%
University Support & Research Grants 29%
Investment Portfolio Expenses 8%
Awards 4%
Operating Expenses 5%

GRATEFUL PATIENT PROGRAM

In addition to ASO members donations and corporate sponsorship, the Foundation has also been funded by the donations of grateful patients. We thank the ASO members who have been encouraging their patients to make a tax-deductible donation to the Foundation via the Grateful Patient Donation Program. A downloadable donation form is available on the ASO website here aso.org.au/support-us

2021 Project Highlights

CAITLIN STEPHENS
University of Queensland

Clinical expression of programmed mandibular canine rotation using various attachment protocols with Invisalign® SmartTrack® aligners

Invisalign is a highly popular, aesthetic orthodontic treatment alternative to fixed appliances. In the past decade the number of Invisalign® trained doctors has significantly increased from 60,800 in 2010 to 168,691 in 2019.[1] While Invisalign® is a welcome addition to the orthodontists' armamentarium, there are sparse and often low-level scientific data available concerning the appliance's precision. Due to its digital nature, Invisalign® undergoes rapid evolution. However, this presents a scientific challenge to produce research fast enough to verify the existing product claims. Any long-term studies lose applicability as the appliance changes and relevance of past literature diminishes. This research focuses on mandibular canine rotation since this tooth and movement has been identified as notoriously difficult with aligners.[2-7] It further investigates the influence of prescribed resin attachments types and wear schedules and their effect on rotation expression. To our knowledge, no existing study has specifically investigated this tooth and movement with SmartTrack aligners or its relationship to attachments and wear schedule.

Materials and methods

Data were sourced from the Australasian Aligner Research Database (AARDVARK), courtesy of the database gatekeeper, Dr Tony Weir. This database contains data from experienced private practitioners only, from 2013-current, using Invisalign® aligners only, with no selectivity of cases provided (all cases whether successful or not must be submitted to database). The final sample was retrieved from the database in August 2021.

Data were collected for 25 patients for each of the three Invisalign® SmartTrack® aligner attachment configurations. Tooth '33' was chosen for majority of patients in each group (OR1: 56%, OR2: 76%, V2: 64%), with predicted rotation mostly in the positive direction (OR1: 72%, OR2: 72%, V2: 52%). Four patients overall had achieved rotation in the opposite direction to predicted rotation; with one patient in each of OR1 and OR2, and two patients in V2.

The primary aim for testing accuracy through equivalence testing of predicted to achieved rotation for each of the Invisalign® procedures using a paired two one-sided tests (TOST) approach is shown in Table 1. For all three groups, TOSTs indicated there were not enough statistical evidence to indicate the predicted rotation was equivalent to achieved rotation ($p>0.05$) at a ±5° equivalence margin. This indicates that none of the Invisalign® SmartTrack® aligner attachment configurations display accuracy in their predicted rotation. The mean difference for all groups was not within the allowed equivalence margin, with negatively biased estimates indicating the predicted rotation overestimates what can be achieved.

IHSAN SAVRAN
University of Sydney

Maxillary sinus volume for prediction of mandibular advancement splint response in obstructive sleep apnoea patients

Mandibular advancement splint (MAS) therapy is an effective treatment for obstructive sleep apnoea (OSA), however difficulties in predicting treatment response is a challenge to its use. It was recently established that the volume of the maxillary sinuses and nasal airway are associated with the OSA severity, however, their relationship to the success of MAS treatment has not been assessed. Therefore, the primary objective of this study was to retrospectively assess the maxillary sinus, nasal and pharyngeal airway parameters between responders and non-responders. The secondary objective of this study was to produce a predictive model with these variables to determine MAS treatment response.

Methods

Sixty-nine adult patients (mean age of 53.5 ± 10.8 years, 67% male) with OSA (AHI > 10 events/h) were previously recruited from a sleep disorders clinic for treatment with a customised MAS. Baseline demographic and anthropomorphic information, as well as, polysomnographic (PSG) and cone-beam computed tomography (CBCT) were taken. Follow up PSG with the MAS in situ was then taken following a 6-week acclimatisation period.

Treatment response was defined as a post-treatment AHI < 10 events/h in addition to a ≥ 50% reduction in AHI. Maxillary sinus, nasal and pharyngeal airway parameters were measured from the CBCTs and compared between the responders and non-responders. A multiple logistic regression model for treatment success was created based on the most significant predictor variables.

Results

There were 39 responders and 30 non-responders. Baseline BMI was the only variable that was significantly different (p = 0.006) between responders (27.5 ± 3.5 kg/m2) and non- responders (30.7 ± 5.2 kg/m2). The multiple logistic regression model included the following significant and marginally significant variables: male gender, BMI, left maxillary sinus volume, maxillary cross-sectional area and maxillary sinus/nasal cavity ratio. The predictive accuracy in terms of the area under the ROC (receiver operating characteristic) curve was 0.81 (95% CI 0.71, 0.91).

Conclusion

In this retrospective study, no differences were found in maxillary sinus, nasal and pharyngeal airway parameters between responders and non-responders to MAS therapy for OSA treatment. A prediction model was produced which suggested, in combination, female sex, a lower BMI, a smaller (left) maxillary sinus volume, an increased maxillary cross-sectional area and an increased maxillary sinus volume/nasal cavity ratio may be predictive of MAS 4 treatment success. Further study with an independent sample is required to cross-validate the model.

JESSICA KONG
University of Western Australia

The determination of gingival biotype In different craniofacial morphologies

Thin and thick biotypes have been shown to respond differently to orthodontic, periodontal, surgical and restorative treatments (1-6). Thus, it remains an important part of orthodontic practice to readily determine a patient's gingival biotype. In particular, individuals with thin biotypes may respond poorly and be prone to the development of gingival recession following dento-alveolar movements (such as proclination and dental expansion) (7-9). This is especially important to assess in orthodontic patients where, depending on the relationship of the maxilla and mandible, treatment may require such movements for camouflage or decompensation prior to combined orthodontic-orthognathic surgery treatment (10-12).The objective of this study is to determine the association between gingival biotype and thickness across orthodontic patients with different craniofacial morphologies using reliable methods of probing and ultrasound. The null hypotheses are 1) there is no association between gingival biotype or thickness and different craniofacial morphology, 2) there is no difference in the distribution of different thickness or biotype between different craniofacial morphologies.

Materials and methods

Data was collected from 180 pre-orthodontic participants from the Oral Health Centre of Western Australia (OHCWA). The following exclusion criteria was applied: periodontitis (attachment loss of ≥4mm), moderate to severe gingivitis, caries, crowns or restorations of the maxillary and mandibular anterior teeth, were pregnant or lactating, were smokers or were taking or had a history of taking any medications that are known to cause gingival enlargement (calcium antagonists, cyclosporin A, phenytoin).

Using ultrasonographic images, the thickness of the labial gingiva of the maxillary and mandibular anterior teeth were measured by a dental and maxillofacial radiologist at the level of the alveolar crest on a bucco-lingual cross section of the enamel, gingiva and crest of the alveolar bone (Figure 1). Gingival biotype was assessed by one examiner using the Colorvue® Biotype Probe inserted into the gingival sulcus at the mid-labial aspect of each mandibular and maxillary anterior tooth with minimal pressure. Gingival recession and the width of the keratinized gingiva were also recorded using a standard periodontal probe.

Based on pre-treatment lateral cephalometric radiographs, participants were divided into 3 groups: skeletal Class I ($0° < ANB < 4°$), Class II ($ANB > 4°$), Class III ($ANB < 0°$) and subgroups of hyperdivergent ($SN\text{-}Md > 37°$), normodivergent ($SN\text{-}Md\ 30\text{-}37°$), hypodivergent ($SN\text{-}Md < 29°$). Maxillary and mandibular incisor proclination was also measured.

Using the above data points, this study aims to calculate whether any significant association between gingival biotype and thickness and craniofacial morphology exists. Statistical analysis is currently ongoing and it is anticipated these results will inform clinicians on soft tissue limitations in patient's with certain craniofacial morphologies.

MIODRAG MLADENOVIC
University of Adelaide

The influence of second premolar extractions on the volume of the oral cavity. A control comparative CBCT volumetric analysis.

Premolar extractions as part of orthodontic treatment have been considered to result in overall retraction of the anterior teeth and a subsequent reduction of available space for the tongue and intraoral soft tissues. In addition, it has been further considered that extraction patients were rendered susceptible to an increased risk of obstructive sleep apnoea. Therefore, the aims of the study were to compare the volumetric changes within the oral cavity before and after orthodontic treatment in extraction and non-extraction samples and to identify influencing variables.

Materials and methods

To provide a three-dimensional volumetric assessment, cone-beam computed radiography scans were acquired of the oral cavity before and after orthodontic treatment of both extraction and non-extraction samples. Fifty-four extraction and 59 non-extraction patients were matched for the level of crowding. The average age of both samples was 15 years old. The images were individually landmarked using a engineered algorithm and subsequently processed for volumetric, linear and angular measurements. The results were statistically analysed using repeated measures analysis of variance, correlations and stepwise regression analyses.

Results

A statistically significant increase in the volume of the oral cavity was found in both the extraction and non-extraction groups. A non-extraction/control group presented a larger increase in oral cavity volume. Gender, age, a change in mandibular and maxillary arch length, along with a change in mandibular and maxillary intermolar width all influenced the change in the oral cavity volume. Twenty-nine percent of the difference between the samples can be explained by gender, a change in mandibular and maxillary arch length plus a change in maxillary intermolar width.

Conclusion

The study concluded that the volume of the oral cavity increased in growing patients with or without extractions and orthodontic treatment; however, cases, which were not treated by extractions had a greater overall increase.
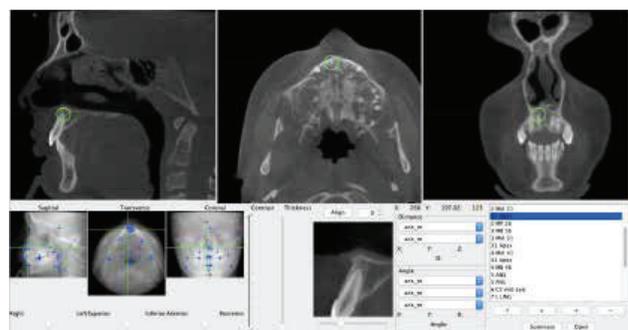

Figure. A screen capture of the landmarking algorithm created by Takeshi Matsumoto to identify and define the oral voume

SARAH ROATH
University of Melbourne

Temporospatial expression of ankylosis-related proteins in mouse tooth germs.

Primary molar ankylosis, the pathologic fusion of teeth to the surrounding bony socket, often results in deleterious consequences on both adjacent teeth and bone especially in actively growing individuals. The molecular aetiology and pathogenesis of primary molar ankylosis was previously elusive until recent studies from the University of Melbourne demonstrated a series of genes that were differentially expressed in the furcal bone and periodontal ligament of infraoccluded primary molars. The present study aimed to investigate the temporospatial expression of six key proteins (with genes differentially expressed in ankylosed primary molars) during tooth germ development, to provide clues as to their possible functions during development and in turn their contributions to ankylosis.

Materials and Methods

Wild-Type mouse mandibular first molar teeth were used at key developmental time points E16, P1, P24 and P31 representing the early bell-stage through to root development stage of the tooth germ. Samples were fixed, decalcified (P24 and P31), paraffinized and sectioned. Six proteins of interest were selected based on their significant role in biological pathways previously found to be enriched in infraoccluded primary molars, combined with putative links to ankylosis in the existing literature. Immunofluorescent staining was carried out to determine the expression of four proteins with genes over-expressed in infraocclusion and two proteins with genes under-expressed in infraocclusion. These proteins were subsequently visualised using confocal microscopy.

Results

Haematoxylin and Eosin staining showed overall good preservation of tissue architecture, however only E16 and P1 proved to have viable structural integrity post-immunostaining. Immunofluorescent detection of the six candidate proteins revealed marked patterns of expression during tooth development, including detailed intracellular expression in ameloblasts and odontoblasts, and extracellular expression within and surrounding the maturing alveolar bone

Conclusions

The results of the present study demonstrate that key proteins involved in ankylosis are expressed in early tooth germ development, recorded at a level of detail not previously observed in the literature, and providing vital clues as to their roles in both.