



ADEE Annual Conference: Barcelona, Spain  
Science and the competent dentist: an inter-  
professional perspective  
24-26 August 2016



## Local Context



### Concepción City, Bio-Bio Region, Chile

The Great Concepción area, is a metropolitan area located in the south-central Chile, consists of ten communes, with a little over a million people, located in the Bio-Bio region.



Famous for its Earthquakes and tsunamis, which razed the town in 1570, 1657, 1687, 1730 and 1751, led the authorities to move the town to its current site.



UNIVERSIDAD  
SAN SEBASTIAN



*"Usefulness perception of dentists, academics and students of the VirTeaSy haptic virtual reality simulator in dental education"*

Marcelo A. Fernández Sagredo, DDS, MEd

### Mecesup Project: Curricular Articulation and Innovation of the Teaching Learning

#### Process

- Improvement of Quality, Equity and relevance in Chilean Higher Education
- Financing coordinated by the Chilean government, that encourages and facilitates higher levels of excellence in Chilean higher education (External: The World Bank input: Euros \$250.000 aprox.)
- 5 VirtEasy haptic virtual reality simulators for 3 different University headquarters, in use 2016.



## Local Context



### Concepción City, Bio-Bio Region, Chile

#### Superior Education: (Colleges and Universities)

- 6 Dental Schools
- 4 Traditional Universities
- 10 Private Universities
- 12 Professional Institutes



## Ongoing Research



#### Objectives:

- Validate the use of the HVR Simulator as a tool for teaching in Dentistry.
- Incorporate the use of the HVR Simulator to preclinical, clinical and post-graduate programs with a stronger scientific background.



## "VirTeaSy Implant Pro" Characteristics



#### Exercises:

- **4 Familiarization** (Blocks, Cross, Key 1 and 2)
- **29 Conservative** (Caries removal, Black's Class 1 and 2 Cavities; and Sista's Cavity preparations in anterior and posterior teeth)
- **4 Root Canal Treatment** (Access cavity preparation for anterior and posterior teeth)



# “VirTeaSy Implant Pro” Characteristics



- **3 Prosthodontics** (Crown Preparations: Full metal, metal/ceramic and full ceramic)
- **32 Implantology** (Treatment planning on CT Scan before implant insertion with expert planning option for single tooth, partial and total edentulism and preclinical exercises)



## Theoretical Framework



HVRS	Haptic Arm	Study	Exercise	Sample Size	Conclusions
IDEA	Phantom	Academic and Student Perception (1)	5 Drilling Tasks (Preclinical)	33 (21/12)	Benefits in Teaching and Self Learning
DentSim	Not Specified	Students Performance; 6 to 10 hours of extracurricular practice (11)	Cavity Preparation	68	Effective training method. Significantly improved first examination performance
PerioSim	Phantom	Dentistry and Dental Hygiene Academics Presentation (2)	Gingival and Dental Realism (Probing)	30	Tactile sensation real for teeth, not gingivitis may aid in developing dental skills and potential self learning
Open Haptics SDK 2.0	Phantom	Novice Vs Experts; Experience Dentists Vs 5 Dental Students (4)	Crown Preparation	10	Simulator can provide objective skill assessment and tutoring feedback comparable to human tutors.
Simodont	Moog's Technology	Comparison between 2D and 3D Vision on First Year Students	Manual Dexterity Exercise (cross)	124	3D Vision has a significant positive effect on students performance

- Gal GB, Weiss E, Gafni N, Ziv A; "Preliminary Assessment of Faculty and Student Perception of a Haptic Virtual Reality Simulator for Training Dental Manual Dexterity"; *Journal of Dental Education*; Volume 75, Number 4, April, 2011.
- Steinberg AD, Bashook PG, Drummond J, Ashrafi S, Zefran M; "Assessment of faculty perception of content validity of PerioSim, a haptic 3D virtual reality dental training simulator"; *Journal of dental education*; volume 77, number 12, diciembre, 2007.
- Rhienmora P, Haddaway P, Suebnukam S, Dalley MN; "Intelligent dental training simulator with objective skill assessment and feedback"; *Artificial Intelligence in Medicine*, 52, 115-121, Elsevier 2011.
- Suebnukam S, Hatadechadusadee R, Suwanmasi N, Supasert N, Rhienmora P, Haddaway P; "Access cavity preparation training using haptic virtual reality and microcomputed tomography tooth models"; *International endodontic Journal*, 44, 983-989, 2011.
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## Theoretical Framework



HVRS	Haptic Arm	Study	Exercise	Sample Size	Conclusions
Open Haptics SDK	Phantom	Novice Vs Experts; Experience Prosthodontics Vs 4 <sup>th</sup> year Dental Students (6)	Crown Preparation	20	Potential to measure and evaluate clinical skill performance, able to clearly distinguish between novice and expert using a VR haptic simulator
FreeForm	Phantom	2 3D CT images transferred and treated to virtual environment in Orthognathic Surgery (8)	Cutting, separation and quantitative rearrangement of bone	2 Cases	Useful for simulating various procedures for orthognathic surgery and three-dimensionally determine surgical movements
VirTeaSy	Phantom	Novice and Simulation Students Vs Expert Dentists (10)	Implant Surgery Drilling	60	Haptic simulator brings a real benefit in training for implant surgery
VirTeaSy	Phantom	Novice (1 <sup>st</sup> year dental students) Vs Experienced (Prothodontic Residents)	Caries Removal	26	First step validation of the device. Experienced subjects removed a greater portion of the carious lesion, but a greater volume of tooth structure

- Suebnukam S, Phatthanasathikul N, Sombattaweeje S, Rhienmora P, Haddaway P; "Process and outcome measures of expert/novice performance on a haptic virtual reality system"; *Journal of dentistry*, 37, 658-665, Elsevier 2009.
- Sahmura T, Hajo H, Nakajima M, Wakabayashi K, Nagao M, Lida S, Kitagawa T, Kago M, Kajima T, Matsumura K, Nakamura K, Takahashi J; "Prototype of simulation of orthognathic surgery using a virtual reality haptic device"; *Int J Oral Maxillofac Surg*; 33, 740-750, 2004.
- Joseph D, Jehl JP, Maurice P, Perrenat C, Miller N, Bovelet P, Ambrosini P, Tran N; "Relative contribution of haptic technology to assessment and training in Implantology"; *Biomed research international*; vol. 2014, article ID 413951.
- Eve E, Koo S, Alshihri A, Cormier J, Kazhenkov M, Doroff R, Karimub N; Performance of Dental Students Versus Prosthodontic Residents on a 3D Immersive Haptic Simulator; *Journal of dental education*; volume 78, number 4, April, 2014.

## Theoretical Framework



HVRS	Haptic Arm	Study	Exercise	Sample Size	Conclusions
DentSim	Non Used	Expert (Operative Dentist) Vs Periodontologists Vs Novice (1 <sup>st</sup> year students) (12)	Class 2 tooth amalgam preparation	18 (6 each)	Valid and reliable tool to capture expert performance, effective screening device for assessing the level of expert.
Not Specified	SensAble Inc. (Phantom creator)	Novice, intermediate Vs Experts to define benchmarking expert criteria	Endodontic cavity preparation	34	Study established construct validity for the haptic VR Dental Simulator by demonstrating its discriminating capabilities between experts and Non.
Self Made Free Form (SensAble)	Not Specified	4 <sup>th</sup> year Dental Students evaluation after training sessions	Caries removal and periodontal probing	33	Self-made simulator was effective at teaching hand skills within short term evaluation
IDEA	Stylus haptic device (SensAble)	Association between the preclinical operative dentistry practical examination scores or PAT scores and performance on haptic simulator exercise	Manual Dexterity Test (D-Circle)	39	The complex haptic exercise was found to be a significant predictor of examination performance in the preclinical setting.

- Wierinck E, Puttemans V, Swinnen S, Van Steenberghe D; Expert Performance on a Virtual Reality Simulation System; *Journal of Dental Education*, vol 71, number 6, June 2007.
- Suebnukam S, Chaisanbat M, Kongpunwijit T, Rhienmora P; Construct Validity and Expert Benchmarking of the Haptic Virtual Reality Dental Simulator; *Journal of Dental Education*, vol. 78, number 10, October, 2014.
- Yamaguchi S, Yoshida Y, Noborio H, Murakami S, Imazato S; The usefulness of haptic virtual reality simulator with repetitive training to teach caries removal and periodontal probing skills; *Dental Materials journal* 2013; 32 (5); 847-852.
- Urbankova A, Eber M, Engbreton S; A Complex Haptic Exercise to Predict Preclinical Operative Dentistry Performance: A Retrospective Study; *Journal of Dental Education*, vol. 77, number 11, November, 2013.

## Ongoing Research



### «Incorporation of a haptic virtual reality simulator in Oral Implantology Post-Graduated Program Curriculum»

Juan Fonseca M. & Marcelo Fernández S.

Universidad San Sebastián, Concepción Headquarters, Chile



## Ongoing Research



### «Incorporation of a haptic virtual reality simulator in Oral Implantology Post-Graduated Program Curriculum»

#### Objectives:

- Provide an environment for learning implantology
- Improve its assessment and proficiency
- Determine the training time necessary in the HVR Simulator for the new post-graduated implantology curriculum

#### Addressed to:

- First year students of the oral implantology post-graduated program at San Sebastian University, Concepción Headquarters, Chile. (12)



## Ongoing Research



### «Incorporation of a haptic virtual reality simulator in Oral Implantology Post-Graduated Program Curriculum»

#### Methodology:

- Students must practice the preclinical exercises on the VirTeaSy HVR Simulator until they are familiarized with the equipment. (Familiarization exercises)
- Must perform the following procedures 8 times corresponding to the virtual “expert” planning furnished by the simulator.
- 2 exercises:
  - a.- 1 Single Gap implant placement (3.5)
  - b.- 2 Partial Edentulism implant placement (4.4 & 4.5)

10. Joseph D, Jehl JP, Maureira P, Perrenot C, Miller N, Bravetti P, Ambrosini P, Tran N; “Relative contribution of haptic technology to assessment and training in Implantology”; Biomed research international; vol. 2014, article ID 413951.

17.- Al-Saud LM, Mushtaq F, Alsop MJ, Culmer PC, Mirghani I, Yates E, Keeling A, Mon.Williams MA, Manogue M; Feedback and motor skill acquisition using a haptic dental simulator; Eur J Dent Educ 2016, Jun 21.



## Ongoing Research



### «Incorporation of a haptic virtual reality simulator in Oral Implantology Post-Graduated Program Curriculum»

#### Methodology:

- Parameters to register in each procedure:
  - 1.- Position difference (in mm)
  - 2.- Average-difference angle (°)
  - 3.- Drilling depth (in mm)
  - 4.- Total time (in seconds)
  - 5.- Actual drilled time (in seconds)
  - 6.- Eventual perforations
  - 7.- How many times plus procedures performed (reference: after 8th)

10. Joseph D, Jehl JP, Maureira P, Perrenot C, Miller N, Bravetti P, Ambrosini P, Tran N; “Relative contribution of haptic technology to assessment and training in Implantology”; Biomed research international; vol. 2014, article ID 413951.



## Ongoing Research



### «Incorporation of a haptic virtual reality simulator in Oral Implantology Post-Graduated Program Curriculum»

#### Student’s perceptions

- Actual feedback from the haptic reality simulator exercises to the first implant placement surgery performed under supervision in a real patient.
- By a questionnaire applied immediately after surgery.

Bioethic’s Advantage:

**THE STUDENT HAS TO APPROVE BOTH EXERCICES BEFORE TO PERFORM HIS FIRST SURGERY!**



## Ongoing Research in Santiago

### USS Simulator Center:

- Objectives:
  - Assess the impact of the use of active teaching strategies and technological development of the first year course of Basic Clinical Integration cycle 1.
  - Determine the level of intrinsic motivation of the students after finalizing the course.
- Methodology
  - 2 Exercises of familiarization (10 min)
  - Black’s Class 2 cavity execution and respective feedback (30 min)
- Address to:  
33 First Year Students



Dr. Mario Zuriaga, Dra. Giorgina Ferri,  
Dr. Felipe Bravo (2016)



## Ongoing Research



### “Usefulness perception of dentists, academics and students of the VirTeaSy haptic virtual reality simulator in dental education”

#### Objective:

“Determine the perception of dental students, dental practitioners and academics from schools of dentistry on the usefulness of haptic simulators in the training of dental students”

#### Sample:

**127 participants** up to July 2016. Distributed in the following way:  
60% 4<sup>th</sup>, 5<sup>th</sup> and 6<sup>th</sup> year students  
10% Dental Practitioners  
30% Dentist who are Academics or Faculty in Dental Education



## Ongoing Research



### “Usefulness perception of dentists, academics and students of the VirTeaSy haptic virtual reality simulator in dental education”

#### Methodology:

- Before the first contact with the haptic simulators each participant received oral supervised and standardized basic instructions, including the study objectives.
- Each participant will practice on the **Cross Preclinical Exercise** for 5 to 10 min; then they perform a **Black’s class 2 cavity** in a Virtual Reality Environment in the HVR Simulator (20 min top).
- A **12 question questionnaire** was build from Steinberg’s publication (2) and mainly by Gal’s (1) work; beside other general information (Age, years of and working experience), also regarding to their experience with 3D technology and gaming. Participants have the chance to voluntarily write down any free comments about their experience.

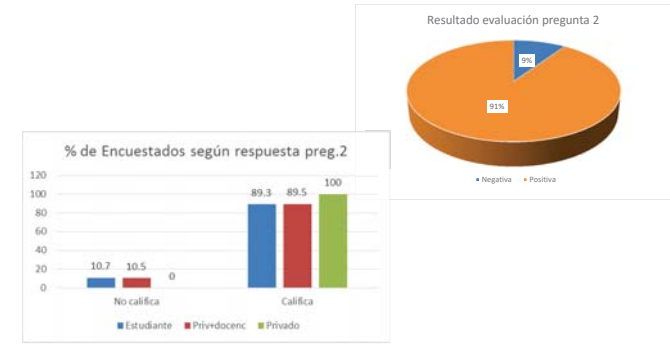
*"Usefulness perception of dentists, academics and students of the VirTeaSy haptic virtual reality simulator in dental education"*

## Results

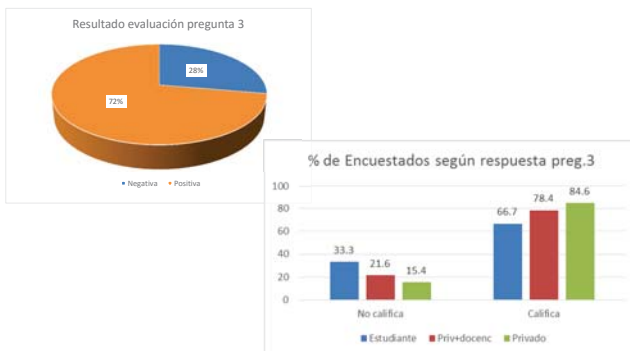
1. To what extent can the simulator be **helpful in teaching manual skills** in dentistry?



2. To what extent can the simulator be **useful in self-training of manual skills** in dentistry?



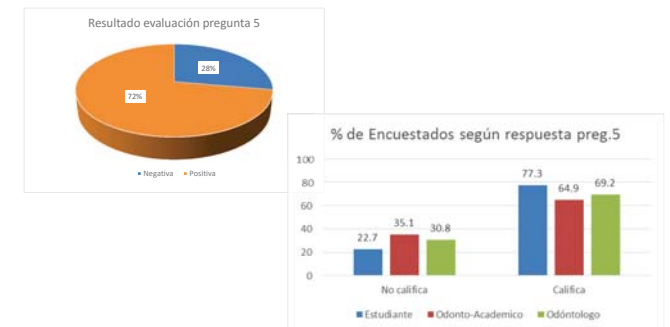
3. To what extent can the simulator be useful in **evaluating manual skills** in dentistry?



4. To what extent is the sensation provided by the simulator similar to **drilling in a real tooth?**



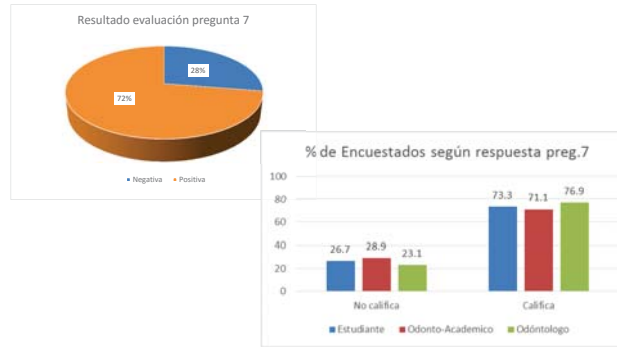
5. To what extent is the sensation provided by the simulator similar to **drilling in an acrylic/marfinite tooth?**



6. To what extent is the **grip** of the simulator similar to a high-speed turbine grip?



7. To what extent is the use of the simulator **comfortable**?



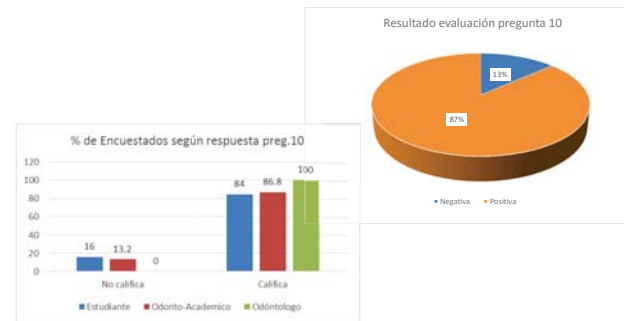
8. What is the extent of your **previous experience with virtual reality simulators**?



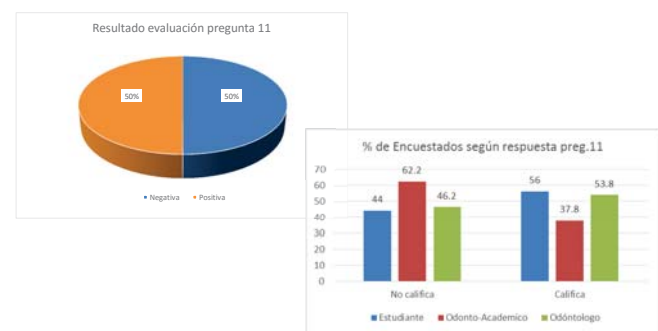
9. What is the extent of your previous experience with **virtual reality haptic simulators**?



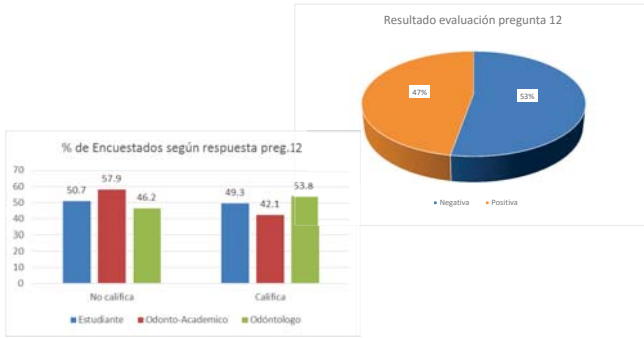
10. Rate your **confidence level in using a computer**



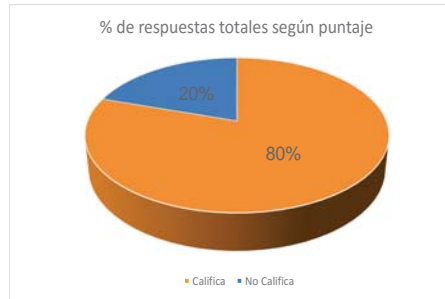
11. What is your level of **experience with Videogames**?



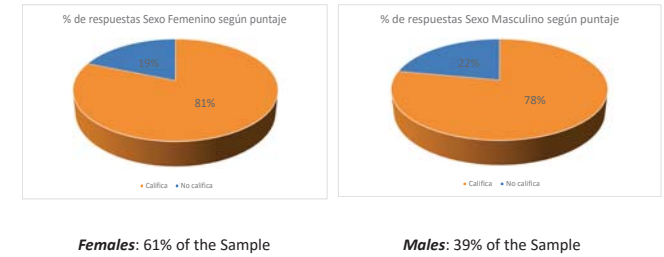
### 12. What is your level of experience with 3D technology?



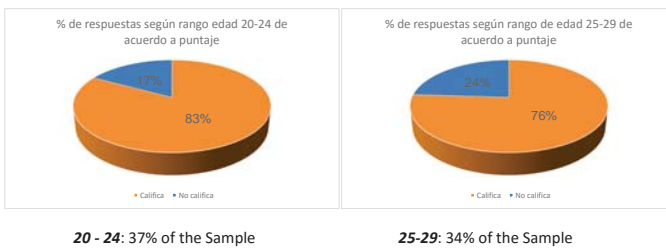
### Sample Distribution of the Answers to Questions 1 to 7



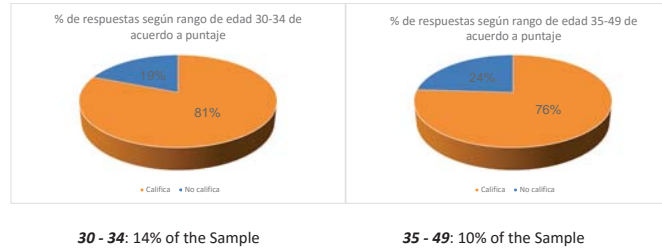
### Gender Distribution of the Answers to Questions 1 to 7



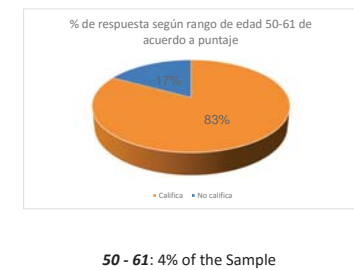
### Age Distribution of the Answers to Questions 1 to 7



### Age Distribution of the Answers to Questions 1 to 7



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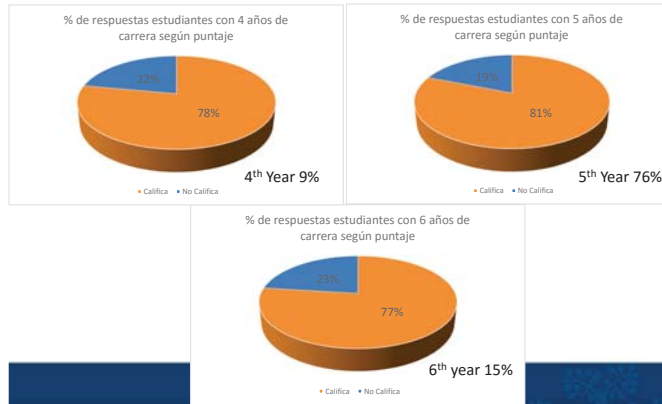


### Distribution of Students Answers to Questions 1 to 7

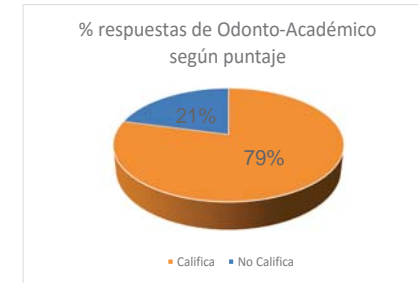


60% of the Sample

### Distribution of Students Answers to Questions 1 to 7



### Distribution of Dentist/Academics Answers to Questions 1 to 7



30% of the Sample

### Distribution of Dental Practitioners Answers to Questions 1 to 7



10% of the Sample

### Free Comments

Comment	Number of Subjects
Lack of water	2
Spatial orientation problems with the 3D	15
Difficulty to handle for a Left Handed	3
Excellent complement to preclinical work (Not replaceable)	9
Headache after use	1
Lack of a good support for the working hand	25
Dizziness after use	3
Excellent technological tool	4
Need for more practice to achieve good performance	5

### Discussion



As it has being published by other studies, were they evaluated perception of students and Faculty, the majority of the participants evaluated as **POSITIVE** their experience with the VirTeaSy HVR Simulator, meaning that could bring **benefits** from it's use in **Teaching and Learning manual skills** in dentistry, differing mildly from Gal's work in parameters like realistic sensation (lower o medium), grip of turbine (medium) and drilling (use of computer mouse).

## Conclusions



*Concepción's students with clinical practice, dental practitioners and dentists/academics rate as **POSITIVE** the use of the VirTeaSy haptic virtual reality simulator in dental education; regardless of their previous experience with a simulator, video-gaming experience, 3D experience, age or gender.*

## Personal Conclusions



There are still **technological improvements** to be made, in the development of:

- A comfortable support for the working hand
  - Better tactile sensation
  - Better 3D spatial orientation
- A Spanish version of the Software (Maybe Tailor-made one)
  - More Maxillary Exercises



USS Concepción Headquarters

Thanks



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