



UNIVERSITI
TEKNOLOGI
MARA

**MAJLIS SYARAHAN
PROFESOR UiTM**

BONE REMODELING DYNAMICS
in Implant Integrated Dental Prostheses

PROFESOR DR. ROHANA AHMAD
Pakar Pergigian Prostodentik

25 FEBRUARI 2025 | 10PAGI - 12TGHARI
Auditorium Al-Biruni, Fakulti Pergigian UiTM, Sungai Buloh

Anggaran
Fakulti Pergigian UiTM

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Majlis Syarahan Profesor UiTM

Bone Remodeling Dynamics in Implant Integrated Dental Prostheses



Program

**(BONE REMODELING DYNAMICS IN
IMPLANT INTEGRATED DENTAL**

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Tajuk : Bone Remodeling Dynamics in Implant Integrated Dental
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Jangka masa : 1 jam 31 minit

Transkrip:

- 04:30 : Yang Berusaha Prof Madya Dr Mohd Haidzir Penolong Rektor Kampus Sungai Buloh, Selayang dan Teluk Intan diiringi oleh Dekan dan Pengurusan Tertinggi Fakulti Pergigian masuk ke dalam dewan. Para hadirin dimohon berdiri. Mohon para hadirin untuk kekal berdiri bagi nyanyian lagu Negaraku dan Wawasan Setia Warga UITM.
- 05:06 : Nyanyian Lagu Negaraku.
- 06:28 : Nyanyian Lagu Wawasan Setia Warga UITM.
- 08:28 : Fakulti Pergigian UITM Prof. Madya. Dr. Siti Mariam Ab Ghani Timbalan Dekan Akademik dan Antarabangsa Fakulti Pergigian UITM, Yang Berusaha Prof. Madya. Dr. Budi Aslinie Md Sabri Timbalan Dekan Penyelidikan dan Jaringan Industri Fakulti Pergigian UITM, Yang Berusaha Dr. Melati Mahmud, Pengarah Program Majlis Syarahan Prof. Fakulti Pergigian UITM, Yang Berusaha Prof. Prof. Timbalan Dekan Ketua-ketua Pusat Pengajian Barisan jawatankuasa Majlis Syarahan Prof. Prof. Dr. Rohana Ahmad, Para pensyarah, Tuan-tuan, Puan-puan yang dihormati sekalian serta para pelajar sekalian. Selamat datang ke Majlis Syarahan Prof. UITM Prof. Dr. Rohana Ahmad. Alhamdulillah, bersyukur kita kehadiran ilahi kerana dengan limpah kurnia dan izinnya dapat kita berkumpul di dalam majlis yang gilang-gemilang pada pagi ini. Hadirin sekalian, bagi memohon keberkatan majlis, majlis dengan hormatnya mempersilakan Ustaz Muhammad Najih Irsyad Ahmad Puhad Untuk memimpin bacaan doa dipersilakan.
- 10:48 : (Bacaan Doa)
- 13:52 : Majlis merakamkan ucapan terima kasih kepada Ustaz Muhammad Najib Irsyad Ahmad Puhad atas pimpinan bacaan doa sebentar tadi. Hadirin yang dihormati sekalian.



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- 14:04 : Program Syarahan Utama Profesor di setiap fakulti di UITM, merupakan salah satu medan pengiktirafan kepada profesor tersohor pada jasa bakti dan kerjaya mereka sepanjang di universiti. Program ini akan menjadi platform dan memberi ruang kepada para profesor untuk berkongsi kajian terkini pandangan dan kewibawaan mereka dalam bidang kepakaran masing-masing. Kepakaran meliputi penyelidikan asal dan pengajaran peringkat kursus-kursus mahasiswa profesional dan lepasan ijazah dalam bidang kepakaran.
- 14:43 : Program Syarahan Utama Profesor ini merupakan peluang terbaik untuk memperkenalkan Profesor daripada Fakulti Pergigian UITM kepada pihak dalam dan luar fakulti khususnya kepada para akademik, pelajar pasca siswazah dan institusi pengajian tinggi yang lain. Program ini juga secara tidak langsung dapat menyebarkan luas kepakaran dan ilmu pengetahuan serta penemuan inovatif oleh profesor universiti ini. Ilmu pengetahuan yang dikongsi melalui syarahan utama ini adalah sebahagian dari inisiatif Fakulti Pergigian UITM untuk mengetengahkan keserjanaan dan ketokohan para akademiknya kepada pemegang taruh yang terdiri daripada Badan-badan Profesional, Pihak Industri dan agensi berkaitan Dalam bidang pergigian.
- 15:34 : Melalui program syarahan utama ini Profesor Dr. Rohana Ahmad akan berkongsi ilmu hasil dari penyelidikan beliau tentang rawatan pergigian di dalam bidang implant prostodontik. Buku hasil tulisan beliau yang bertajuk *Bone Remodeling Dynamics in Implants Integrated Dental Prosthesis* akan memberikan input dan perbandingan beberapa analisa berkaitan dengan rawatan prostetik implant dan kesannya kepada proses pemodelan tulang.
- 16:06 : Tuan-tuan, puan-puan dan hadirin sekalian bagi meneruskan acara pada pagi ini majlis menjemput yang berusaha Prof. Madya Dr. Mas Suryalis Ahmad Dekan Fakulti Pergigian UITM untuk menyampaikan ucapan aluan dengan segala hormatnya dipersilakan.



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- 17:07 : Yang Berusaha Prof Madya Dr Mohd Haidzir Abd Manaf UITM Cawangan Selangor, Yang Diraikan Prof. Dr. Rohana Ahmad, Prof. Fakulti Pegigian UITM, Yang Berusaha Prof. Madya Dr. Siti Mariam Ab Ghani, Timbalan Dekan Akademik dan Antarabangsa, Fakulti Pegigian UITM, Yang Berusaha Prof. Madya Dr. Budi Aslinie Md Sabri, Timbalan Dekan Penyelidikan dan Jaringan Industri Fakulti Pegigian UITM, Yang Berusaha Dr. Melati Mahmud, Pengarah Program Majlis Syarahan Prof. Fakulti Pegigian UITM, Yang Berusaha Prof. Prof. UITM, Timbalan-Timbalan Dekan, Ketua-Ketua Pusat Pengajian, Barisan Jawatankuasa Majlis Syarahan Prof. Prof. Dr. Rohana Ahmad, Tuan-Tuan dan Puan-Puan yang dihormati, serta para pelajar sekalian. Alhamdulillah, dengan limpah kunia dan rahmatnya, kita semua diberikan kesempatan untuk berhimpun dalam majlis yang penuh bermakna ini.
- 18:07 : Adalah satu penghormatan buat saya berdiri di hadapan hadirin sekalian bagi meraih kejayaan besar dalam perjalanan akademik seorang tokoh yang amat dihormati di Fakulti Pegigian, iaitu Prof. Dr. Rohana Ahmad. Hari ini, kita bukan sahaja berasa bertuah, malah berbangga kerana diberi peluang untuk mendengar syarahan beliau yang merupakan satu pengiktirafan terhadap sumbangan luar biasa yang telah beliau curahkan kepada institusi ini, serta komuniti secara keseluruhannya. Perjalanan akademik Prof. Dr. Rohana adalah bukti bahawa kehausan terhadap ilmu, disertai dengan semangat yang tidak pernah pudar dan komitmen yang teguh, mampu membawa kepada kejayaan yang cemerlang.
- 19:05 : Kepakaran beliau dalam bidang penyelidikan, pedagogi, serta kerjasama profesional bukan sahaja menyemarakkan lagi pemahaman kita terhadap bidang pegigian, malah membantu dalam mengasimilasikan amalan pegigian kontemporari serta memperkasakan penyelidikan berimpak tinggi demi pembangunan Fakulti Pergigian khususnya dan UITM amnya. Dalam era di mana inovasi menjadi pemangkin kepada kemajuan dalam bidang pergigian, Prof. Dr. Rohana terus menunjukkan dedikasi serta komitmen yang tidak berbelah bagi. Keazaman beliau dalam menuntut ilmu dan menyumbang kepada kemajuan akademik menjadi sumber inspirasi buat kita semua untuk terus berusaha mencapai kecemerlangan.



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- 19:51 : Mewakili Fakulti Pergigian UITM, saya ingin merakamkan ucapan setinggi-tinggi tahniah kepada Prof. Dr. Rohana Ahmad atas pengiktirafan yang berprestij ini. Semoga pencapaian luar biasa beliau menjadi dorongan buat kita semua untuk terus maju dalam bidang akademik, penyelidikan dan inovasi pada masa hadapan. Hari ini bukan sahaja meraikan kejayaan Prof. Dr. Rohana tetapi juga detik-detik penting untuk kita menjadikannya sebagai inspirasi dalam menyuburkan budaya kecemerlangan dan cita-cita tinggi.
- 20:31 : Tanpa melengahkan masa, mari kita sama-sama mendengar perkongsian ilmu dan pencapaian Prof. Dr. Rohana Ahmad. Sekian, wa bilahi taufiq wa hidayah, wassalamualaikum warahmatullahi wabarakatuh. Majlis dengan segala hormatnya, mempersilahkan.
- 21:39 : Assalamualaikum, good morning esteemed guests, respected colleagues, distinguished professors, lecturers, postgraduate and undergraduate students. It is my distinct honour and privilege to introduce to you our keynote speaker for today, Prof. Dr. Rohana Ahmad. Prof. Dr. Rohana Ahmad is a distinguished academic, researcher and clinician in the field of prosthodontics. With a specialisation in implant dentistry.
- 22:09 : With a specialisation in implant dentistry her research endeavours focus primarily on the biomechanics of implant integrated prosthesis implant materials, surface characteristics and mechanobiology associated with implant-induced bone remodelling. Today's lecture titled, *Bone Remodelling Dynamics in Implant Integrated Dental Prosthesis* will shed light on the innovative work that has positioned her as a leader in this field. Prof. Rohana embarked on her academic journey with a Bachelor of Dental Surgery from the University of Manchester, United Kingdom in 1993.
- 22:46 : Her quest for knowledge took her across continents, where she earned a Master of Science and a Certificate in Prosthodontics from Boston University, USA in 1999. Her relentless pursuit of academic excellence culminated in her PhD from the University of Sydney, Australia in 2012 Where she delved into the biomechanical intricacies of oral mucosa and bone remodelling. Her doctoral research provided groundbreaking insights into the bone remodelling dynamics associated with implant retained overdentures.



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- 23:21 : Her academic career began as a tutor at the Faculty of Dentistry, University of Malaya in 1994 Where she later served as a lecturer and subsequently as a Senior Lecturer in the Department of Conservative Dentistry. In 2006, she joined University Technology Mara, UITM As an Associate Professor at the Centre of Study for Restorative Dentistry. She was one of the pioneer faculty members and was instrumental in designing the faculty curriculum, setting up the simulation laboratory, the clinical and research facilities.
- 23:57 : She had served as the Deputy Dean for Academic Research as well as for Student Affairs Professor Rohana is not only a dedicated educator but also a respected postgraduate supervisor over the years, she has successfully guided numerous students to the completion of their Master's, Doctoral and Clinical Doctorate degrees Fostering a new generation of dental professionals and researchers Her current supervision portfolio includes.
- 24:25 : MSc, PhD and D.Clinden candidates working on topics ranging from implant biomechanics to salivary biomarkers for bone remodelling. Her contributions to the field of prosthodontics are noteworthy with numerous publications, primarily in high-impact journals reflecting the significance and quality of her research output her research has garnered national and international recognition including awards for innovative work in implant materials such as the Gold Award from PECIPTA, IENA Germany and ITACS. For her research on porous nickel-titanium dental implants Which is a collaborative work with NITIUM Technologies Sdn Berhad and the College of Engineering, UITM.
- 25:01 : Together, they hold multiple patents. Professor Rohana's research portfolio is notable, with numerous grants secured from prestigious bodies including the Ministry of Science Technology and Innovation Malaysia or MOSTI, from the Ministry of Higher Education and international collaborations such as the Australia-Malaysia Institute. Her work on bone remodelling associated with implant overdentures Has provided invaluable insights into the dynamics of residual resorption and the structural optimisation of implant prosthesis.



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- 25:44 : Beyond her research and teaching commitments, Professor Rohana has held several key administrative positions including that of the Deputy Director of the Health and Wellness Research Nexus at UITM, The Deputy Dean for Academic, Deputy Dean for Research, Industrial Linkages, Alumni and Networking and as members of various national and international research committees. She is also the current Chief Editor of the Faculty's Academic Journal which is the compendium of oral science contributing to the scholarly discourse in dentistry. Her role as a grant assessor for national and international funding bodies highlights her standing in the research community.
- 26:24 : Her dedication to the profession extends to her active involvement in professional associations. She has served as the President of the International Association for Dental Research IADR Malaysian Section and as the Vice President of the Malaysian Association of Prosthodontics. She remains as an active member of the International Society for Maxillofacial Rehabilitation and the International College of Prosthodontics.
- 26:51 : Her contributions to the development of postgraduate prosthodontic curricula and her involvement in the Malaysian Conjoined Board for Prosthodontics. Further underline her commitment to advancing dental education. In addition to her academic and research achievements, Professor Rohana has shared her expertise at numerous conferences worldwide. Including keynote addresses at the International Association for Dental Research, The Malaysian Association of Prosthodontics and other esteemed platforms. Her insights into the interaction of mechanical forces with biological responses in implant prostheses has significantly influenced both clinical practice and academic discourse.
- 27:32 : On a more personal note, Professor Rohana is known for her genuine passion for teaching her meticulous approach to research and her unwavering commitment to patient care. She is admired by her colleagues and students for her approachable demeanour and dedication to advancing dental education and clinical practice. Her hobbies include swimming spending time on social media and not forgetting online shopping. Offers a glimpse into the person behind the academic persona.



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28:05 : Ladies and gentlemen It is indeed a privilege to have with us today such an accomplished and inspiring individual So without further ado. Please join me in welcoming Professor Dr. Rohana Ahmad to deliver her professorial lecture titled *Bone Remodelling Dynamics in Implant-Integrated Dental Prosthesis* Thank you.Oh. Baiklah, saya rasa ada penerbitan dulu.

28:33 : Terima kasih diucapkan kepada yang berusaha, Prof. Madya Dr. Budi Aslinie atas bacaan ucap jasa sebentar tadi.

28:51 : Hadirin sekalian, sekarang marilah kita saksikan sebuah tayangan montaj yang telah disediakan. Assalamualaikum Warahmatullahi Wabarakatuh.

31:44 : And hi, I'm Dr. Zatianu Binti Muhammad Qasim. A lecturer from the Restorative Department, UITM. I've known Prof. Rohana for over 20 years. Prof. has been a very kind and encouraging educator. She is also a very talented researcher who has published high-impact research work. I would like to congratulate Prof. on her professorial talk and I wish her all the best for her future endeavours.

32:13 : Prof. Rohana, being the first few academic staff who were involved in setting up Faculty of Dentistry. At the initial planning brings all the advanced prosthodontics equipment and putting the ground very well for the prosthodontic disciplines for that, we were very grateful and we are also fortunate to have her. As one of the senior members in the department where we always go to, to seek for advices and opinions.

33:05 : Terima kasih, Prof. Hadirin sekalian, untuk makluman para hadirin, majlis syarahan Prof. UITM, Prof. Dr. Rohana Ahmad pada hari ini dipancarkan secara langsung melalui siaran langsung UITM channel, melalui siaran YouTube. Kini tibalah acara kemuncak yang dinantikan. Dengan ini majlis menjemput Prof. Dr. Rohana Ahmad untuk naik ke pentas bagi menyampaikan syarahannya yang bertajuk *Bone Remodeling Dynamics in Implants Integrated Dental Prosthesis*. Dengan segala hormatnya, dipersilakan Prof. Dr. Rohana Ahmad.



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- 34:40 : Yang berusaha Prof. Madya. Dr. Mas Suryalis Ahmad Dekan Fakulti Pergigian UITM. Yang berusaha Prof. Dr. Tuti Ningseh Mohamad Dom dekan Fakulti Pergigian Universiti Kebangsaan Malaysia. Yang berusaha Prof. Madya. Dr. Siti Mariam Ab Ghani Timbalan Dekan Akademik dan Antarabangsa Fakulti Pergigian UITM. Yang berusaha Prof. Madya. Dr. Budi Aslinie Md Sabri Timbalan Dekan Penyelidikan dan Jaringan Industri Fakulti Pergigian UITM. Yang berusaha rakan-rakan Profesor dari UITM yang sudi hadir. Timbalan-Timbalan Dekan, Ketua-Ketua Pusat Pengajian, para pensyarah. Tetamu jemputan dari Fakulti Pergigian Universiti Kebangsaan Malaysia. Prof. Dr. Badiah Baharin, Timbalan Akademik Fakulti Pergigian UITM.
- 35:44 : Prof. Madya Dr. Jasmina Qamaruz Zaman Yang juga the past president of the International Association for Dental Research Malaysian Section. Rakan industri dari UITM. Barisan jawatankuasa Majlis Syarahan Profesor yang dipengerusikan oleh Dr. Melati Mahmud. Staff-staff pentadbiran dan klinikal, para pelajar yang dikasihi dan yang terakhir disebut, tetapi paling dekat di hati, ahli keluarga saya. Yang datang dari dekat dan jauh untuk sama-sama meraikan hari yang sangat bermakna bagi diri saya.
- 36:38 : Terima kasih banyak kerana datang. Assalamualaikum Warahmatullahi Wabarakatuh. Salam sejahtera dan salam UITM di hati.
- 36:47 : Alhamdulillah, setinggi-tinggi kesyukuran saya panjatkan ke hadrat Allah SWT. Kerana dengan limpah rahmat dan kurnianya dapat kita bersama-sama berkumpul pada hari ini. Dan dalam satu majlis ilmu yang diberkati oleh Allah SWT.
- 37:02 : Terima kasih yang tidak terhingga saya ucapkan di atas kesudian para hadirin sekalian meluangkan masa menghadiri majlis Syarahan Profesor saya. Saya amat berterima kasih kepada Dekan Fakulti Pergigian, Dr. Mas Suryalis Ahmad Dan mantan dekan, Prof. Dr. Aida Nur Ashikin. Serta barisan jawatankuasa penganjur. Dan yang dipengerusikan oleh Dr. Melati Mahmud di atas segala usaha. Yang telah dijalankan untuk menjayakan program ini semenjak bulan Disember tahun lepas.



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- 37:29 : Saya amat terharu di atas penghargaan yang diberikan kepada saya oleh fakulti ini dan kenangan indah ini akan saya simpan hingga ke akhir hayat. Terima kasih juga saya ucapkan kepada rakan industri Mikim Teknologi Sdn Bhd dan stroman di atas sumbangan yang diberikan.
- 37:48 : Izinkan saya untuk menyampaikan syarahan saya seterusnya dalam Bahasa Inggeris.
- 38:00 : It's a great honour to be standing here this morning to share inside my work modelling dynamic in implant integrated which I will be focusing on residual risk resorption associated will completed and implant.
- 38:43 : My research journey in this particular field began with my PhD in 2008 In Implant Dentistry and Bone Dynamics where I conducted a clinical study With a 5 year follow up to assess implant integrated prosthesis outcome we then conducted following the completion of the clinical study. We conducted finite element modelling to understand the biomechanics Related to the prosthesis and to find mechanisms of the clinical findings. More recently we used predictive modelling and artificial intelligence To improve the treatment predictions of this prosthesis.
- 39:24 : This body of work has been a collaborative effort with the School of Aerospace Engineering University of Sydney from 2008 Until about middle of last year in 2024 when we published our last work on predictive modelling Professor Emeritus Michael Swain Was my main supervisor for the project. He is a physicist. He worked in both the School of Engineering and the Faculty of Dentistry teaching biomaterial sciences to dental students, so he understood both engineering and dentistry so he was able to bridge the gap between our fields and he made communication easier between myself and the... So, he made communication easier between myself and the engineers so his support was key to the project's success which leads to many high impact publications.



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40:28 : Professor Chin Lee was my co-supervisor and he guided me with patience, kindness and understanding as I learned The biomechanics of implant prosthesis. Dr. Junning Chen and Jane Zhong Were also PhD students of Chin Lee and Mike Swain And they were incredibly helpful In working with me with the final element analysis to try to support and substantiate my clinical findings. So this professorial lecture and the professorial book are based on the key findings of these 17 years of research.

41:08 : So before I start with my lecture I would like to take this opportunity To express my deepest gratitude. First and foremost to University of Technology Mara For providing the scholarship for my PhD study At the University of Sydney I would also like to acknowledge the research findings That supported this work Which I received from the Australia-Malaysia Institute From the Ministry of Science and Technology To the FD Science Grant From the Ministry of Higher Education To the ERGS and FRGS Grant. I would also like to thank the founding dean Professor Dato' Dr. Muhammad Ibrahim Abu Hassan for supporting this project. I am immensely grateful to our DSA Puan Rohaya Rahman or assisting with all the clinical procedures And managing the various patient appointments and recall visits For a period of about 8 years. I am also thankful to our dental technologist Encik Firdaus Kamarudin Who is now retired for making all the procedures for me As I wanted to ensure Standardization of the procedures. And last but not least I would like to thank, all the patients involved in the clinical study who were mostly parents of the UITM staff And the USM Kubang Kerian. Most of these elderly patients Have since passed away And I pray that Allah will repay them generously in the hereafter for their contribution to science.



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- 42:41 : In this lecture, I will first give an overview of the bone remodelling dynamics of residual ridge. This will be followed by the internal dynamics that influence bone remodelling. Namely the hydrostatic pressure and mucosal deformation. This will be followed by the clinical factors affecting bone resorption and finally I would like to talk about the predictive modelling that we have developed for bone remodelling. Let us start with the bone remodelling dynamics once becoming edentulous once all the teeth are gone the mandible and maxillary bone undergoes progressive resorption. It is a continuous process That lasts throughout life Because of lack of stimulus in the bone As a result of tooth loss. This progressive resorption can also be referred to as catabolic resorption or baseline resorption or also known as dysresitrophy.
- 43:47 : This progressive resorption Is affected by anatomic, metabolic functional, and prosthetic factors. The anatomic factors Like the patient's geomorphology And the metabolic factors. Such as the patient's age, diseases Or hormonal status is beyond our control. But the functional and prosthetic factors Are within the clinician's control and which we should take into account when providing prosthesis for the patient to make sure that our prosthesis do not cause severe bone resorption in the long run for the patient. So understanding this phenomenon of resorption this bone remodelling dynamics is important As it affects the long-term stability And success of the prosthesis That we give to the patient. To understand the bone remodelling dynamics Of edentulous ridge.
- 44:26 : Let us compare between the bite force distribution of the natural dentition with that of the denture teeth. In the natural dentition The bite force is transmitted directly to the jawbone via the periodontal ligament so the bite force stimulates the Bone cells, the osteoclasts, and osteoblasts Within the periodontal ligament And the alveolar bone to form and resorb bone for bone maintenance to maintain bone volume and density. So this continuous stimulus From the bite force Helps to preserve the bone structure And prevent bone resorption.



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- 45:03 : In contrast without teeth as in this confidential situation, the bite force is transmitted through the denture teeth to the alveolar bone through the mucosa but the mucosa is not as efficient as the periodontal ligament In transmitting the forces to the bone as a result of this lack of stimulus the bone tends to resorb. So this phenomenon is also called disuse of trophic and is very similar to an individual who uses a wheelchair because they cannot walk so this long term use of the wheelchair this long term disuse of the leg Will make the bone Lose its mass And the bone will become smaller. So exactly the same thing. So critical factor In influencing this bone remodeling under this denture Is the interstitial fluid pressure or the hydrostatic pressure within the mucosa It is the pressure. Exerted By the interstitial fluid Within the mucosa to resist deformation When the patient bites on the denture.
- 46:25 : When the hydrostatic pressure Inside the deformed mucosa Gets too high It can squeeze the tiny blood vessels The capillaries inside the mucosa and block the blood flow within the mucosa. So this happens when the hydrostatic pressure within the mucosa gets above the systolic blood pressure In the capillaries Which is about 140 mmHg Or 19 kPa. So blood flow disruption disturbs the oxygen supply and nutrient exchange to the bone. And can cause stress-induced inflammation leading to bone resorption. Theoretically the higher the compressive pressure on the mucosa, the greater the mucosa deformation and the resultant hydrostatic pressure and the greater would be the blood flow disruption. To best illustrate this blood flow disturbance, Sorry for the interruption To best illustrate This phenomenon of blood flow disruption.
- 51:22 : Let us compare between The complete denture situation with that of the implanted over denture because of their different degree of bite forces. For a patient without teeth In a complete denture situation they tend not to bite too hard so the bite force is quite low. Because the complete dentures are sitting on the mucosa So they cannot bite too hard Or otherwise they will feel painfull. Because the mucosa will be compressed And also The complete dentures, because they are resting on mucosa They are not very stable and not very attentive So if they bite too hard They might just dislodge the denture In contrast.



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Jangka masa : 1 jam 31 minit

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- 52:05 : For the implanted over denture patient when we place two implants in the anterior part of the mandible, The denture will become more stable and more attentive and the patient tends to bite harder. So we measured the patient's bite force by asking the patient to bite on a load cell that is connected to a datalogger and to a computer so we asked the patient to do this multiple times and we calculated the average value of the bite force. And we found that the average bite force for a complete denture is about 76 N And the average bite force for the implanted over denture is about 135 N. So patients with Implanted over denture can bite much harder than the complete denture and the bite force is about double in magnitude. So what happened to the mucosa and the bone underneath the denture when subjected to the higher bite force. So we to answer these questions we conducted a clinical study. Where we provided New complete dentures for all the patients involved. Then we took a CBCT scan as a baseline level For the bone level as baseline reference for the bone level. Then we placed two dental implants for the implant retained overdenture group So we placed two implants in the mandibular anterior region and after three months of healing We exposed the implants. We connected the abutments and we converted the complete denture Into an implant retained over the denture.
- 53:51 : And after one and two years we repeated the CBCT scan because we want to measure the amount of Resorption that has occurred. So this is how we quantify the bone resorption We quantify it in 3D manner using the STL superimposition based techniques and mimics. So we superimpose the models taken at three time points The red model is the model that we calculated From the CBCT Taken before treatment. The yellow model The yellow model is from the CBCT From the CBCT Taken one year after treatment. And the green model At two years after treatment.



Program

**(BONE REMODELING DYNAMICS IN
IMPLANT INTEGRATED DENTAL**

Fakulti Pergigian UITM

25 Februari 2025

Nama : Profesor Dr. Rohana Ahmad
Tajuk : Bone Remodeling Dynamics in Implant Integrated Dental
Prostheses
Jangka masa : 1 jam 31 minit

Transkrip:

- 54:34 : So we superimpose the models in mimics And we export it to Trimetics to reveal the areas and patterns of bone resorption. So this is this image here Illustrates one of the bone resorption patterns of one of our participants after she has worn the implant retained over denture for about two years. If you look at the Bone remodeling scale here, the red areas indicate bone resorption and the white and green areas are bone deposition for this particular patient You can see a lot of red Meaning she has suffered a lot of bone resorption And the deepest bone resorption that she had goes to about 2.5 mm In some areas.
- 55:19 : In coronal section In this region, in the posterior part of the mandible. We can see pattern of bone resorption. You can see here the red outline indicates the model before treatment and the yellow outline is after one year so the difference between the red outline and the yellow outline Is how much bone resorption has occurred after a period of one year. So we can observe the same thing on the other side of the mouth and if you look more interiorly In the closer to the canine area so you can see this is after two years so you can see the green outline Is after two years so the gap between the yellow outline and the green outline is much smaller. So it shows that resorption is most rapid during the first year and it slows down in the second year.
- 56:18 : So the same thing can be observed more interiorly where you can see that the outline between the red and yellow is quite big a lot of resorption very rapid in the first year, but in the second year, the green outline ss much closer to the yellow one so much less resorption after the second year. So to measure the area of volume of bone resorption this is how we do it so we cut the region of interest which is distal to the implant and up to the ascending ramus and we converted this block of model into solid blocks as you can see the red is the pre-treatment model and the yellow after one year,



Program

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Fakulti Pergigian UITM

25 Februari 2025

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Prostheses
Jangka masa : 1 jam 31 minit

Transkrip:

- 57:04 : So you can see that the yellow model is quite small compared to the red model because resorption has occurred. So the program can automatically calculate the area and volume of bone resorption at each year so the difference between the two would be how much bone resorption has occurred, so we can repeat the same procedures for the second year. So just to recap so the implant retained overdenture exerted 135 N of force Which is about double that of complete denture and as a result has caused more bone resorption compared to the complete denture which is also about double that of complete denture. So to understand The Biomechanics Of this Prosthesis why this happened So we conducted 3D final element analysis to simulate and substantiate our clinical findings so we used the CPCT scan of a specific patient and we modelled the complete denture and also the implant retained overdenture cases so in this final element analysis we analysed the mucosa Hydrostatic pressure as well as the mucosa deformation So this is the result of the Mucosa contact surface deformation.
- 58:28 : If you look at the scale here for the contact surface deformation for the areas of blue, very little deformation About 0.1-0.2 mm and as we go to the right the right areas indicate greater surface deformation can go up to 1 mm or beyond. So for the complete denture patients we can see that the mucosa contact surface deformation Is fairly uniform a lot of blue, that means minimal deformation around average about 0.16 mm and the deepest part goes to 0.58 mm. In contrast if we look at the implant retained overdenture scenario the mucosa deformation Is much greater you can see more red and yellow areas and the deformation is only concentrated in the posterior region of the mandible. It's not uniform like the complete denture It's concentrated in the posterior region and there's almost like 0 deformation In the anterior region where the Implants are placed. Maybe you will say This is expected because greater pressure Will deform the mucosa more.



Program

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25 Februari 2025

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Tajuk : Bone Remodeling Dynamics in Implant Integrated Dental
Prostheses
Jangka masa : 1 jam 31 minit

Transkrip:

- 59:36 : But what if we increase The bite force of the complete denture. If we Increase the bite force of the complete denture to 135 N Which is similar to the implant retained overdenture we can see that the mucosa deformation still retains fairly uniform. Although there's Some increase in the mucosa deformation it's still uniform, and it's not concentrated like in the implant retained overdenture which is very damaging so there are three possible reasons for this. Why Why In the complete denture the deformation is fairly uniform and low in magnitude, because number one for the complete denture It has a large denture bearing area to support the denture in comparison to the implant retained overdenture the posterior support here is much smaller so the posterior part of the implant retained overdenture acts like a cantilever. And the second reason for the complete denture, it can move about during use It's not fixed But for the implant retained denture, it is rather fixed in nature.
- 1:00:45 : So because of that It always hits the same consistent point every time causing a lot of bone desorption and the third reason the complete denture, it can flex a little bit so it can absorb some of the bite force but for the implant retained overdenture, it's more rigid so it will transfer more force to the mucosa. Now Let us then look at hydrostatic stress So this is how we measure it. So we use a fortran subroutine In the bakers and it was determined by one third of the sum of these principal stresses And this is the result of the hydrostatic pressure.
- 1:01:25 : So as we can see in the complete denture the hydrostatic pressure again is fairly uniform and also low in magnitude As you can see here. It's like Within this region you see the yellow the greenish color but for the implant retained overdenture the hydrostatic pressure is mostly concentrated in the posterior region and is much higher in magnitude. So it is about 36-40 kPa So if we compare the hydrostatic pressure with the mucosa deformation we can see that the pattern matches for the complete denture the fairly uniform hydrostatic stress and fairly low In magnitude corresponds. To the fairly uniform mucosa deformation In the complete denture And for the implant retained overdenture You can see the concentrated Hydrostatic pressure causes more mucosa deformation In the posterior region.



Program

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Prostheses
Jangka masa : 1 jam 31 minit

Transkrip:

- 1:02:35 : And if we compare, we try to correlate with bone resorption, we can see that greater surface deformation greater hydrostatic pressure results in greater surface deformation which in turn causes more bone resorption in the mandible compared to the complete denture so to recap the implant retained overdenture Which exerts twice the force of the complete denture causes greater surface deformation about twice that of the complete denture which in turn causes greater hydrostatic pressure and which subsequently causes more bone resorption In the implant retained overdenture patient compared to the complete denture situation so to further assess the cushioning role of the mucosa. The absorption of the strain energy density In mucosa was used to measure the severity of the compression Induced disturbance The total strain energy density was calculated By summing up the stress strain products.
- 1:03:35 : Across all mucosal elements under stress, so the strain energy density absorbed by the mucosa In the complete denture situation we can see that almost 95% of the strain energy density is absorbed by the mucosa. Meaning the mucosa underneath the complete denture can absorb a lot of the force In comparison to the implant retained overdenture. Only about 75% Of the force Is absorbed by the mucosa. So it is much less efficient So We have seen how the Hydrostatic pressure Corresponds With the contact surface deformation In terms of the intensity and the Bone resorption that it causes So is it true that can we really Substantiate this finite element modelling.
- 1:04:25 : So we measure Blood flow measurement in the patient So we use laser dopameter to measure the blood flow return to the mucosa so we call the patient in then we ask the patient to remove the denture. So we measure the blood flow return Every half an hour for a period of 2 hours. So the initial blood flow Under the implant retained overdenture was significantly lower than in the complete denture group and the blood flow disturbance was found to be significantly correlated with bone resorption. So having seen that how the bite force affects the internal dynamics of bone remodeling and affects the bone resorption so we now have to think of external factors that can affect this bite force. So logically It's a muscle strength so the Greater the power of the muscle The stronger the muscle the higher would be the bite force So what would influence



Program

**(BONE REMODELING DYNAMICS IN
IMPLANT INTEGRATED DENTAL**

Fakulti Pergigian UITM

25 Februari 2025

Nama : Profesor Dr. Rohana Ahmad
Tajuk : Bone Remodeling Dynamics in Implant Integrated Dental
Prostheses
Jangka masa : 1 jam 31 minit

Transkrip:

1:05:22 : This muscle strength So one of the factors that influence muscle strength is the geomorphology. So we then proceeded to investigate the effect of this mandibular morphology on bone resorption. So we investigated several parameters several dimensions of the mandibular bone. So we investigated the ramus length, ramus width the corpus length and corpus height as well as the corneal angle which is the angle of the angle of the mandible. So we found that only the corneal angle Which is the angle of the mandible Significantly influenced the bone resorption The other dimensions of the mandible Does not play any significant role So when we compare The corneal angles with the bone resorption.

1:06:13 : We found that patients with a low corneal angle suffered more bone resorption compared to the patient with a high corneal angle. So we can see a lot of red here indicates resorption. So patients with a low corneal angle smaller corneal angle will experience a lot of bone resorption. And patients with a high corneal angle suffered minimal bone resorption. So this is because in the low corneal angle patients the masseter is positioned more vertically and it is more perpendicular to the occlusal plane. So that's why it kind of intensifies the hydrostatic pressure and the mucosal deformation Leading to higher bone resorption For the large corneal angle patients The muscles Is more longitudinal It's more parallel To the occlusal plane So the void force is much smaller And it also directs The denture to move forward Causing more bone resorption In the anterior part of the mandible Rather than in the posterior part.



Program

**(BONE REMODELING DYNAMICS IN
IMPLANT INTEGRATED DENTAL**

Fakulti Pergigian UITM

25 Februari 2025

Nama : Profesor Dr. Rohana Ahmad
Tajuk : Bone Remodeling Dynamics in Implant Integrated Dental
Prostheses
Jangka masa : 1 jam 31 minit

Transkrip:

- 1:07:23 : But not all of our patients experienced this not all patients with a high corneal angle get a lot of bone resorption. So we suspect there's something else so this is not the complete story, So we suspect maybe the mucosa actually plays a protective role In these low corneal angle patients. So We then proceeded To investigate the effect of the mucosa thickness on bone resorption so we quantified the mucosa thickness in three-dimensional manner using the patient's CBCT With a barium sulphate denture in place, So that we can delineate the mucosa thickness clearly. So This is the segmented mucosa and this is the color map of the mucosa revealing the various range of thickness and then we correlate the mucosa thickness and bone resorption and we found that where the mucosa is thin. There is a lot of bone resorption And where the mucosa is thick There is much less bone resorption.
- 1:08:24 : So there is an inverse relationship between the mucosa thickness and bone resorption. So this slide illustrates the scenario for the other six patients. That we have investigated. So basically we can see where there is a lot of red on the bone which means a lot of bone resorption. It corresponds to thicker mucosa which is also color coded green. In this case so where you see a lot of green. there is corresponding green that means minimal bone resorption when the mucosa is thick and a lot of bone resorption when the mucosa is thin thin means the mucosa is 1.5 mm thickness and below. So it seems that a mucosa thickness Of at least 2 mm is protective of bone resorption So what are the clinical implications?
- 1:09:09 : Patients with smaller bone angles and thin mucosa less than 2 mm are at greater risk of developing bone resorption. So what are the strategies that we can take to minimize this bone resorption? So perhaps In an implant within a dangerous patient Instead of just putting 2 implants in the anterior part of the mandible, We can also place short implants in the posterior mandible just to prevent the load on the mucosa in the posterior part also we have to make sure that when we take an impression for the patient. We want to capture all the danger-bearing areas because we want to distribute the force over a big area to minimize the force on the mucosa and also we must make sure that we give the patient.



Program

**(BONE REMODELING DYNAMICS IN
IMPLANT INTEGRATED DENTAL**

Fakulti Pergigian UITM

25 Februari 2025

Nama : Profesor Dr. Rohana Ahmad
Tajuk : Bone Remodeling Dynamics in Implant Integrated Dental
Prostheses
Jangka masa : 1 jam 31 minit

Transkrip:

- 1:10:15 : A causal balance to try to distribute the force over a bigger area so finally I would like to talk about the predictive model that we have developed for bone remodeling so this predictive modeling can help us to forecast bone resorption for a specific patient. So we integrate the mucosa hydrostatic pressure and mucosa deformation into the system so that we can predict how likely the bone will remodel over time so to do this in silico computational framework. A computer-based method to analyse changes in the jawbone over time so there were 4 key processes to achieve this so first we did data processing. Where we extract CBCT images from the real patient and we use the tomographic geometric stimuli analysis to segment and track changes in the jawbone over time and then we conducted finite element analysis.
- 1:11:10 : Based on a specific patient to analyse the hydrostatic pressure in the mucosa and strain energy density in the bone and then we do machine learning machine learning analysis. We use self-organising maps to identify patterns in bone loss and helps determine which factors contribute most to bone resorption and then a governing equation for bone resorption driven by hydrostatic stress was then developed using power law modelling. Finally we do the simulation, we integrate everything into the Python application simulation to predict future bone loss based on the governing equation So this is the governing equation that we have developed. So Briefly, ΔD Represents the change in residual ratio height of the bone resorption so the negative value indicates bone loss and this part of the equation.



Program

**(BONE REMODELING DYNAMICS IN
IMPLANT INTEGRATED DENTAL**

Fakulti Pergigian UITM

25 Februari 2025

Nama : Profesor Dr. Rohana Ahmad
Tajuk : Bone Remodeling Dynamics in Implant Integrated Dental
Prostheses
Jangka masa : 1 jam 31 minit

Transkrip:

- 1:12:05 : Here denotes the average hydrostatic stress in the mucosa and C , it represents the baseline resorption independent of stress and it accounts for intrinsic or age related bone loss not driven by mechanical stimuli. So if the hydrostatic pressure is less than 0, there is no bone resorption but if the hydrostatic pressure is greater than 0 then there is bone resorption and we use the second expression to calculate the bone loss so the predictive model demonstrated a reasonable accuracy, with an R value of 0.62 Indicating a good correlation between the simulated bone resorption and the clinical measurements, so you can see here this is our clinical resorption and this is the simulation It's fairly close and if we tabulated the amount of bone resorption that has occurred so you can see the clinical and the predicted differs By only about 5%.
- 1:13:13 : So when we correlate between hydrostatic stress and resorption, the hydrostatic stress is a significant biomechanical stimulus driving resorption particularly in the first year post-treatment. However, this correlation diminished After the first year suggesting that soft tissue driven resorption is time sensitive And primarily active during the initiation Adaptation period So strain energy density Showed a weaker correlation. Compared to the hydrostatic pressure and indicates that bone resorption was less influenced by direct mechanical loading on the bone than hydrostatic stress in the mucosa there is also a temporal trend in this correlation during the first year bone resorption is mainly driven by hydrostatic stress leading to rapid bone loss but after the first year.



Program

**(BONE REMODELING DYNAMICS IN
IMPLANT INTEGRATED DENTAL**

Fakulti Pergigian UITM

25 Februari 2025

Nama : Profesor Dr. Rohana Ahmad
Tajuk : Bone Remodeling Dynamics in Implant Integrated Dental
Prostheses
Jangka masa : 1 jam 31 minit

Transkrip:

- 1:14:08 : The process stabilizes with age-related bone loss becoming more dominant this finding highlights why early adaptation strategies such as optimized denture design are essential, So what is the clinical significance? Most resorption occurs during the first year due to the increased hydrostatic stress In the deformed mucosa, as the residual ridge tries to conform to the contour of the new denture's fitting surface this is called the denture settling effect the denture settling effect occurs during the first year So most bone resorption occurs during this period but the influence of this hydrostatic stress diminishes over time as the residual ridge adapts to the denture reducing the rate of bone resorption during the subsequent years.
- 1:14:54 : So, we saw that in our clinical study earlier and to minimize the need for significant adaptation accurate fitting of a new denture to the residual ridge is essential and reducing the denture settling effect helps reduce early bone resorption and promotes long-term prosthetic stability. So what are the strategies to reduce this hydrostatic pressure? So number one, gradual transition to implant within overdenture so we should delay the conversion from the complete denture to implant within overdenture to allow the denture settling effect to take place under smaller biting loads this gradual transition helps reduce mucosal stress and reduce early bone resorption.
- 1:15:40 : Second, we should do a proper chest-side pickup technique of the implant abutments Into the fitting surface of the denture so during the chest-side pickup of the male or female components of the abutments we have to ensure that the denture is fully seated on the mucosa In its original position because any misalignment can disrupt. The denture-mucosa relationship requiring further adaptation and potentially increasing the stress on the mucosa and the bone number three, we should limit frequent denture remakes avoid remaking dentures too frequently because as repeated adjustments. Force the residual ridge to continuously adapt so increasing the stress-induced bone resorption, so the more dentures we give to the patients, the more the patient has to adapt to new dentures and the process will just cause.



Program

**(BONE REMODELING DYNAMICS IN
IMPLANT INTEGRATED DENTAL**

Fakulti Pergigian UITM

25 Februari 2025

Nama : Profesor Dr. Rohana Ahmad
Tajuk : Bone Remodeling Dynamics in Implant Integrated Dental
Prostheses
Jangka masa : 1 jam 31 minit

Transkrip:

- 1:16:30 : A lot of bone resorption so we should also minimize mucosal compression during impression when we take impression, we shouldn't compress too much on the mucosa because we want to make sure we capture the mucosa in its resting state. So prevent excessive mucosal compression during the impression process to ensure the denture rests on a stable and uncompromised tissue base And finally we can also use soft liner, so the use of soft liner underneath the denture can also help reduce some of this hydrostatic stress so to conclude these are the conclusions based on the 17 years of research So number one, related to the hydrostatic stress and bone resorption hydrostatic stress in the mucosa Is the primary driver of residual resorption during the critical first year post-treatment and early resorption diminishes Over time as the residual ridge Adapts to the prosthesis.
- 1:17:28 : The clinical relevance accurate denture fit and proper prosthetic design are essential to minimize hydrostatic pressure and stress-induced bone resorption. Strategies such as gradual load introduction and careful impression techniques can enhance long-term outcomes of our prosthesis and as for prosthetic recommendation, gradual transition from complete dentures to implanted over dentures is required We should also minimize frequent denture remakes and avoid over compression of the mucosa.
- 1:18:00 : And for the future implications, advanced modelling and simulation techniques can further refine prosthetic designs and individualized treatment planning remains key to reducing bone resorption and also Improving prosthetic longevity. Thank you very much for your kind attention.
- 1:18:21 : Ribuan terima kasih diucapkan kepada Profesor Dr Rohana Ahmad atas perkongsian ilmu yang sangat mahal nilainya buat kita semua. Mohon Profesor Dr Rohana Ahmad untuk kekal berada di atas pentas untuk acara seterusnya.



Program

**(BONE REMODELING DYNAMICS IN
IMPLANT INTEGRATED DENTAL**

Fakulti Pergigian UITM

25 Februari 2025

Nama : Profesor Dr. Rohana Ahmad
Tajuk : Bone Remodeling Dynamics in Implant Integrated Dental
Prostheses
Jangka masa : 1 jam 31 minit

Transkrip:

- 1:18:37 : Sebagai tanda penghargaan dan ingatan dengan ini majlis menjemput Yang Berusaha Profesor Madya Dr Mohd Hezer Abdul Manaf diiringi oleh Yang Berusaha Prof Madya Dr Masurialis Ahmad dan ketua Pusat Pengajian Pergigian Resoratif Dr Tengku Fazrina Tengku Mohd Arif untuk naik ke pentas bagi menyampaikan cenderahati Ikhlas daripada Pusat Pengajian Pergigian Resoratif Fakulti Pergigian UITM dipersilakan.
- 1:19:48 : Terima kasih diucapkan kepada Yang Berusaha Prof Madya Penolong Rektor Dekan dan Dr Tengku Hazlina atas penyampaian cenderahati kepada Profesor Dr Rohana Ahmad.
- 1:20:00 : Dijemput Prof Madya Penolong Rektor Dekan Dr Tengku Fazlina dan Profesor Dr Rohana Ahmad untuk Kembali ke tempat semula.
- 1:20:28 : Hadiri sekalian, kita telah pun berada di penghujung majlis. Kuning emas masaknyapadi, penuh kepek hasil tampian.
- 1:20:38 : Terima kasih daun keladi, budi tuan-puan jadi kenangan. Andai ada sumur di ladang, boleh saya menumpang mandi. Andai ada umur yang panjang, boleh kita berjumpa lagi.
- 1:20:52 : Jawatankuasa Penganjur merakamkan ucapan penghargaan dan terima kasih kepada dif dihormat dan para tetamu atas kesudian hadir memeriahkan majlis pada hari ini. Tidak lupa juga kepada semua pihak yang telah memberikan sumbangan dan kerjasama dalam menjayakan majlis ini. Saya bagi pihak Jawatankuasa Majlis Syarahan Profesor Fakulti Pergigan UITM memohon seribu kemaafan atas sebarang kekurangan semasa majlis ini berlangsung.
- 1:21:21 : Sebelum berpisah, ayuh kita abadikan detik bersejarah pada pagi ini dalam satu sesi fotografi. Dengan ini dimohon para hadirin untuk bergerak ke bahagian tengah auditorium dan untuk rakaman gambar bersama Prof. Dr. Rohana dan dif dihormat. Dipersilakan.



Program

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Prostheses
Jangka masa : 1 jam 31 minit

Transkrip:

- 1:22:26 : Silakan. Okey, sedia. Satu, dua, dan tiga.
- 1:23:56 : Okey, sekali lagi. Satu, dua, tiga. Silakan.
- 1:24:22 : Sekian sahaja Majlis Syarahan Profesor UITM Prof. Dr. Rohana Ahmad. Untuk itu, majlis menjemput Prof. Dr. Rohana Ahmad bersama-sama dif dihormat ke Dewan Al-Jabar bagi jamuan makan tengah hari. Sehingga kita bertemu lagi di lain masa.
- 1:24:38 : Sekian, wabilahi taufiq wal hidayah. Assalamualaikum warahmatullahi wabarakatuh.